Pollutant Release and Transfer Register and Civil Society

EUROPEAN UNION
ARNIKA
NEXUS3 FOUNDATION

Pollutant Release and Transfer Register and Civil Society

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December 2023

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1) Arnika – Toxics and Waste Programme (Czech Republic)
2) Nexus3 Foundation (Indonesia)
3) Ecological Alert and Recovery Thailand (EARTH) (Thailand)
4) Centre for Regulation, Policy, and Governance (CRPG) (Indonesia)

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Cover page photo: Martin Plocek

Contents

List of Abbreviations

ASGM - Artisanal and Small-scale Gold Mining
BAT/BEP - Best Available Techniques and Best Environmental Practices
BD – Brčko District (part of Bosnia and Herzegovina)
CAPE - Canadian Association of Physicians for the Environment
CEHO - Center for Waste Management
CELA - Canadian Environmental Law Association
CLRTAP - Convention on Long-Range Transboundary Air Pollution
CRI - Chemical Release Inventory
CSO - Civil Society Organization
DIW - Department of Industrial Works
EARTH - Ecological Alert And Recovery Thailand
EFSA - European Food Safety Authority
ENINA - Task Force on Energy, Industry and Waste Management
EPCRA - Emergency Planning and Community Right-To-Know Act
EPER - European Pollutant Emission Register
EPOC - Environment Policy Committee
EPPO - European and Mediterranean Plant Protection Organization
E-PRTR - European Pollutant Release and Transfer Register
EU - European Union
FBiH - Federation of Bosnia and Herzegovina
FOE UK - Friends of the Earth UK
GCM - Global Community Monitor
GIS - Geographic Information System
HazWI - Hazardous Waste Incineration
HEIS - Hydroecological Information System
IARC - International Agency for Research on Cancer
IPPC - Integrated Pollution Prevention and Control
IREP - Le Registre des Emissions Polluantes (French PRTR)
IRZ - Integrovaný registr znečišťování (Integrated Pollution Register; Czech PRTR)
JICA - Japan International Cooperation Agency
MedWI - Medical Waste Incineration
MEWAT – Task Force on Water
MOE - Ministry of Environment
MOP3 - Third session of the Meeting of the Parties
MSDS - Material Safety Data Sheets
MSWI - Municipal Solid Waste Incineration
MTPIE - Map Ta Phut Industrial Estate
NAICS - North American Industry Classification System
NBS - Nature-Based Solutions
NECD - National Emission Ceilings Directive
NGO - Non-Governmental Organization
NPRI - National Pollutant Release Inventory
OECD - Organisation for Economic Co-operation and Development
PAHs - Polycyclic Aromatic Hydrocarbons
PBDEs - Polybrominated Diphenyl Ethers
PCDD/Fs - Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans
PFAS - Per- and polyfluoroalkyl substances
PM10 - Particulate Matter 10
PM2.5 - Particulate Matter 2.5
POPs - Persistent Organic Pollutants
PRTR - Pollutant Release and Transfer Register
REACH - Registration, Evaluation, Authorization, and Restriction of Chemicals
RETC - Mexican PRTR system
REZZO - Registry of Air Pollution Sources
RS – Republika Srpska (part of Bosnia and Herzegovina)
SC - Stockholm Convention
SDGs - Sustainable Development Goals
SEI - State Ecological Inspectorate
SEMARNAT - Secretariat of Environment and Natural Resources (Mexico)
SIC: Standard Industrial Classification
TEQ - Toxic Equivalent Quantity
TgL - Task Force on Agriculture and Land Use
TRI - Toxics Release Inventory
UK - United Kingdom
UN - United Nations
UNCED - United Nations Conference on Environment and Development
UNFCCC - United Nations Framework Convention on Climate Change
UNITAR - United Nations Institute for Training and Research
USA - United States of America
U.S. - United States
V&V - Task Force on Traffic and Transportation
VOCs - Volatile Organic Compounds
WB/GEF - World Bank/Global Environment Facility
WESP - Task Force on Service Sector and Product Use

1. Introduction

The inception of Pollutant Release and Transfer Registers (PRTRs) traces back to a collective global acknowledgment of the need for enhanced transparency in environmental reporting. This study embarks on a comprehensive exploration of the evolution of PRTRs, shedding light on their historical underpinnings and the subsequent global proliferation of these registers. This report aims to strengthen civil society groups and the public's awareness of the need for integrated data and monitoring of toxic pollution, its sources, and its impacts on human health and the environment.

Within the broader context of PRTRs, the study emphasizes the different developed national PRTRs, offering a nuanced examination of their creation, evolution, and the mechanisms employed for data. By delving into the intricacies of PRTR, this study seeks to exemplify the practical implementation of PRTRs at a national level, unraveling the methodologies employed for data collection, reporting, and quality assurance.

Beyond national boundaries, this study navigates the global landscape of PRTR implementation. From the European Pollutants Release and Transfer Register (E-PRTR) to counterparts in developed countries such as the United States, Canada, Japan, and Korea, to the initiatives in developing and low-middle-income nations like Chile, Colombia, Bosnia and Herzegovina, Tajikistan, Kazakhstan, Moldova, and Thailand, an intricate web of PRTRs unfolds. This study seeks to discern the efficiency disparities among various PRTRs through comparative analysis.

This study examines the connections between PRTRs and agreements such as Principle 10 of the Rio Declaration, the Aarhus Convention, the Stockholm Convention on POPs, the Minamata Convention on Mercury, and the United Nations Framework Convention on Climate Change (UNFCCC). Moreover, it delves into the role of civil society in utilizing PRTR data for advocacy and awareness, presenting case studies from around the globe.

This study can serve as a guidebook for civil society and other stakeholders in Indonesia for establishing a good and transparent PRTR system, which is used as a tool for lowering releases of pollutants into the air, water as waste, and other transfers. Information gathered in this guidebook is partly based on some previous studies (Havel et al. 2011; Petrlik et al. 2018; Petrlik and Man 2016), including a desk study within the project "Transparent Pollution Control in Indonesia" (Septiono et al. 2023). Its preparation was funded by the European Commission under the budget line EuropeAid/168799/DD/ACT/Multi and co-funded by the Ministry of Foreign Affairs of the Czech Republic, Sigrid Rausing Trust, and Swedish International Development Agency via IPEN. Its content is the sole responsibility of Arnika and Nexus3 Foundation. It does not necessarily reflect the views of the donors, such as the U.S. Department of State and Terre des Homme Germany, which partially supported Nexus3's personnel.

2. Pollutant Release and Transfer Registers (PRTRs)

The Organisation for Economic Cooperation and Development (OECD), which has been dealing with Pollutant Release and Transfer Registers (PRTRs) since 1993 (OECD 2000), offers a comprehensive definition of this tool for accessing information about toxic releases into the environment (OECD 2023a).

A PRTR is a publicly accessible database or inventory that shares information on chemicals or pollutants released into the air, water, and soil and sent off-site for treatment. It compiles details about what chemicals are released, where, how much, and by whom (OECD 2023a).

In its introduction to Czech legislation, one of the research team members characterized PRTR as follows: *"The obligation to report data applies to companies defined either by the number of employees (e.g., more than ten) or by the quantity of emissions. Companies annually provide data on emissions of specific substances into water, air, landfills, or other handling (sale, purchase) in special forms. Several tens to hundreds of selected hazardous substances are recorded. The registry is freely accessible, for example, in libraries and on the internet "*(Velek and Činčera 2008).

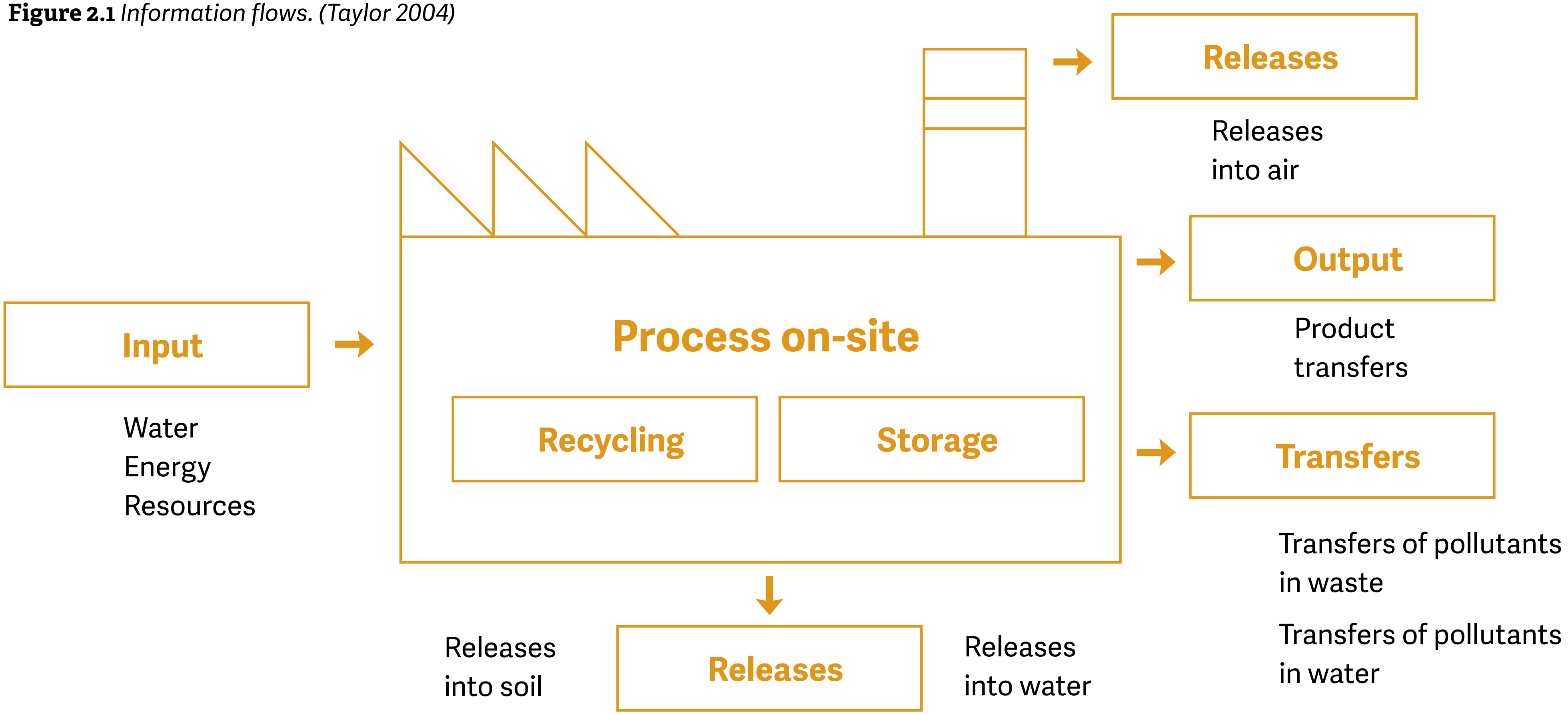
PRTRs typically mandate facility owners or operators to quantify and regularly report their chemical releases to governments, especially in manufacturing and mining. This reporting covers emissions from fixed sources (like factory smokestacks) and diffuse sources (like vehicles – automobiles, trucks, aircraft, and trains). The reporting threshold set by governments determines the range of facilities covered, from large industrial sites to small operations like dry cleaners (OECD 2023a).

PRTRs offer valuable data for various stakeholders:

- Government agencies (national, state, and local) can use PRTR data to track trends in pollutant releases, guide environmental policy decisions, assess environmental programs, and identify potential health and environmental risks when combined with health data.
- The public can use PRTRs to discover potential chemical exposures and risks from nearby facilities, make informed decisions, and monitor facilities' efforts to reduce their environmental impact.

- Companies can utilize PRTR data to find opportunities for efficiency improvements and waste reduction as a metric for measuring progress toward sustainable development.
- Other stakeholders, like non-governmental organizations, the media, and researchers, benefit from access to PRTR information, especially when combined with Geographic Information Systems (GIS) and toxicity data, to identify potential areas of concern or correlations between exposure and observed health or environmental effects.
- Financial organizations use PRTR data to support socially responsible investments, identify potential liabilities of firms, and assess impacts on real estate prices (OECD 2023a).

Figure 2.1 *Information flows. (Taylor 2004)*



2.1 History of PRTR

The first PRTR is always considered to have been established in 1978 in the U.S. state of New Jersey, where information on the production and use of 155 chemical substances (including their flows into waste) from more than 7,000 industrial facilities was collected in a one-time effort (Muir et al. 1995). However, a kind of PRTR database existed in the Netherlands since 1974 (Ruyssenaars et al. 2007).

The New Jersey model then became the basis for proposing a federal data collection and disclosure system in the form of the Toxics Release Inventory (TRI) in the United States, which was enacted in 1986 in the law known as the Emergency Planning and Community Right-To-Know Act – EPCRA (Jobe 1999). On June 19, 1989, the Toxics Release Inventory became publicly accessible online via TOXNET (Jobe 1999). It was the world's first system for informing the public about releases of toxic substances into the environment (air, water, soil, and injections into the ground). Policy-makers have judged the TRI a tremendous success, as national releases declined by 43% between 1988 and 1999 (Bui and Mayer 2003).

The creation of the Toxics Release Inventory is also described in the book "The Right to Information on Chemicals," published in Czech in 1995 (Muir et al. 1995). This book highlights the important role of non-governmental organizations in creating the U.S. register: "*The non-governmental environmental organization INFORM Inc. conducted a three-year study, the results of which were published in 1985 in a book called Cutting Chemical Wastes. INFORM explored 29 chemical companies to determine how they reduce waste production and what organizational, economic, or legislative factors stimulate or enforce efforts to reduce hazardous waste production. During audits, the availability of information on used chemical substances and their releases into water, air, and solid waste was examined, among other things. It was found that information available in the surveyed companies was scattered in various parts of the companies, sometimes processed systematically, often hidden in extensive documents, or stored in incompatible databases. The data were in such a form that even if extraordinary efforts were made to collect them from various places, the result would be a pile of documents containing only poor or incomplete information. Such data could not be used to estimate the quantities of toxic chemicals used, waste production, or environmental releases. It was impossible to track trends or evaluate the reduction of waste production from the data at all*" (Muir et al. 1995).

It is generally agreed that the proximate cause for mandating some form of toxics release reporting occurred on December 4, 1984, when a cloud of extremely toxic methyl isocyanate (MIC) gas seeped from a Union Carbide plant in Bhopal, India. Death estimates vary from 4,300 to nearly 20,000 people (Terry and Yandle 1997).

Among the experiences of states that introduced national pollution registers, positive ones prevailed, showing that this measure leads to a reduction in releases and improves the situation without special costs. Therefore, the U.S. delegation at the UNCED Conference in Rio in 1992 recommended including the PRTR system in the tools of Agenda 21. The Organization for Economic Cooperation and Development (OECD) developed Recommendations for Governments to Implement PRTR Systems through several workshops. OECD prepared a Guidance Manual for governments considering establishing PRTRs, published in 1996; the OECD Council adopted a Recommendation on Implementing PRTR in the same year (OECD 2001).

PRTRs were gradually being introduced by states all over the world. In 1996, Japan; 1997, Mexico; 1998, Sweden; and others. However, some

Photo 2.1 *Union Carbide pesticide factory, Bhopal, India, 1985. Photo: Bhopal Medical Appeal, Martin Stott via Wikimedia Commons*

Photo 2.2: *Monument to the 1984 Bhopal disaster. Photo: Luca Frediani via Wikimedia Commons*

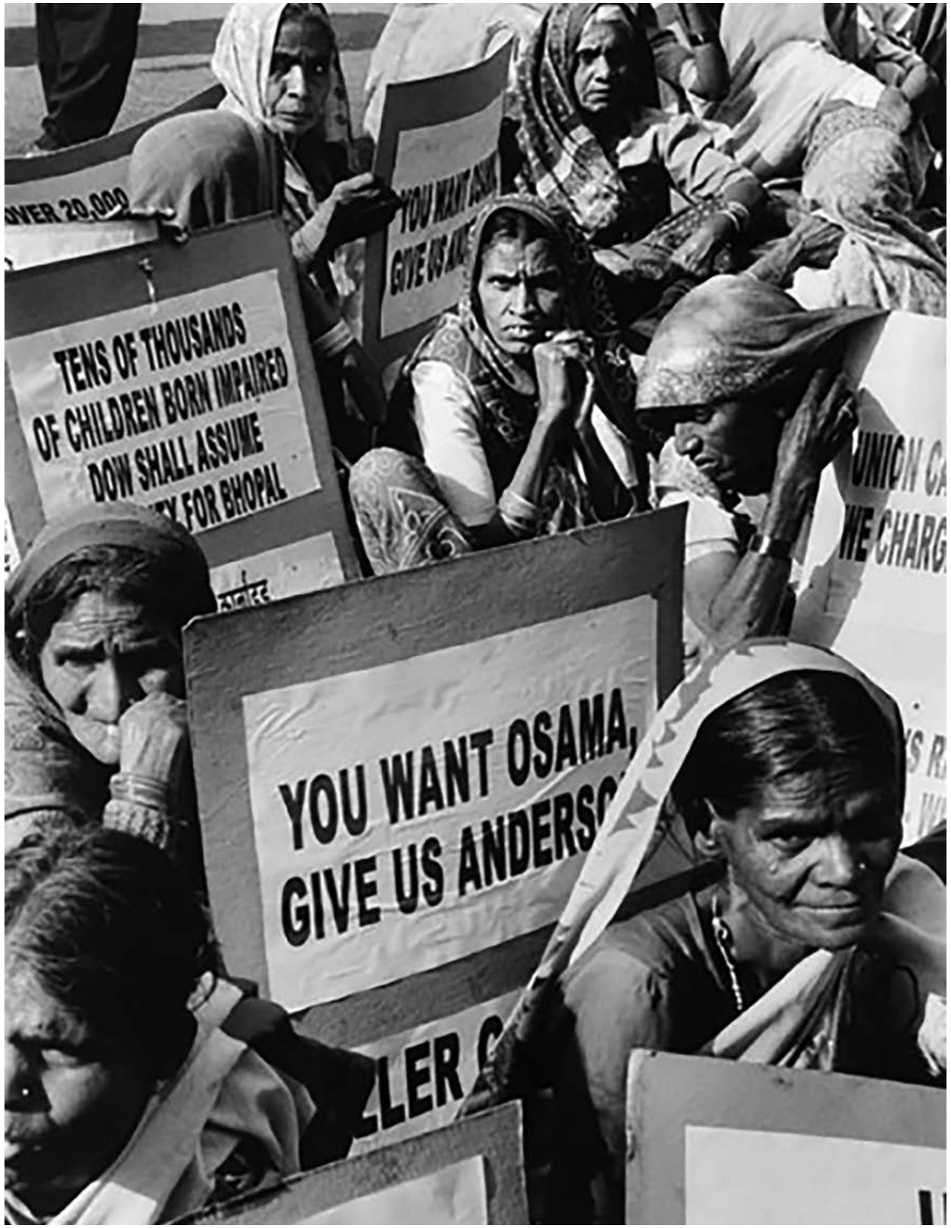


Photo 2.3: *Victims of Bhopal disaster march in September 2006 demanding the extradition of American Warren Anderson from the United States. Photo: Obi from Roma, London via Wikimedia Commons*

Global inventory of Pollutant Releases

The Global Inventory of Pollutant Releases provides information on the Pollutant Release and Transfer Registers (PRTRs) from countries around the world. Explore trends in releases, access the data, and view OECD's collection of publications on pollutant inventories and release estimation techniques.

Photo 2.4: *OECD started with PRTRs in the 1990s and, in 2021, released a Global Inventory of Pollutant Releases. Source: (OECD 2021)*

Photo 2.7: *Cement kilns, often co-incinerating waste, are another significant source of pollution in China. An illustrative photo of a cement plant across the Yalu River in Ji'an, Dongbei, North China. Image: Caitrianna Nicholson, CC BY-NC-ND 2.0 (https://www.flickr.com/photos/caitriana/7730900090/)*

Photos 2.5, 2.6, and 2.7: *China is among the countries lagging behind, although its pollution problems are increasing. The growing number of large municipal waste incinerators significantly contributes to this issue. Photos 2.5 and 2.6 depict the Wuhan municipal waste incinerator, identified as a serious source of dioxin contamination, including its fly and bottom ash (Katima et al. 2018; Weber et al. 2015).*
Sources: Jindrich Petrlik, Arnika, Zhang et al. (2015)

Photo 2.6

Photo 2.9

Photos 2.8, 2.9 and 2.10: *Russia is also lagging in providing open information about toxic releases from industrial enterprises. The chlorine industry*, partly built for military uses during the Cold War, is part of the problem. A considerable amount of contaminated waste produced by chemical factories remains dumped, contaminating the environment. Additionally, current factories are sources of pollution, particularly with mercury and chlor-organic pollutants (Akhmedkhanov et al. 2002; Shelepchikov et al. 2008; Speranskaya et al. 2005). The photos are from Igumnovo and Gorbatovka in the Dzerzhinsk region, taken near chlorine industrial sites in 2004, which are identified as sources of dioxin contamination. Source: Speranskaya et al. 2005*

Photo 2.10

*Chlorine was absorbed practically in all industry branches including drinking water purification, plastics production and even manufacturing of solid-fuel engines for ballistic rockets manufacturing. Chlorine industry enterprises, as a rule, were combined into industrial complexes, including factories producing miscellaneous target products of civil and military purpose as well as auxiliary production of semi-finished products and raw materials, including molecular chlorine. Basic technology of chlorine manufacturing was and still is electrolysis using graphite electrodes. A considerable part of industrial waste was incinerated on the territory of production complexes. Furnaces with alkaline scrubbers were used for burning of organic chlorine waste. Other waste materials were incinerated in furnaces equipped with low-effective cyclone dust separators. Wastes that are not subject to incineration were land-buried near the enterprises (Shelepchikov et al. 2008).

Photo 2.11: *The Volga River (in the photo) is close to many industrial facilities, including the Kaustik factory in Volgograd, identified as a serious source of mercury contamination, releasing almost 0.7 metric tons of mercury annually (Speranskaya et al. 2013). Photo from the EcoAccord archive. (Katima et al. 2018; Shelepchikov et al. 2008; Speranskaya et al. 2013; Speranskaya et al. 2005; Weber et al. 2015); Zhang et al. 2015*

large countries where environmental pollution is a significant problem, such as Russia, China, or India, are still lagging. China has introduced some reporting systems since 2013. However, its format differs greatly from other PRTRs, and data are not publicly accessible (Shi 2013). According to recent research on related pilot projects, an authentic PRTR system has not been established (Guo et al. 2021).

The international process of preparing a global convention on registers of releases and transfers of toxic substances culminated in creating the Protocol on PRTR to the Aarhus Convention. The working group, which met eight times between February 2001 and January 2003, created the protocol. This protocol (The Protocol on Pollutant Release and Transfer Registers) was adopted on May 21, 2003, at the meeting of the parties to the Aarhus Convention in Kyiv, which was part of the 5th Ministerial Conference “Environment for Europe.” From January 1, 2004, all states, including those that had not yet ratified the Aarhus Convention and were not members of the United Nations Economic Commission for Europe, can accede to this so-called Kyiv Protocol, which has been signed by 36 countries, including the Czech Republic. The protocol became a full-fledged part of European law in 2009. The United Nations Economic Commission for Europe (UNECE) is the guardian of this protocol (UNECE 2011). The Kyiv PRTR Protocol has 38 parties as of December 2023 (InforMEA 2023). The integrated PRTR also operates at the European level. The first version, from 2001 to 2004, was called EPER (European Pollutant Emission Register), serving as a repository for data reported in connection with the Integrated Pollution Prevention and Control (IPPC). More than 12,000 industrial facilities across the EU were required to report to EPER, reporting 50 substances in 32 industrial sectors every three years. The European Commission’s materials set the limit so that up to 90% of the total industrial emissions in the EU were reported to EPER (Petrlik and Man 2016; UNECE 2008).

In 2006, EPER was replaced by the European Pollutant Release and Transfer Register (E-PRTR), whose legal framework was established by Regulation 166/2006/EC, requiring member states to harmonize reported data to be compatible with the pan-European database. The first reporting year to the new E-PRTR register was 2007. More than 30,000 industrial facilities in the EU exceeded the reporting limits for E-PRTR (Petrlik and Man 2016; UNECE 2008).

Table 2.1 *Differences between EPER and E-PRTR. Source: (Petrlik and Man 2016)*

	EPER	E- PRTR
Legal form of the register's establishment	Decision	Regulation
Number of substances in the register	50	91
Number of activities monitored	56	65
Releases to soil	No	Yes
Emergency releases	No	Yes
Transfers of waste	No	Yes
Transfers of wastewater	Yes	Yes
Dispersed sources	No	Yes
Only IPPC facilities	Yes	No
Reporting cycle	Triennial	Annual

2.2 European Pollutants Release and Transfer Register (E-PRTR)

European PRTR (E-PRTR) covers environmental release and emission reporting from 2007 to 2017 by EU Member States, Iceland, Liechtenstein, Norway, Serbia, and Switzerland. It is implemented under the mandate of Regulation (EC) No. 166/2006 of The European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutants Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC (European Parliament and Council 2006), as well as EU Commission Implementing Decision 2019/1741 (European Commission 2019). In Europe, PRTR started with seven countries reporting in 2007, then progressed to 18 countries in 2017 (EEA 2022).

Photo 2.12: *Accidental (emergency) releases of toxic substances were not part of the reports into the EPER system. An accident in the hazardous waste incinerator in Vyškov, Czech Republic is shown in a photo taken by the Fire Brigade in 2005 Source: (Petrlik and Bell 2017)*

E-PRTR presents release and transfer data that can be searched for various information, such as facility, activity, off-site transfer, pollutants or waste, facility owners, etc[1]. The mandatory reported annual data is based on measurement, calculation, or standardized estimation

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[1] Article 4 of EC No. 166/2006

methods to indicate chemicals/pollutants released to air, water, land, and off-site transfers[2]. The data collection is mandated by the EU Commission Implementing Decision 2018/1135 (European Commission 2018). This data would then be published within 16 months after the end of the reporting year[3], after going through assessments and coordination for quality assurance and assessment processes[4]. An example of the public information in E-PRTR is shown in Table 2.3 below.

There are multiple industry sectors covering 65 industry types/economic activities, included in the mandatory list to report 91 chemicals and pollutants[5] with a standardized format[6], such as[7]:

- Energy sector,
- Production and processing of metals,
- Mineral industry,
- Chemical industry,
- Waste and wastewater management,
- Paper and wood production and processing,
- Intensive livestock production and aquaculture,
- Animal and vegetable products from the food and beverage sector and
- Other activities

The 91 types of reported pollutants in the E-PRTR are classified under seven groups:

- Greenhouse gases
- Other gases
- Heavy metals
- Pesticides
- Chlorinated organic substances
- Other organic substances
- Inorganic substances

Even though multiple data gaps have yet to be submitted and there are incomplete reports (EEA 2021; EEA 2022), the implementation and publication of such information enables data accessibility and analysis of release and emissions over time, and triggers industries to continually improve their Best Available Techniques and Best Environmental Practices (BAT/BEP).

This mandatory reporting of various industry types and chemical pollutants differs from the list in Indonesia's environmental conservation and pollution protection regulatory framework. The comparison analysis was provided in section 4 of the desktop study report on PRTR by Nexus3 and Arnika (Septiono et al., 2023).

The Industrial Emissions Portal covers over 60,000 industrial sites from 65 European economic activities (EEA 2021).

2.3 Examples of the National PRTRs in EU Member States

2.3.1 Integrated Pollution Register (IRZ) as PRTR in the Czech Republic: A Brief Overview

The PRTR system in the Czech Republic called Integrated Pollution Register (Integrovaný registr znečišťování or IRZ) is a publicly accessible online database (www.irz.cz) that contains information about

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[2] Article 5 of EC No. 166/2006

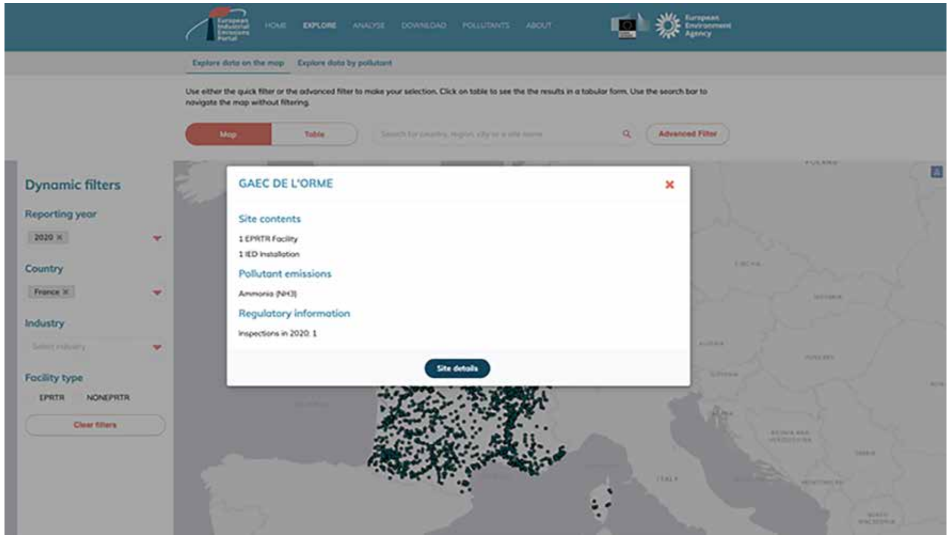
[3] Article 7 of EC No. 166/2006

[4] Article 9 of EC No. 166/2006

[5] Annex 2 of EC No. 166/2006

[6] Annex 3 of EC No. 166/2006

[7] Annex 1 of EC No. 166/2006



Use either the quick filter or the advanced filter to make your selection. Click on table to see the the results in a tabular form. Use the search bar to navigate the map without filtering.

GAEC DE L'ORME

Site contents

1 EPRTR Facility

1 IED Installation

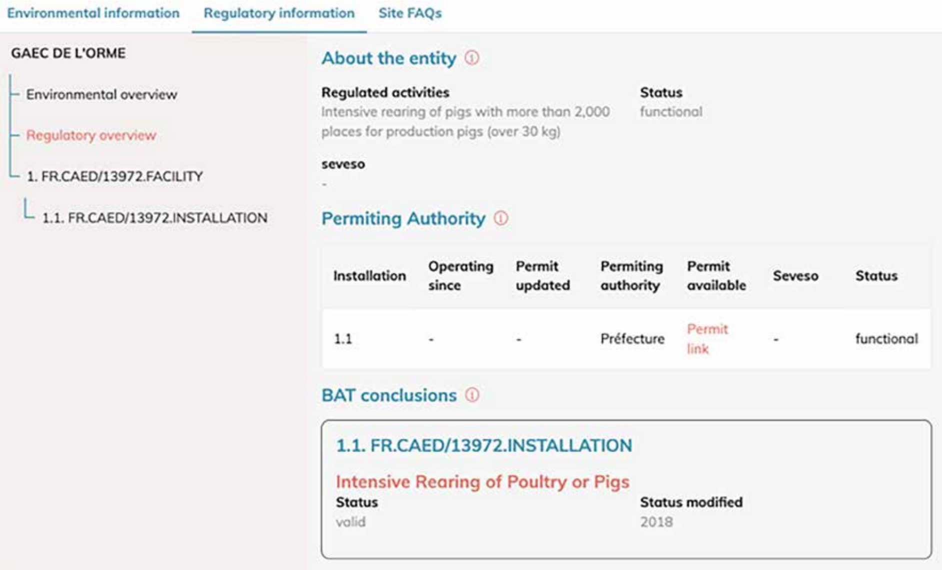
Pollutant emissions

Ammonia (NH3)

Regulatory information

Inspections in 2020: 1

(a) Map-based display of PRTR facility reporting



About the entity

Regulated activities
Intensive rearing of pigs with more than 2,000 places for production pigs (over 30 kg)

Status
functional

seveso
-

Permiting Authority

Installation	Operating since	Permit updated	Permiting authority	Permit available	Seveso	Status
1.1	-	-	Préfecture	Permit link	-	functional

BAT conclusions

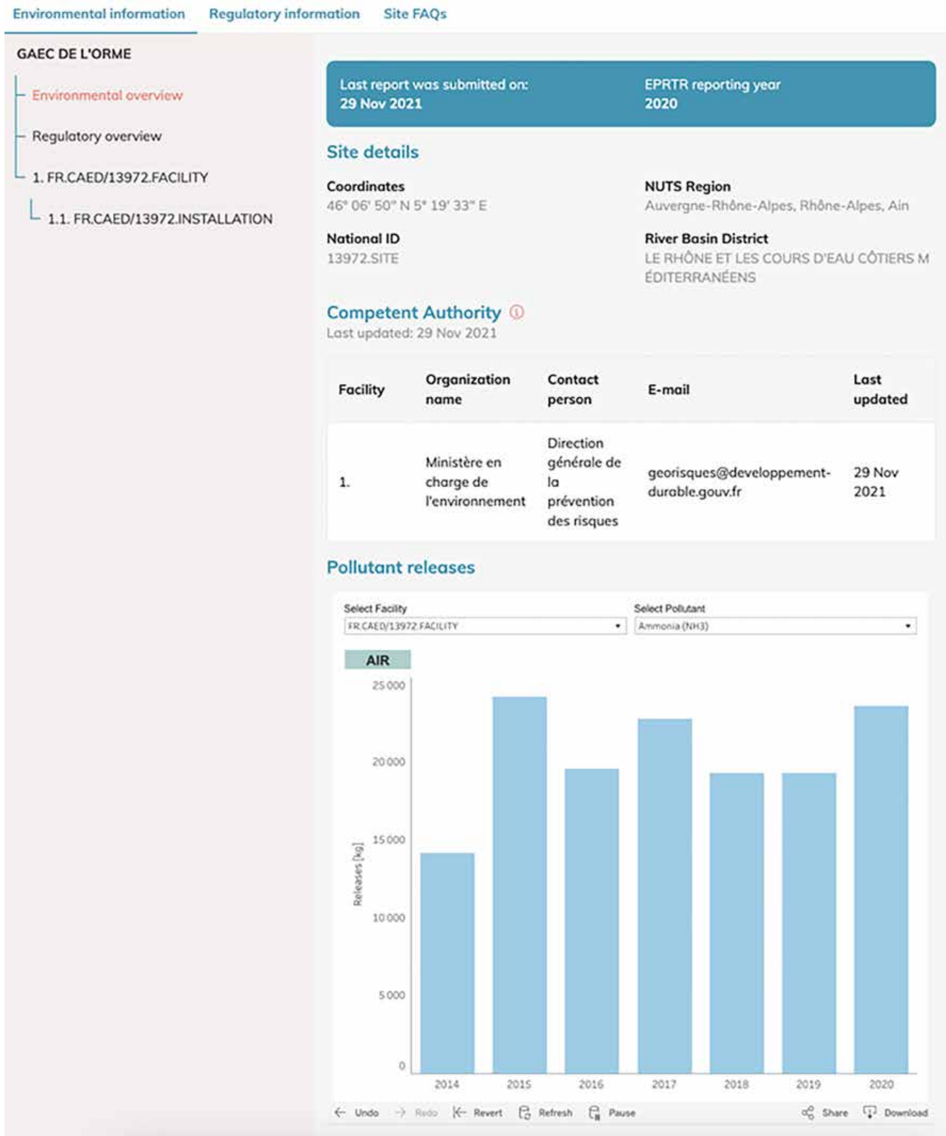
1.1. FR.CAED/13972.INSTALLATION

Intensive Rearing of Poultry or Pigs

Status
valid

Status modified
2018

(b) Regulatory overview of the reporting PRTR facility



Last report was submitted on:
29 Nov 2021

EPRTR reporting year
2020

Site details

Coordinates
46° 06' 50" N 5° 19' 33" E

NUTS Region
Auvergne-Rhône-Alpes, Rhône-Alpes, Ain

National ID
13972.SITE

River Basin District
LE RHÔNE ET LES COURS D'EAU CÔTIERS MÉDITERRANÉENS

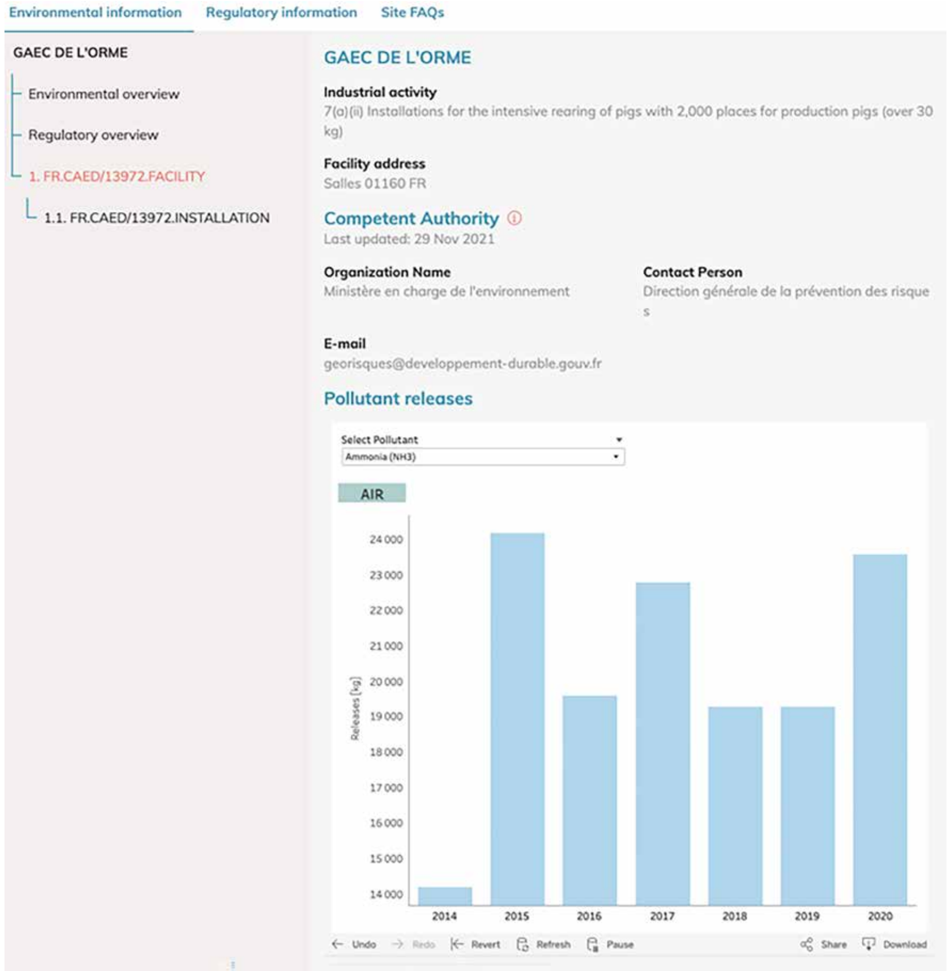
Competent Authority

Last updated: 29 Nov 2021

Facility	Organization name	Contact person	E-mail	Last updated
1.	Ministère en charge de l'environnement	Direction générale de la prévention des risques	georisques@developpement-durable.gouv.fr	29 Nov 2021

Pollutant releases

(c) Environmental data overview of the PRTR facility in the E-PRTR



GAEC DE L'ORME

Industrial activity
7(a)(ii) Installations for the intensive rearing of pigs with 2,000 places for production pigs (over 30 kg)

Facility address
Salles 01160 FR

Competent Authority

Last updated: 29 Nov 2021

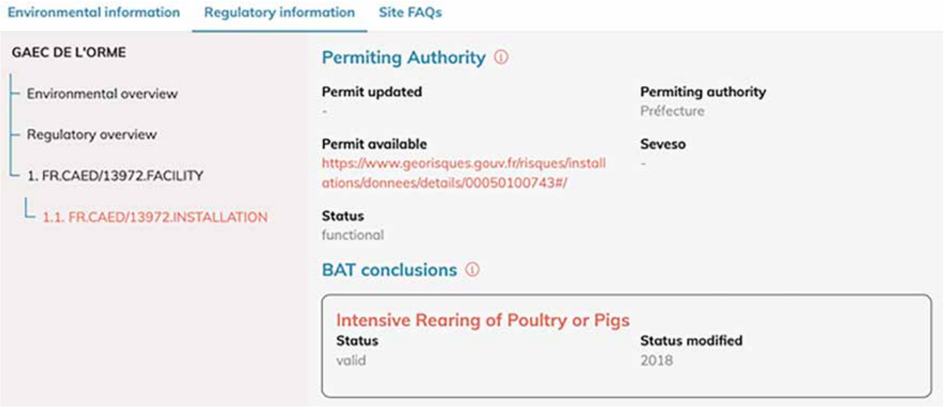
Organization Name
Ministère en charge de l'environnement

Contact Person
Direction générale de la prévention des risques

E-mail
georisques@developpement-durable.gouv.fr

Pollutant releases

(d) Details on the relevant authority for PRTR reporting



Permiting Authority

Permit updated
-

Permiting authority
Préfecture

Permit available
https://www.georisques.gouv.fr/risques/installations/donnees/details/00050100743#/

Seveso
-

Status
functional

BAT conclusions

Intensive Rearing of Poultry or Pigs

Status
valid

Status modified
2018

(e) Details of inspection results from the relevant authority for PRTR reporting

specific facilities' contributions to environmental pollution. Managed by the Ministry of the Environment, IRZ has been operational since 2003, established by Law 76/2002 Coll. on Integrated Prevention to implement the European Commission Directive on Integrated Prevention (96/61/EC). The creation of IRZ fulfilled commitments arising from ratifying the Aarhus Convention, focusing on providing information to the public. The register, introduced in the fall of 2005, marked the beginning of the dataset, covering reported data from 2004. Since 2004, 72 pollutants have been reported (MŽP 2021c; Petrlik and Man 2016).

2.3.1.1 Brief History of the Creation of the Czech IRZ

Preparations for the IRZ in the Czech Republic began in 1994, responding to pressure from international institutions and non-governmental organizations. Several studies were commissioned, but the quality was insufficient. Simultaneously, NGOs developed proposals. The inclusion of IRZ in the draft law on integrated pollution prevention in 2001 marked its first appearance, serving as a tool to monitor the fulfillment of goals set by this new law.

Photos 2.13 – 2.14: *In 2003, Arnika proposed a much longer list of substances for the Integrated Register of Pollutants (IRZ) to Minister of the Environment Libor Ambrozek than was ultimately approved. The Ministry of the Environment suggested 122 substances. Still, other ministries in the government reduced the list to 72 substances in the first phase and 88 in the second phase of the IRZ's validity (Arnika 2003). Photo: Arnika, 2003*

Representatives of the Association of Industry and Transport of the Czech Republic (Svaz průmyslu a dopravy ČR) attempted to remove or at least weaken the IRZ from the draft law on integrated prevention. To help instigate the process, the Czech environmental NGO Arnika worked to generate more than 10,000 signatures on a petition, "Toxics-Free Future," that called for PRTR and included local authorities, scientists, and prominent figures (DiGangi 2011). Law No. 76/2002 Coll., on Integrated Prevention, thus included the promise of creating IRZ, outlining its general framework. In 2003, Government Regulation No. 386/2003 Coll. established the final form of the first Czech IRZ. In 2008, IRZ was legally separated from integrated pollution prevention and control into Law No. 25/2008 Coll., aligning data outputs with E-PRTR (MŽP 2021c; Petrlik and Man 2016).

The list of reported substances, originally 72, increased due to European regulations, reaching the later 93. Reporting to IRZ began in 2004, and as of 2007, the number of reported substances increased to 93, surpassing the E-PRTR requirements of 91 substances. Currently, over 1,600 facilities report releases and transfers to IRZ annually, with data publicly accessible with a nine-month delay. Reporting obligations arise if facilities exceed pollutant limits set by decree (Petrlik and Man 2016).

In 2016, under pressure from industrial associations and the Ministry of Industry and Trade of the Czech Republic, a new law was issued listing operations subject to the obligation to monitor reported substances (MV ČR 2016). A key point of the IRZ law amendment was limiting the impact of reporting obligations to IRZ only for 232 selected other activities or activities with lower threshold values for capacity compared to E-PRTR (MŽP 2021c). This mostly concerns defining selected areas of industrial or agricultural activities and the operation capacity. Due to this change, reporting no longer applies, for example, to small hazardous waste incinerators, even though they can be significant local sources of dioxin emissions and their transfers in ash. In addition to this change, there were earlier restrictions on reporting certain substances in waste, including some persistent organic pollutants (POPs), such as hexachlorobutadiene. For the reporting year 2021, polychlorinated naphthalenes and benzo(a)pyrene were added to the list of reported substances, and a new group of reported polybrominated diphenyl ethers (PBDEs) was distinguished (MV ČR 2020).

In 2023, the Government of the Czech Republic supplemented its IRZ regulation with the obligation to report per- and polyfluoroalkyl substances (PFAS) in discharged waters. It tightened the reporting threshold for cyanide transfers in waste from 500 to 50 kg/year. This was in response to an incident in 2020 on the Bečva River, where a cyanide leak resulted in massive fish mortality over a 40 km stretch of the river (Čtk 2023). The tightening was prompted by the Arnika Association's call "Toxics-Free Rivers" (Arnika 2020a), signed by over 7,000 people (Arnika 2020b). The requirement was also supported by committees of the Parliament of the Czech Republic (Čtk 2023).

The IRZ database does not include all facilities polluting the environment, but generally focuses on larger enterprises or those dealing with larger quantities of chemical substances. Separate lists of substances with different limits are established for each emission pathway:

- Emissions to the air (67 substances)
- Emissions to water (75 substances; expanding to include PFAS from 2025)
- Emissions to soil (65 substances)
- Transfers of substances in waste (24 substances)
- Transfers of substances in wastewater (71 substances)

The IRZ, or the Czech version of PRTR, contains data on 97 individual pollutants or groups of substances (MŽP 2021b).

2 3.1.2 Enhancing Accessibility in the 21st Century

Today, people expect easy access to information from various sources in one place, ideally from the comfort of their smartphones or PCs online. In this light, the integrated PRTR appears to be a full-fledged tool of the 21st century. Before 2005, it was not nearly as easy to check what toxic substances companies in the vicinity were releasing. It's not that emitted chemicals were not monitored or measured, but there was a lack of integration of information and data accessibility to the public.

The thought of lengthy correspondence with environmental protection authorities or directly with the management of a particular industrial operation discouraged many curious individuals. For example, obtaining information about a complete overview of substances released into the environment by all major companies in a given region was unimaginable for a citizen or organization before the introduction of IRZ. Currently, a few clicks provide an overview of the entire Czech Republic (www.irz.cz), and with a basic knowledge of English, a few more clicks opens the door to a vast pollution database across Europe (https://industry.eea.europa.eu/#/home).

Table 2.2: *Number of reported substances to IRZ according to legal norms from 2004, 2008, and 2011. Source: (MŽP 2021b; Petrlik and Man 2016)*

	2004	2008	2011	2021
Air	57	62	62	67
Water	43	71	71	75
Soil	44	61	61	65
Waste Transfers	56	72	26	24
Total	72	93	93	97

2 3.1.3 About the IRZ in More Detail

2 3.1.3.1 Who and how often reports to the IRZ

The basic industrial unit for reporting and measuring the quantity of a chemical substance is a specific facility characterized by geographic location and technology. This is important, especially for large chemical companies or smelters and similar facilities, where there may be multiple production lines, melting plants, etc. According to the IRZ law, a facility is defined more broadly than an operation or production line. In large production areas of a company (foundries, chemical plants), you cannot find specific emissions from a specific smelting column, for example, or identify leaks from each production line or associated equipment, such as a power plant. Different operation or production lines within one location and one owner report into IRZ as one facility collectivelly, not as different facilities.

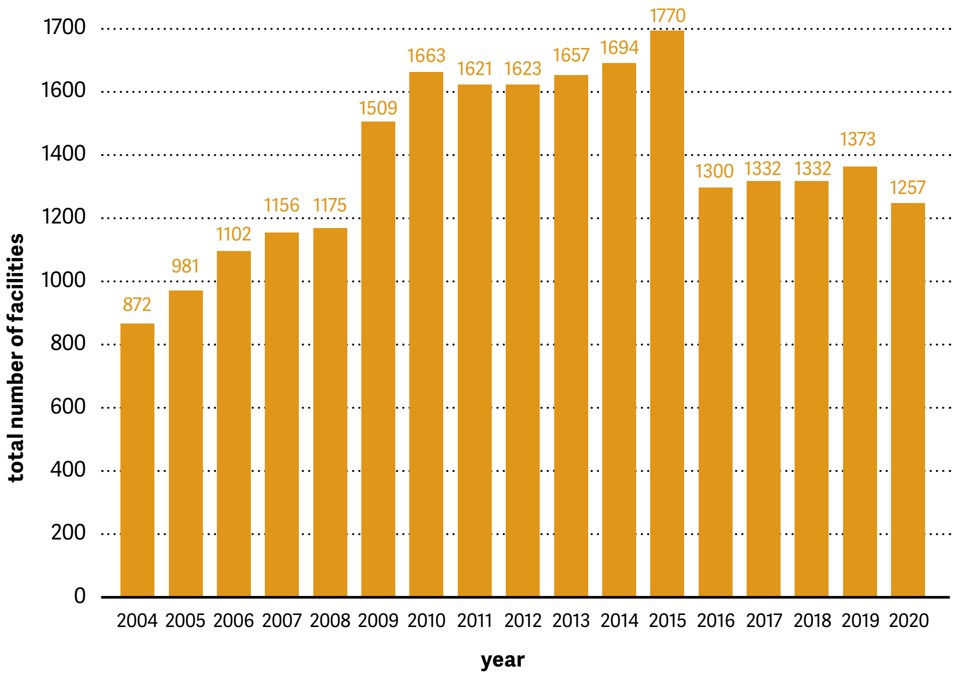
Facilities report to the IRZ themselves. Reports are usually prepared by the company's environmental specialist or another authorized person. Companies or facilities, therefore, ensure, at their own expense and responsibility, the collection and reporting of data to the IRZ.

The amount of substances emitted in one calendar year should be reported to the IRZ. It is reported in total quantities for the entire year. This is not a report on concentrations in emissions. The total amount of substances released into the air for the year can be calculated from these concentrations, but they cannot be used as data for the IRZ. Facilities must submit data by the end of March of the following year, and the information is made available to the public by September 30.

It is also important to mention that reporting to the IRZ is only done online - electronically. Traditional paper reporting is eliminated, but some traditional companies initially found this problematic. There is no alternative reporting option. The technical change in reporting came in 2008 when Czech IRZ legislation was harmonized with the European E-PRTR register to make data easily transferable to the pan-European register.

Even with modern online reporting, industrial companies sometimes submit incorrect data. A common unintentional error is the displacement of the decimal point, which can lead to reporting the production of a toxic substance from one facility higher than its estimated emissions for the entire European Union.

Figure 2.2: *Graph shows the development of the number of facilities reporting releases or transfers of substances into the Czech PRTR during its first ten years. The graph does not show facilities reporting only waste quantities. Decrease of number between 2015 and 2016 was caused by change in the rules for reporting introduced under the pressure from industry lobbyist.*



Companies had to learn how to report to the IRZ in a certain way. Only in the last few years has the number of facilities reporting to the IRZ more or less stabilized. Currently, there are more than 5,000 reporting. Still, only 1,674 facilities reported leaks and transfers of substances. In contrast, the rest reported only the total amount of produced waste, which does not indicate the extent of facilities' contribution to environmental pollution. The number of reporters has increased since 2004. Initially, it was mainly because companies were getting used to the new obligation. Today, the number of facilities reporting releases and transfers of chemical substances is twice as high as in 2004.

2 3.1.3.2 How are data reported to the IRZ obtained?

Reporting emissions or transfers of pollutants to the IRZ does not always require measurement or professional laboratory analysis. When introducing the IRZ or discussing adding or removing a monitored substance from the legal list, industry representatives often mislead themselves and the public by claiming they will incur expensive and complex measurements or chemical analyses. However, this is not always true and depends on the data acquisition method chosen by the company. There are three ways companies can approach data collection for reporting:

I. Measurement
II. Calculation
III. Estimation

It is important to note that only methods and technologies certified under applicable law may be used to determine emissions or transfers of pollutants. Companies must ensure that the measurement method is carried out by authorized persons, and these measurements must be documented and archived for at least three years. The situation is similar for calculations and estimates.

In special cases, exceptions exist where a non-certified method can be used. Emissions from a single facility are aggregated. This is important for complying with the legal limit for reporting to the IRZ. For example, a facility with two boilers aggregates emissions from both and reports the resulting sum. Similarly, total emissions or transfers of substances from different technologies within a single facility are aggregated.

2 3.1.3.3 Measurement

Measurement is a method of directly determining the quantity of a released substance. Typically, this occurs during short-term emission monitoring or water, soil, or waste analyses, such as semi-annual monitoring for IPPC requirements. This method is usually supplemented by additional calculations, where the annual volume of released or transferred substances is determined from measurements, as measurements are usually taken only a few times a year and not continuously throughout the year. The IRZ database marks measured data with the letter "M" (measurement).

2 3.1.3.4 Calculation

Another method is calculation, based, for example, on knowledge of the quantity of input fuel or other raw material, the performance and efficiency of the technology, or other input and process parameters from which it is possible to calculate the quantity of produced pollutants professionally. For example, in power plants, it is usually the knowledge of the quantity of fossil fuel burned annually, the performance and the emission coefficient of a given boiler and the number of operating hours. In the IRZ database, calculated data is marked with the letter "C" (calculation).

2 3.1.3.5 Estimation

Estimation is primarily used when measuring or calculating emissions is impossible or economically unjustifiable. For example, it is impossible to measure emissions from small boilers or stoves in households, garden composting, or the disposal of green waste from gardens. In these cases, emissions are estimated based on statistical data, expert estimates, and known quantities of processed materials. For example, the amount of household waste is known, and the composition of biodegradable waste is statistically known, so the quantity of biodegradable waste disposed of in gardens can be estimated. In the IRZ database, estimated data is marked with the letter "E" (estimation).

2 3.1.3.6 What data are reported to the IRZ?

Data reported to the IRZ includes the total quantity of substances released into the air, water, and soil or transferred in waste. This is reported by individual substances and technologies or installations from which the substances are released. Reports also include data on waste transfers. The reporting facility also provides information on individual technologies' operational status and technological parameters. This includes data on the number of hours of operation, the quantity of raw materials consumed, and the performance of technologies. Such data is important for the subsequent calculation of emissions or transfers.

Data reported to the IRZ also includes information about the facility's environmental impact. This includes data on the consumption of resources, energy, and water, as well as waste generation and its impact on human health. In addition, the reporting facility must provide information on the measures taken to reduce emissions or transfers, the use of the best available technologies, and the implementation of cleaner production processes.

2.3.1.4 How is the Quality of Reported Data Ensured?

The quality of reported data is crucial for the reliability and credibility of the IRZ. It is, therefore, essential to ensure that the data reported by facilities is accurate and meets certain quality standards. Several mechanisms are in place to ensure data quality:

I. Verification of reported data
II. Certification of measurement methods
III. Certification of authorized persons
IV. Penalties for non-compliance

Overall, the combination of verification processes, certification of measurement methods, certification of authorized persons, and penalties for non-compliance helps ensure the accuracy and reliability of the data reported to the IRZ. This, in turn, contributes to the effectiveness of the IRZ in monitoring and managing environmental impacts from industrial activities.

2.3.1.4.1 Verification of reported data

The data reported to the IRZ is subject to verification by the relevant environmental authorities. This involves a thorough examination of the data to ensure its accuracy and consistency. If discrepancies or inaccuracies are identified, the facility may be required to provide additional information or correct the reported data.

2.3.1.4.2 Certification of measurement methods

The methods used by facilities to measure emissions or transfers of pollutants must be certified under applicable law. This certification ensures that the measurement methods are reliable and accurate. Facilities must use certified methods to obtain data for reporting to the IRZ.

2.3.1.4.3 Certification of authorized persons

Individuals responsible for conducting measurements or calculations for reporting purposes must be authorized and certified. This certification ensures that the personnel involved have the expertise and competence to perform accurate measurements or calculations.

2.3.1.4.1 Penalties for non-compliance

Facilities that fail to comply with reporting requirements or provide inaccurate data may face penalties. These penalties are designed to incentivize facilities to adhere to reporting obligations and maintain the quality of the data submitted to the IRZ.

2.3.1.5 Photogallery of Facilities Reporting into Czech PRTR

Photo 2.18: *Although Triton laundry and clothing cleaning facility in the town of Rakovník in Central Bohemia faced complaints in 2010 mainly due to black smoke from its chimney, it ranked among the top polluters in the Czech Republic from 2004 to 2010 due to emissions of 2.8 to 8.5 tons of tetrachloroethylene (Arnika 2023b). Photo: Jaromír Olič, authorized chimney sweep by the Ministry of the Environment of the Czech Republic, 2010*

Photo 2.15: *A chemical factory producing nitrogen fertilizers, Lovochemie, located near the largest Czech river, the Elbe, at the foothills of the Protected Landscape Area of the Czech Central Highlands, is a source not only of pollutants released into the air (being a significant emitter of the greenhouse gas nitrous oxide), but also of zinc and its compounds in releases to water (Havel et al. 2011). Photo: Jan Losenický, Arnika, 2017*

Photo 2.17 *One of the large brown coal thermal power plants in Ledvice, owned by the energy company ČEZ, is situated in the Podkrušnohorská Basin, where brown coal is mined. As it is a valley surrounded by mountains on both sides, frequent inversions occur here from autumn to spring, trapping pollution closer to the ground. However, the power plant chimney and cooling towers peek above the inversion cloudiness in this photograph. Brown coal power plants, besides emitting sulfur dioxide, carbon dioxide, and dust, are also significant sources of heavy metals, including arsenic, which then accumulate in the residues from flue gas cleaning (Petrlík 2010). Photo: Daniela Endrštová*

Photo 2.16: *The smaller smoking chimney in this photograph belongs to a waste-to-energy plant (municipal waste incinerator), while the larger one belongs to the Liberec Heating Plant. We delve into it further in Subchapter 4.1.7.3. Photo: Marek Jehlička (www.skywalker.cz), 2021*

Photo 2.19: *The Lukavec wood processing plant is located in a rural landscape. Nevertheless, it is among the largest polluters of the carcinogen formaldehyde, similar to another wood processing plant, Kronospan, in Jihlava (see Photo 4.4). Since 2007, the Lukavec plant has reported air emissions of formaldehyde ranging from 2.4 to 9 tons to the Czech PRTR (IRZ) (Arnika 2023a). Photo: Jindřich Petrlík, Arnika, 2011*

Photo 2.20: *Wastewater treatment plants in large cities reflect the toxic substances present in households or used by craft industries in the city. Not all of these substances can be completely removed from wastewater. Thus, even the Central Wastewater Treatment Plant in Prague, pictured here, is among the largest sources of surface water pollution with heavy metals (Arnika 2023c). Photo: ŠJů (cs:ŠJů) via Wikimedia Commons*

2.3.2 IREP as PRTR in France

The General Directorate for Risk Prevention of the Ministry of Ecological Transition and Territorial Cohesion oversees the compilation of crucial data on pollutant releases and transfers in France. This information, sourced from major industrial installations, urban sewage treatment plants catering to over 100,000 equivalent inhabitants, and specific livestock operations, is publicly accessible through the French Register of Pollutant Releases and Transfers (IREP).

The IREP is a comprehensive national inventory encompassing chemical substances and potentially hazardous pollutants released into the air, water, and soil. It also includes data on the production and treatment of both hazardous and non-hazardous waste. The register plays a vital role in meeting international obligations, such as the requirements of the International PRTR Protocol and the European Regulation E-PRTR, ensuring transparency in pollutant releases and transfers.

The decree of January 31, 2008 (available at http://www.ineris.fr/aida/consultation_document/23106) defines the list of establishments subject to this annual declaration and the list of pollutants concerned and the thresholds for mandatory reporting. Here's a breakdown of the targeted pollutants in different environmental mediums:

1. **Emissions into Water:**
   - Targeted Pollutants: 150 pollutants (including global indicators, substances, or substance families)
2. **Emissions into Air:**
   - Targeted Pollutants: 87 pollutants
3. **Emissions into Soil:**
   - Targeted Pollutants: 70 pollutants
4. **Waste Categories:**
   - Targeted Categories: 400 categories of waste

Additionally, the register includes information on volumes of water taken and discharged, subject to specific thresholds. Notably, these pollutants span various types, reflecting the diverse nature of pollutants released into the environment. Small installations and low emitters are not required to produce a declaration; nor are installations in certain sectors of activity. Similarly, the Pollutant Emissions Register does not include estimated releases from diffuse sources such as agriculture and transportation or from individuals.

The IREP provides a detailed and categorized overview of the pollutants, facilitating a comprehensive understanding of the environmental impact of different sources, including major industrial installations, urban sewage treatment plants, and certain livestock operations. This information is crucial for regulatory compliance, environmental management, and public awareness (MTECT 2023).

2.3.3 PRTR in The Netherlands

Emission estimates in the Netherlands are registered in the PRTR, which is the national database for sectoral monitoring of pollutant and greenhouse gas emissions to air, water, and soil. The database was set up to support national environmental policy, as well as to meet the requirements of the EU National Emission Ceilings Directive (NECD),

Photo 2.21: *Sanofi Chimie in Sisteron, France, pharmaceutical industrial facility reporting into the French PRTR. Photo: K800i via Wikimedia Commons*

Photo 2.22: *The incinerator in Lunel-Viel is likely to cause serious illnesses. Professor Dominique Belpomme identified the incinerator as the reason for the increased number of cancer cases in 2015. Large waste incinerators are among the pollution sources reported to the PRTR system, even in France. Source: (Goyon 2015)*

CLRTAP, the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (National System) (Wever et al. 2023).

In 1974, the Netherlands initiated the establishment of PRTR, evolving it into a robust national database for emissions (Ruyssenaars et al. 2007; Wever et al. 2023).

Task forces, including ENINA, MEWAT, TgL, V&V, and WESP, oversee the meticulous collection, processing, and validation of emission data, ensuring a unique dataset. Since 2010, point source emissions have been electronically submitted, emphasizing consistency and validation under the ENINA task force (Wever et al., 2023).

The E-PRTR directive mandates approximately 1,000 Dutch facilities to report emissions, supplemented by estimates for comprehensive coverage. Recent enhancements integrate GIS and web-based tools, enabling online updates and facilitating public access.

The transition from the Pollutant Emission Register (PER) to PRTR signifies a shift towards increased public engagement and adherence to international standards. The PER, initiated in 1974, monitors national-scale emissions, with dedicated task forces collecting data for diverse sectors (Ruyssenaars et al. 2007; Wever et al. 2023).

Annual updates of emission estimates for 375 compounds use country-specific methods and have been coordinated by the Emission Registration team at the National Institute for Public Health and the Environment (RIVM) since 2010. The PRTR aims to maintain up-to-date, transparent, and accurate emission data (Wever et al., 2023). In 1997, PRTR included the emission data for about 170 substances, including waste, listed in the Annex (see Annex 2, subchapter 6.2) (Evers 1997).

Organized by sectors, task forces conduct annual trend analysis for data collection, processing, and validation. Point source emissions, monitored since 2010, contribute to the PRTR database. Integrating GIS and web-based tools, the PRTR facilitates online updates, public access, policy-making, and international reporting (Wever et al., 2023).

Ongoing developments addressed the increasing demand for detailed data at various levels. The Netherlands adapts to international requirements, emphasizing transparency, consistency, and comparability in emission inventories. Attention to emission data quality

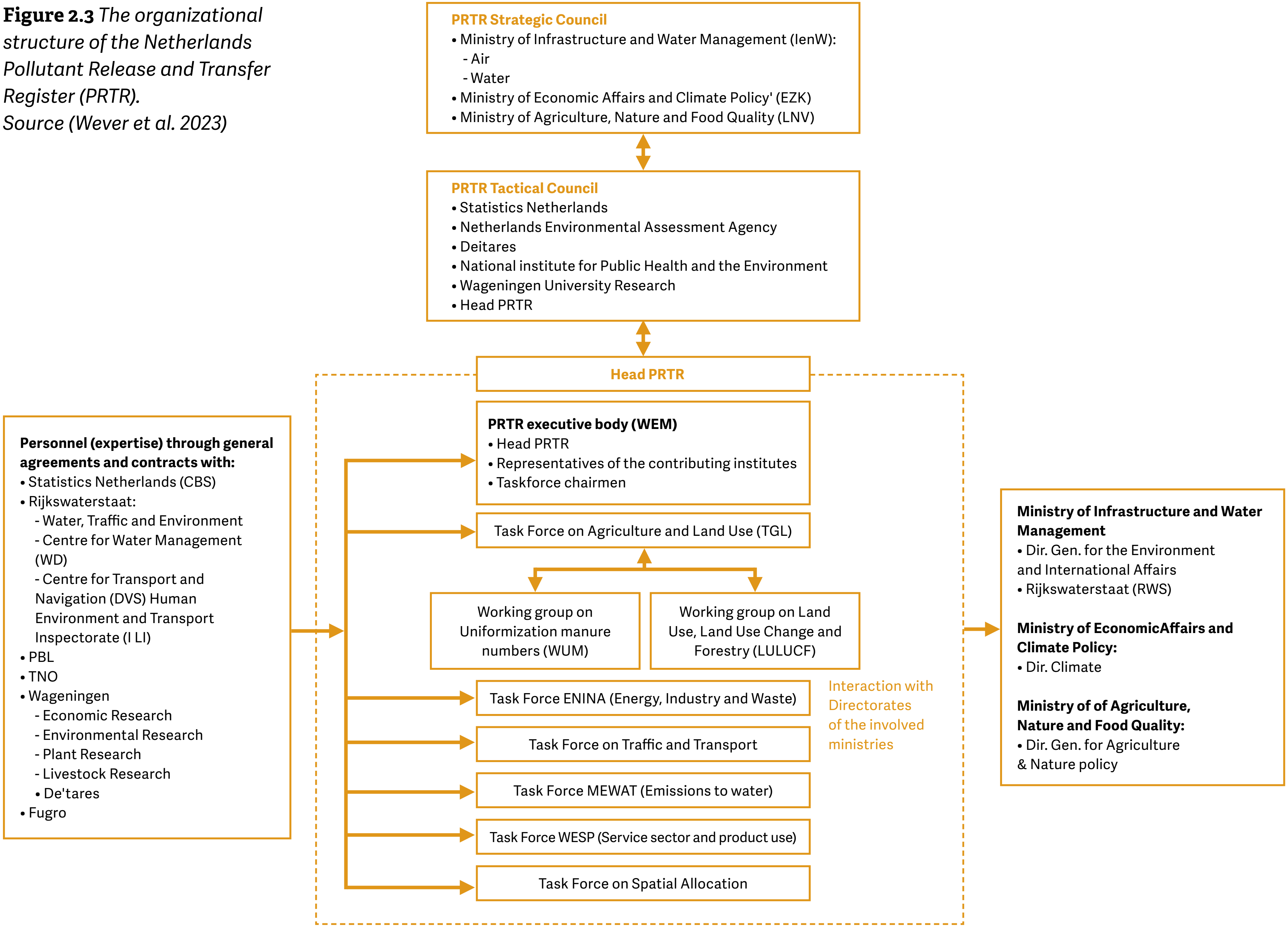


Figure 2.3 *The organizational structure of the Netherlands Pollutant Release and Transfer Register (PRTR).*
Source (Wever et al. 2023)

intensifies at national and regional levels, underscoring the necessity for emissions to be considered in evaluating environmental policy. The PRTR database, managed by RIVM, collaborates with contributing research institutes to store emission data effectively. Each contributing institute is responsible for data collection, emission calculations, and quality control. These are laid down in general.[8]

In comparison to the E-PRTR, the Dutch PRTR encompasses a broader range of substances, with a notable focus on air emissions. However, it distinctly lacks information concerning the transfer of chemical substances in waste. Specifically, details about chemical substances in waste are absent, as the information about waste types in the Dutch PRTR cannot substitute for this critical data.

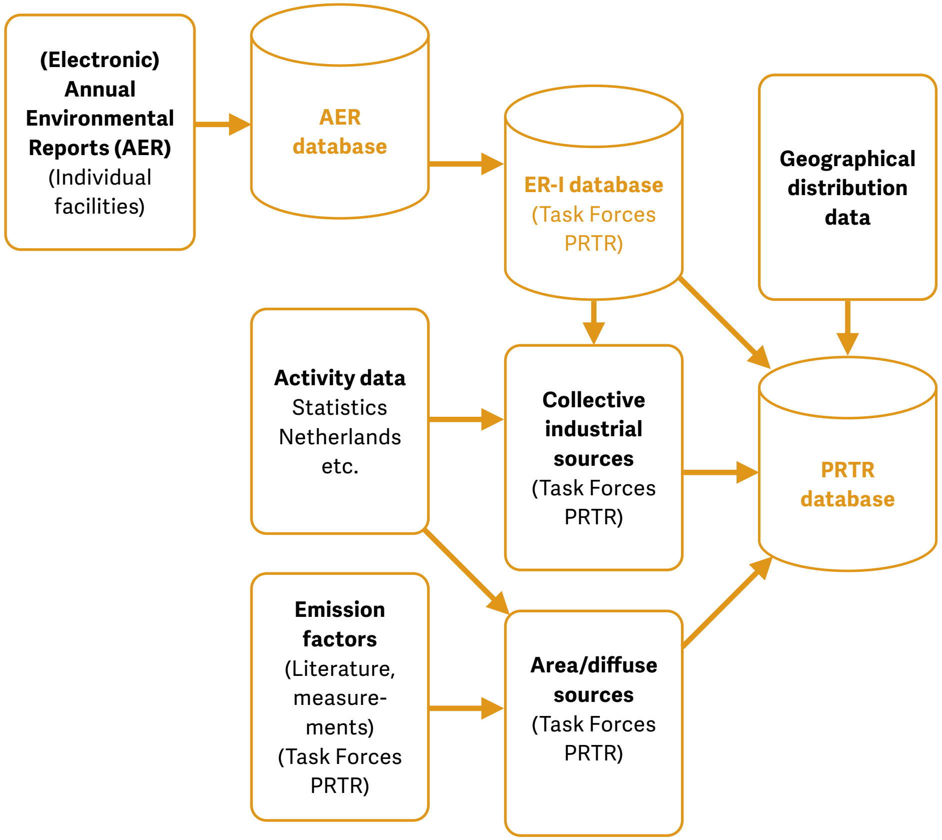
The sophisticated PRTR system in the Netherlands is described in the diagram in Figure 2.2 and its flow chart in Figure 2.3.

The Dutch authorities have developed a special guide for facility operators to calculate their emissions for reporting to the PRTR, called the "Methodology Report on the Calculation of Emissions to Air from the Sectors of Energy, Industry, and Waste," as used by the Dutch Pollutant Release and Transfer Register (Honig et al. 2021). This is a very useful tool for proper reporting into the PRTR system.

2.4 PRTRs in Other Developed Countries

In this section, we will briefly address PRTR systems in other countries that are not members of the European Union, which is already covered in the previous section. Countries that are discussed in this section are the United States, Canada, Japan, and Korea.

Figure 2.4 *The data flow in the Netherlands Pollutant Release and Transfer Register (PRTR). Source: (Wever et al. 2023)*



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[8] Emission data is produced in annual (project) cycles. In addition to RIVM, various external agencies/institutes contribute to the PRTR by performing calculations or submitting activity data: 1) Netherlands Environmental Assessment Agency (PBL); 2) Statistics Netherlands (CBS); 3) Netherlands Organisation for applied scientific research (TNO); 4) Rijkswaterstaat; Water, Traffic and Environment (RWS-WVL); 5) Deltares; 6) Wageningen University & Research (WUR), Statutory research tasks: – Wageningen Environmental Research (WEnR); – Wageningen UR Livestock Research (WLR); – Wageningen Economic Research (WEcR); – Wageningen Plant Research (WPR). Each of the contributing institutes has its own responsibility and role in the data collection, emission calculations and quality control. These are laid down in general agreements with RIVM and in the annual project plan (Wanders, 2021).

Photo 2.23: *Abel Arkenbout has been monitoring the long-term operation of the municipal waste incinerator in Harlingen, the Netherlands. His studies have focused on, among other things, how dioxin emissions are monitored, showing that, for example, estimates of dioxin emissions vary significantly between one-time measurements and semi-continuous measurements using the Ames system (Arkenbout et al. 2018; Arkenbout and Petrlik 2019). This, of course, also affects data reporting to the PRTR. Photo taken during poster presentation at Dioxin Conference 2018 in Krakow, Poland. Photo: Jindrich Petrlik, Arnika*

2.4.1 Toxics Release Inventory in USA

The PRTR system in the United States is addressed through the Toxics Release Inventory (TRI) policy (USEPA 2023b), which requires industries that belong to the 11 major group industry codes in the US Standard Industrial Classification (SIC) to report their toxic chemical release, where one of the codes is further described in certain sub-sector codes in the North American Industry Classification System (NAICS).[9] Based on their activity, these industries must report certain chemicals listed among 200+ required chemicals. The latest required chemicals, added in 2022, were PFOS, PFBS, potassium-PFBS, and chemicals with CAS No. 203743-0307 (USEPA 2022a). The information on the characteristics of these chemical pollutants is also accessible through their multiple national databases, including the TRI-CHIP (TRI-Chemical Hazard Information Profiles), among other available referable databases (USEPA 2022b), (USEPA 2022a). The information on the characteristics of these chemical pollutants is also accessible through their multiple national databases, including the TRI-CHIP (TRI-Chemical Hazard Information Profiles) among other available referable databases (USEPA 2022b), (USEPA 2022a).

More information about the history of TRI development in the USA was included in chapter 2.1 History of PRTR of this guide.

2.4.2 National Pollutant Release Inventory (NPRI) in Canada

The National Pollutant Release Inventory (NPRI), established in 1992 and launched in 1993, is Canada's national pollutant release and transfer register (Johnston Edwards and Walker 2019; Taylor et al. 2020). Facilities that meet reporting requirements must report to the NPRI under the Canadian Environmental Protection Act, 1999 (Canada 1999).

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[9] 40 CFR Part 372 § 372.22

As of 2021, there were 320 pollutants on the NPRI list, including volatile organic compounds (VOCs), toxics like mercury, lead, polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, etc. Over 7,191 facilities nationwide reported 4.99 million tonnes of pollutants for 2021. These facilities include the chemical industry, oil and gas sector, electricity, mining and quarrying, iron and steel, and government facilities such as incinerators, landfills, and sewage treatment plants (CELA 2023).

The facilities must report on their:

- release of pollutants to air, surface waters, and on land;
- disposal on-site, such as in landfills, land application, deep well injection, and mining tailings and waste rock;
- off-site transfer for treatment and disposal; and
- off-site transfers for recycling (CELA 2023).

Some of the NPRI's valuable features are:

- it provides the public with facility-specific data for each pollutant;
- the data is reported by each polluter annually;
- the polluters are required by law to report and can be charged if they fail to do so; and
- the data is available to the public through the NPRI website.

A NPRI Multi-Stakeholder Working Group has been established. The NGO representation in that group includes current members from the following groups: Canadian Association of Physicians of the Environment (CAPE), Canadian Environmental Law Association (CELA), Citizens' Network on Waste Management, Keepers of the Water, Mining Watch Canada, Watershed Sentinel Education Society and New Brunswick Lung Association (CELA 2023).

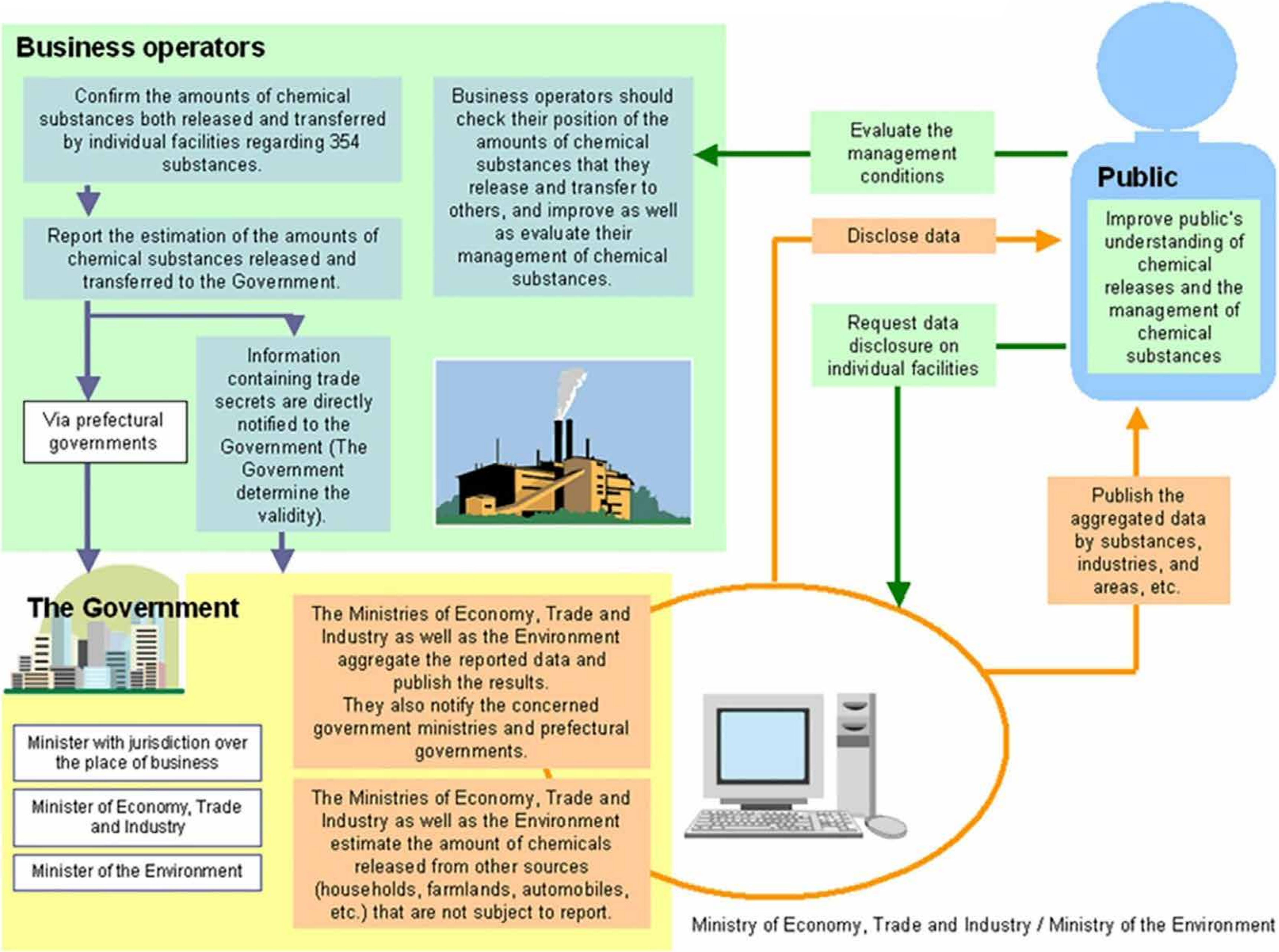
2.4.3 PRTR in Japan

Photo 2.24: *Kawasaki Industrial Area, 2014.*
Photo: Darwin via Wikimedia Commons

Japan implemented PRTR in 2002, although it was established in its legislation earlier (MoE-GoJ 2007). The implementation was stimulated by the OECD's recommendation in 1996 and went through several processes, including establishing a technical advisory committee, bill submission, nationwide concept introduction, interim evaluation, and full implementation for six years (MoE-GoJ 2007). Its implementation began by enacting the Act on Confirmation, etc., of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof in 1999. The Environment Agency of Japan (which later became the Ministry of the Environment, MOE) started a pilot PRTR project in 1998 (Yamaguchi 1999), covering 30 cities and about 2000 facilities. This ran for three years before the system was implemented nationally (Nakachi 2010).

The Japanese government requires 462 chemicals in their Class I and another 15 substances in their Specified Class I Designated Chemical

Figure 2.5 *The Japanese PRTR system. Source: (MoE-GoJ 2007)*



Substances to be reported by the relevant 24 types of industry (MoE-GoJ 2007). These data, both the compiled data and the outline of the result, are available publicly on their PRTR data page (MoE-GoJ 2023).

The significance of the PRTR system, as outlined by the Japanese Ministry of Environment, encompasses several key aspects (MoE-GoJ 2007):

- **Obtainment of Basic Data for Environmental Conservation:** The system provides essential data that forms the foundation for environmental conservation efforts.
- **Determination of Priorities in Administrative Measures:** It aids in determining priorities for administrative measures related to chemical substances.
- **Promotion of Voluntary Improvement:** The PRTR system promotes voluntary improvement in the management of chemical substances by business operators.
- **Provision of Information to the Public:** The system provides information to the public, fostering their understanding of chemical substances.
- **Understanding the Effect of Environmental Conservation Measures:** It facilitates understanding of the impact of environmental conservation measures and the improvements brought about by them.

In 2010, the non-governmental organization Toxic Watch Network provided an overview of the system (Nakachi 2010), noting that data at the individual facility level were available, with over 34,830 reporting sites in 2001. The sheer volume of data, exceeding 30,000 pages if printed, prompted considerations for more accessible dissemination. *"However, the data can be recorded on a CD-ROM in a format for upload into a database or spreadsheet program. The disk costs only JPY 1,090 (= approximately 10 euros), an affordable amount in Japan. Nevertheless, it became an issue for review because the national government was supposed to freely disseminate the data to engage with citizens and empower them."* (Nakachi 2010)

Mizutani (2013) evaluated the state of the Japanese PRTR as follows: *"This system is expected to aid in reducing the amount of toxic chemicals being released along with the associated environmental risks. For Japan's fiscal year 2011, based on the national PRTR system, 36,638 business entities reported chemical substance amounts being released and transferred. The total amount released was approximately 174 thousand tons, and the total transferred amount was approximately 225 thousand tons, for an amount of 399 thousand tons released and transferred in total."*

Since the establishment of the PRTR system in Japan, there has been a tendency for the total amounts of released and transferred substances to decrease. This suggests that the system has played a role in contributing to the reduction of environmental risks associated with these chemical substances. As highlighted, moving forward with PRTR requires consideration of several key issues: *"1) how to develop/revise a method for estimating the chemical amounts that have not been reported by certain sectors, such as waste treatment facilities; 2) how to properly promote alternatives to chemicals that can work as safe substitutes; and 3) how consumers and waste industries can have access to information on these chemicals using PRTR data."* (Mizutani 2013)

2.4.4 PRTR in the Republic of Korea

The Japanese NGO Toxic Watch Network described Korea's Toxics Release Inventory (TRI) system in 2010: *"Korea introduced a PRTR system earlier than Japan, from 1996. The Korean system is called the Toxics Release Inventory (TRI). At the "Symposium regarding international trends for chemical substances" held by the Ministry of the Environment* *of Japan in March 2007, a manager for the Chemical Substance Safety Department in the Ministry of Environment of the Republic of Korea described the TRI as a system which imposes duties on corporations to report quantities of chemical substances released into the environment during production and use. Corporations shall also report amounts transferred for recycling and disposal. The Korean TRI covers 388 chemical substances, and sites that deal with or produce more than 100 kg of chemical substances must report the amounts. It was also reported that while the handling amounts were 372,250 tonnes and the released amounts were 16,243 tonnes in 2001, in 2005, the handling amounts were 454,910 tonnes, and the released amounts were 7,750 tons. Although the handling amounts had increased by 22.2%, the released amounts were drastically reduced by 53.5%.*

According to a survey conducted in 2006, the number of sites that reported data was 2,829.

A unique feature of the Korean TRI system is that the registered data has not been disclosed since 1996, when the system was introduced. Meanwhile, European countries, the US, and Japan all publish their data through various media such as websites, CDCDs, and reports. The Korean MOE shows only the total handling amounts and release amounts (aggregated at the national level) on their website. These data are published (in pdf format) in Korean. Toxic Watch visited Korea in March 2010 for research and found that even citizen groups working on environmental issues did not know of the existence of the TRI system because the Korean government does not make the data public." (Nakachi 2010)

The official Korean PRTR site in English contains aggregated data for 2001 – 2012 only (NICS 2014). More specific data on various industrial sectors can be downloaded in PDF format from the PRTR website (NICS 2014).

2.5 PRTRs in some Developing and Low-Middle Income Countries

Apart from the PRTR implementation in developed nations, we will also address the implementation of PRTR systems in developing and/or Low-Middle Income Countries (LMIC), which include, for example, Chile, Colombia, Bosnia and Herzegovina, Tajikistan, Kazakhstan, Moldova, and Thailand.

2.5.1 PRTR in Chile

In Chile, voluntary reports of emission and waste transfers, including 121 pollutants and nine physical and biological parameters, are submitted to the government. Its implementation was established through the regulation *Administración del Registro de Emisiones y Transferencias de Contaminantes* (The Management of the Registry of Emissions and Transfers of Pollutants) in 2010. There are two main pieces of information in the Chilean PRTR system: those associated with point and non-point sources. The point sources information collect information on air emissions, hazardous waste generation, water discharge (surface and marine waters), and transfers to the sewage system, while the latter collects emissions from transportation, agriculture burning, forest fire, urban fire, as well as urban and rural firewood estimation (Ministerio del Medio Ambiente 2022).

2.5.2 PRTR in Colombia

Over the past 20 years, Canada has assisted Colombia in building the capacity to develop and implement PRTR (ECCC 2019). The implementation of the PRTR system itself has been embedded into several policy documents throughout the years, including Colombia National Action Plan (2013-2020) and Environmental Performance Review (2014), to name a few (Alarcón 2020). According to the 8th meeting of the Working Group of the Parties to the Protocol on PRTRs on 18th December 2020, Colombia planned to develop a pilot test of the PRTR with productive sectors and environmental authorities in 2019-2020 and the issuance of the regulation in 2020-2021. Although the PRTR in Colombia had not yet been launched in 2020 (Alarcón 2020), in 2022, the OECD assessed the task of implementing the PRTR as fulfilled (OECD 2022).

2.5.3 PRTR in Bosnia and Herzegovina

However, even though, in 2009, the EU financed a 1,200,000 EUR project to implement the EU PRTR Directive in BiH (European Commission 2009; Zahumenská et al. 2015), its enforcement was far from satisfactory. A new server and software were purchased, but only a single Federal Ministry of Environment and Tourism employee was entrusted with the password to access the data (Bjelić et al. 2017). Instead of publishing the information from the register in a publicly accessible manner, access to it is limited to individual requests filed with the Ministry. Requests are usually answered after long delays, and applicants often receive the information too late to be able to use it in decision-making procedures. Moreover, the system only covers the Federation of Bosnia and Herzegovina (FBiH while Republika Srpska (RS) and Brčko District (BD) are developing self-standing schemes. It is of great concern that no progress has been noted throughout the reporting period (Bjelić et al. 2017).

Photo 2.25: *The metallurgical complex in Zenica (in this photograph from 2014) is among the largest polluters in Bosnia and Herzegovina. This was confirmed by the results of analyses of dioxins and other POPs in free-range chicken eggs conducted by Arnika in 2015 (Petrlik and Behnisch 2015). Photo: Martin Plocek, Arnika*

More information about PRTR in Bosnia and Herzegovina is in a case study in subchapter 4.1.4.

2.5.4 PRTR in Tajikistan

Tajikistan is a mountainous landlocked country in Central Asia, where agricultural pollution has become the main environmental issue. In May 2006, Tajikistan joined “The Kyiv Protocol on Pollutant Release and Transfer Registers,” referring to the Aarhus Convention, which then established its PRTR working group under the State Committee for Environmental Protection and the Forestry of the Republic of Tajikistan (Aarhus Center - Republic of Tajikistan 2008). Despite the signing of the PRTR and acknowledging the importance of monitoring pollutant releases to be publicly accessible, the creation of the PRTR itself is a challenging task for Tajikistan. Efforts have been taken to transform the initiative into a real paper, for instance, participating in the “Enhancing Capacity Building for the Development of the National Registers of Pollutant Release and Transfer in Two Countries in Transition: the Republic of Belarus and Republic of Tajikistan under the Aarhus Convention” project from 2011 to 2013 resulting in several key points to accelerate

Photo 2.26: *Like Bosnia and Herzegovina, steel mills are among the largest polluters in Kazakhstan. The photograph shows Mittal Steel's steelworks and coking plant in Temirtau in 2013. Photo: Ondřej Petrlík, Arnika*

the realization. However, no PRTR has yet been established, with the absence of funding as the main reason (UNECE 2017).

Civil society is often not included in the consultations about establishing PRTRs in the countries (Alarcón 2020). This approach excludes a critical stakeholder of PRTR.

2.5.5 PRTR in Kazakhstan

On January 27, 2020, Kazakhstan joined the UNECE Protocol on PRTRs, becoming its 37th Party and marking a crucial step for environmental transparency in Central Asia (UNECE 2020). Before 2020, discussions focused on creating a working PRTR, involving a decade-long effort with achievements and challenges (Mogilyuk 2017).

Photo 2.27: *The Kazakhstani PRTR (Pollutant Release and Transfer Register) includes only releases, but industrial operations' waste contains a significant amount of toxic substances. These substances can then accumulate in fish or chicken eggs, as demonstrated by Arnika's studies (Petrlik et al. 2015a; Petrlik et al. 2016; Petrlik et al. 2015b). The photograph shows the sampling of ash storage in Temirtau in 2013. Photo: Ondřej Petrlík, Arnika*

In 2013, voluntary reporting from 134 facilities provided valuable environmental data, but analysis revealed a concerning trend – about 90% of the data contained errors. Common mistakes included reporting pollutants below limits and confusing air and water pollutants (Mogilyuk 2017).

Recommendations by the Eco Forum of NGOs of Kazakhstan aimed to address these challenges. They included operator consultations, robust data verification, mandatory reporting, focusing on emissions exceeding limits, an online reporting form, and capacity building for media and the public (Mogilyuk 2017).

The rules for maintaining the state register of pollutant emissions, approved by the Ministry of Energy dated 10 June 2016 No. 241, established the list of substances reported by the PRTR. It contains information on the volume of both actual air emissions of pollutants for 60 substances and water emissions for 62 substances (OECD 2019).

As of 2017, Kazakhstan had not ratified the PRTR Protocol to the Aarhus Convention and was still in the process of forming a PRTR system. With 778 nature users providing reports, the system lacked real-time emissions ranking, industry-specific information, and comprehensive national coverage. The PRTR system, operating in a pilot mode, faced challenges in providing accurate and transparent information about emissions. Information was presented only by region. Additionally, some enterprises in some regions are not represented in the PRTR system at all. For example, the system does not issue reports for Pavlodar and Turkestan (OECD 2019).

In conclusion, discussions before 2020 emphasized the need for a functional PRTR in Kazakhstan. Transparency, accuracy, and stakeholder engagement were recognized as essential elements for the success of the PRTR in the country.

2.5.6 PRTR in Moldova

The Central Laboratory of the Chisinau Ecological Agency under SEI monitored air, soil, and water quality, while SEI and ecological inspections maintained data on economic agents in their Annual Report. The "Apele Moldovei" Agency managed water-related policies, and the Sustainable POPs Management Office under a WB/GEF Project handled contaminated sites and PCB data. The Environment Pollution Prevention Office of the Ministry of Environment was involved in drafting chemicals and waste-related legislation (Isac et al. 2016).

The Climate Change Office focused on UNFCCC reports, and the Ozone Office oversaw the phase-out of Ozone Depleting Substances. The National Bureau of Statistics (NBS) collected environmental data, but evaluations indicated issues meeting UNECE requirements (Isac et al. 2016). Moldova aimed to establish a PRTR by 2020, facing challenges involving economic agents and NGOs. Since 2013, steps have included project proposals, working group formation, and awareness efforts. Recommendations stressed creating a legislative framework, promoting the draft Law on Access to Environmental Information, and aligning laws with the IPPC Directive. Proposals included an integrated reporting procedure with a designated competent authority for streamlined data flow and better environmental decision-making (Isac et al. 2016).

The 2019 presentation outlined steps toward PRTR establishment, involving legal frameworks, infrastructure development, capacity building, and international reporting. However, funding challenges post-2017 impacted the operational status of the PRTR in Moldova (Republic of Moldova 2018b; Tugui 2019), suggesting a hiatus despite indications of functionality in 2018/2019.

Reports by individual facilities are available on the official website. However, only data for the years 2015 – 2017 is available (Republic of Moldova 2018b). So, it seems that with the end of funding from multilateral funds, the PRTR stopped its operation in Moldova, although it seemed to be fully functional and ready to start in 2018/2019.

This situation was confirmed by the EU4Environment Report published in 2022 (EU4Environment 2022). The electronic PRTR register was developed in 2016, and the number of registered operators increased significantly in subsequent years. In 2017, 75 operators joined, followed by 188 in 2018. Moldova also adopted a regulation on the national PRTR in 2018. However, as of November 2020, the transfer of PRTR management from the Office of Air Pollution to the Environmental Agency faced operational challenges, rendering the PRTR non-operational (EU4Environment 2022).

Data contributors to the PRTR include registered operators reporting emitted or transferred pollutants, the Inspectorate for Environmental Protection (for non-sanitary or illegal landfills), the Apele Moldovei Agency (concerning aquatic resources), the National Agency for Food Safety (related to phytosanitary products, fertilizers, livestock farms, and wastewater disposal), the Public Services Agency (providing data on registered cars and engine types), and the National Bureau of Statistics (contributing to the energy balance) (EU4Environment 2022).

The Environmental Agency serves as the information register for the PRTR, handling primary registration, data updates, and removals. The inspectorate is responsible for diffusing pollutants, demonstrating the complex data management structure of the PRTR system in Moldova (Republic of Moldova 2018a).

Plans for the solution are as follows: *"There are plans to integrate the PRTR with various other information systems through the interoperability platform MConnect. There are also plans to elaborate a Guide to Facilitate the Implementation of the National PRTR. This would indicate the types of activities to be monitored, methodology, indicators, data recording instructions and deadlines for sending the data.*

It will be important to have a mechanism for checking reports to the PRTR. This could, for example, compare information provided against records required for permits, inspections, and samples from the Reference Laboratory. The Inspectorate for Environmental Protection should be a recipient of the data, which can feed into its risk assessment process." (EU4Environment 2022)

The situation in Moldova appears to be similar to that in the Czech Republic when the introduction and initial years of operation of the IRZ system faced challenges in coordinating the reporting of environmental data into various inadequately coordinated databases, such as the air pollution register, hydrological register HEIS, etc. (see subchapter 5.3).

2.5.7 PRTR in Thailand

The Map Ta Phut Industrial Estate (MTPIE) in Thailand is part of the Eastern Seaboard Development Program, which aims to boost industrial growth. However, this progress has led to environmental and public health issues due to industrial pollution. Ongoing efforts to regulate and improve the situation involve both public and private sectors, but concerns persist in society. In 2011, the Japan International Cooperation Agency (JICA) initiated a PRTR pilot project in Rayong province in collaboration with Thai environment NGO EARTH (Ecological Alert and Recovery Thailand), the Pollution Control Department, the Department of Industrial Works (DIW), and the Industrial Estate Authority of Thailand to address these concerns (Enviliance Asia 2022).

The pilot scheme targets 107 substances from 7 categories of point sources (refinery, chemical/petrochemical, automobile and auto part industry, fabricated metal, wood/furniture, electrical machinery, plastic, and rubber) and non-point sources (mobile sources, agriculture, construction/paint, small industry, and other industry outside point source, e.g., gas station and households) (PCD and JICA 2014). The pilot implementation was expanded to cover two more provinces, Samutprakarn and Chonburi, between 2017 and 2019.

Photo 2.28: *Industrial operations in Tha Tum, Thailand shouldn't be left out and undoubtedly belong among those reported to the planned PRTR. For instance, high mercury concentrations were found in fish from the Shalongwaeng Canal near a coal power plant (Saetang et al., 2013). Photo: Ondřej Petrlík, Arnika, 2016*

A study conducted in Thailand revealed that stakeholders had misunderstandings about the private sector's implementation of PRTRs (Kondo and Limjirakan 2013). Concerns were raised about costs, technical issues, and data confidentiality. Despite these concerns, most petrochemical companies expressed willingness to adopt PRTR, while some were hesitant due to cost, technical barriers, and stakeholder understanding of the scientific nature of the data. Additionally, the discussion included the possibility of including non-point sources in the PRTR. However, some companies expressed willingness to participate

Photo 2.29: *Khon Kaen in Thailand hosts, among other things, a paper mill. Here is the discharge of wastewater from the canal of this operation. The planned PRTR should also cover emissions of toxic substances from such discharges (Mach et al. 2017). Photo: Jindřich Petrlík, Arnika, 2016*

despite this concern, citing other reasons, such as limited scientific knowledge among stakeholders.

Compared to Japan's PRTR, the PRTR in this pilot project in Thailand reported fewer substances and limited the number of point sources to 7 categories due to the small scale in only two provinces. Despite being a pilot project, it has received good cooperation from business operators in both provinces, including voluntary submission to PRTR reporting. The top pollutants found in Rayong Province were toluene, N-hexane, xylenes, methanol, and isopropyl alcohol. In Samutprakarn Province, the top pollutants were toluene, isopropyl alcohol, xylenes, ethyl acetate, and zinc. In 2017, the PRTR system extended to Chonburi Province, identifying toluene, n-pentane, and xylenes as pollutants. The data collected between 2013 and 2017 indicates that the industrial sector has significantly improved its understanding and reporting capabilities. In Rayong Province, the emissions of the top three pollutants decreased annually from 2015 to 2017. This reduction may be attributed to the successful implementation of the PRTR system, which mandates the industrial sector to increase awareness and voluntarily reduce emissions (Enviliance Asia 2022). However, no emission reporting and transfer data for point sources and emission estimation of non-point sources from the pilot scheme have been released for public access.

The Ministry of Industry aims to limit the future enforcement of PRTR from national legislation to ministerial notification and to refrain from public disclosure of individual facilities' emission data. In September 2022, the Thailand Ministry of Industry opened the latest draft, "Notification of Ministry of Industry: Reporting Pollutant Release and Transfer Register (PRTR), B.E.25XX" for public consultation. It was planned to come into force in January 2023 (Umeyama 2022), but enforcement was delayed until the end of 2023.

In March 2022, Greenpeace Thailand, Enlaw, EARTH, Northern Region Breathe Council and Chiang Mai Breathe Council filed a lawsuit in court against the National Environment Board and two ministries (Natural Resources and Environment and Industry) for failing to step up action on the PM2.5 crisis. The measures have fallen behind the implementation outlined in the Driving National Agenda on "Solving the Problem of Particulate Matter," resulting in the state's failure to protect public health. Surachai Trong-ngam, secretary of the Environmental Law Foundation, stated that the website aims to provide the public with easy access to information on the amount and type of pollutants from different sources. According to Greenpeace Southeast Asia (2023), he also mentioned that PRTR could help Thailand deal with air pollution more effectively.

2.6 List of Existing PRTR Websites

Australia: http://www.npi.gov.au/ (oficial site)
Austria: https://secure.umweltbundesamt.at/PRTR-web/state.do?stateId=APP_START (German)
Canada: https://www.canada.ca/en/services/environment/pollution-waste-management/national-pollutant-release-inventory.html (official site)
https://cela.ca/community-right-to-know/ (civil society website by CELA)
Chile: https://retc.mma.gob.cl/ (Spanish)
Croatia: http://roo-preglednik.azo.hr/Default.aspx (Croatian)
Cyprus: http://www.prtr.dli.mlsi.gov.cy/prtr/iweb.nsf/ContentDocsByCountry/Greek (Greek, English)
Czechia: http://www.irz.cz/ (Czech)
http://znecistovatele.cz/ (civil society website by Arnika Association, Czech only)

Denmark: https://datacvr.virk.dk/data/ (Danish)
Finland: https://www.ymparisto.fi/en/pollution-and-environmental-risks/clean-air/air-pollutant-emissions-finland/prtr-non-point-source-emissions (Finish, English)
France: https://www.georisques.gouv.fr/risques/registre-des-emissions-polluantes/etablissement/donnees#/ (French)
Germany: https://thru.de/ (German)
Israel: https://www.gov.il/en/departments/topics/prtr/govil-landing-page (English and Hebrew)
Japan: http://www.prtr.nite.go.jp/index-e.html (official site)
http://toxwatch.net/ (civil society organization Toxic Watch Network site in Japanese, available also in English version but only until 2012)
South Korea: https://icis.me.go.kr/prtr/english.do# (English)
Malta: https://era.org.mt/topic/prtr/ (English)
Moldova: https://retp.gov.md/#/ (Romanian)
Netherlands: http://www.emissieregistratie.nl/(Dutch)
Norway: https://www.norskeutslipp.no/ (Norwegian)
Romania: http://prtr.anpm.ro/Main.aspx (Romanian)
Slovakia: http://nrz.shmu.sk/index.php (Slovakian)
Spain: http://www.eper-es.es/ (Spanish)
Sweden: https://utslappisiffror.naturvardsverket.se/en/Search/ (English)
Switzerland: http://www.bafu.admin.ch/chemikalien/prtr/index.html?lang=en (English, German)
Thailand: https://thaiprtr.com/ (civil society organizations' website to support PRTR in Thailand, Thai version only)
USA: http://www.epa.gov/tri (official site)
http://www.rtknet.org/ (civil society organizations The Right-to-Know Network)
UK: https://www.gov.uk/guidance/uk-pollutant-release-and-transfer-register-prtr-data-sets (English)

2.7 Comparison of the Efficiency Between Various PRTRs

Kerret and Gray (2007) compared PRTRs in the United States, Canada, England, and Australia. Their analysis came with interesting outcomes: *"The results from the four studied countries suggest that there is no consistent relationship between various surrogate measures of risk and mass emissions. In some cases, reductions in mass may nevertheless increase risk. This could happen while reductions are focused on chemicals with a lower risk coefficient while, at the same time, the amounts of more risky substances are on the rise. These results support further research to unravel the reasons behind the differences among the countries and the relations between risk and mass trends."* (Kerret and Gray 2007). It also supports previous work that implies that risk and emissions are not necessarily correlated (Gray 1999). Another practical aspect of these findings is additional support for the suggestion to include risk categorizations in the PRTRs (Karkkainen 2019).

Reporting emissions according to their potential risk may increase the correlation between risk and reductions. This aspect can be very well demonstrated by the releases of substances such as dioxins, which are measured in fractions of grams. While this may not significantly affect the overall number of reported releases and transfers in PRTR, these are highly hazardous substances from a risk perspective. Saving every gram released into the environment can impact millions of people's health (EFSA CONTAM 2018; Petrlik et al. 2022a; Petrlik et al. 2021). Differentiating between risk levels may increase the focus of reporting facilities on reducing the emissions of higher-risk substances, concluded Kerret and Gray (2007).

The analysis of the four studied countries suggested that there are significant variations between the trends in air emissions as represented by the national PRTRs: *"Clearly, the presence of a PRTR does not auto-*

matically lead to reductions in air emissions of the target chemical. The United States and England show consistent reductions in emissions on many different measures. At the same time, it seems that the Canadian NPRI system did not have a similar effect, and air emissions increased for some measures and decreased in others. Australia saw increased emissions by most measures. The latter evaluation clearly shows that further research is required to assess the benefits of the PRTR approach to environmental management and, if desired, to identify factors that influence PRTR" (Kerret and Gray 2007).

From the perspective of civil society, in analyzing and comparing the PRTR systems in those four countries, it is important to note that in the USA and England, very active NGOs used PRTR to exert pressure to reduce emissions from industrial operations (Taylor 2004; Working Group on Community Right-To-Know 1991; Working Group on Community Right-To-Know 1997). To be objective, we must acknowledge that in Canada, CSOs also engaged in campaigns related to PRTR (CELA 2023; Environmental Defence and CELA 2004) data and used a system similar to Friends of the Earth UK (OECD 2000; UNITAR 2003), but such a campaign did not take place in Australia. The US EPA also announced the so-called 33/50 Program in the USA and actively utilized TRI data (Bi and Khanna 2012; Khanna and Damon 1999; USEPA 1991).

3. Multilateral Agreements, Inter-governmental Organizations and PRTR

UNITAR Guidance gives a very good overall picture of the international framework of multilateral agreements and/or UN global initiatives related to PRTRs to a certain extent. Some of them build a base for establishing PRTRs in whole UN regions (UNITAR 2018) and/or support their development globally (OECD 2023b).

3.1 Principle 10 of the Rio Declaration

The United Nations Conference on Environment and Development (UNCED) provided specific references to establishing national emission inventories and the right of the public to access this information. Principle 10 of the Rio Declaration aims to safeguard the right to a healthy and sustainable environment for present and future generations. This principle also bridged the government's accountability with environmental protection. It states that *"environmental issues are best handled with the participation of all concerned citizens"* and that *"each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes."* In addition, "*states shall facilitate and encourage public awareness and participation by making information widely available."*[10] This Principle will lay the groundwork for PRTRs. The Agenda 21 was also adopted during the UNCED-2. Through Chapter 19, which addresses the environmentally sound management of toxic chemicals, Agenda 21 recommends that *"governments and relevant international organizations with the cooperation of industry should improve databases and information systems on toxic chemicals, such as emission inventories programs."* Chapter 19 also states that governments should *"consider adopting community-right-to-know or other public information dissemination programs as possible risk reduction tools."* Without such requirements, *"industry should be encouraged to adopt, on a voluntary basis, community right to know programs… including sharing of information on causes of accidental and potential releases … and reporting on annual routine emissions of toxic chemicals to the environment"* (UNITAR 2018).

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[10] https://leap.unep.org/en/knowledge/glossary/access-information

3.2 OECD

U.S. delegation at the UNCED Conference in Rio in 1992 recommended including the PRTR system in the tools of Agenda 21. The OECD developed Recommendations for Governments to Implement PRTR Systems. In 1996, the OECD Council adopted its "Recommendation of the Council on Implementing Pollutant Release and Transfer Registers" (OECD 2001), which was revised in 2018 (OECD 2023c). Through this recommendation, the OECD encourages Adherents (i.e., Members and non-members having adhered to the Recommendation) to design and establish PRTRs through a transparent and objective process. The Council recommends that Adherents take into account certain principles in implementing PRTRs, which include fostering enhanced international comparability of PRTR data by incorporating core elements such as triggers for reporting based on a harmonized list of pollutants and sectors; making the data accessible to the public in a timely and regular basis and in a user-friendly format such as through an electronic search tool; ensuring the quality and timeliness of the data; and regularly evaluating the effectiveness of the PRTR (OECD 2023c; UNITAR 2018).

Since the beginning of its involvement, OECD activities have aimed at developing practical tools and guidance to help countries install and implement a PRTR, including providing information and technical support. Special focus goes to improving PRTR data quality, exploring PRTR data applications and harmonizing PRTRs across the countries (OECD 2023b).

OECD work on PRTRs is overseen by the Task Force on PRTRs (TF PRTRs), composed of experts on PRTR in member countries. The TF PRTRs' activities aim at:

- advise the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology on specific opportunities and challenges for the implementation of PRTRs and propose appropriate measures to meet the challenges, including ways and means for national and international actions;
- promote communication and a close working relationship between the Task Force on PRTRs and the Task Force on Exposure Assessment, as well as relevant organizations on the various aspects of the PRTR work; and
- analyze developments in the field of PRTRs and bring the implications of such developments to the attention of the member countries (OECD 2023b).

3.3 Aarhus Convention

The United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making, and Access to Justice in Environmental Matters (Aarhus Convention 2005) was adopted in 1998 in the Danish city of Aarhus at the Fourth Ministerial Conference as part of the "Environment for Europe" process.

The Aarhus Convention gives the public certain rights related to the environment:

- **Access to Environmental Information:** Everyone has the right to get environmental information from public authorities. This includes details about the environment, policies, measures, and their impact on human health and safety. People can request this information; authorities must provide it within a month without asking why.

- **Participation in Environmental Decision-Making:** Public authorities must let the public and environmental groups give their input on decisions that affect the environment. This includes projects, plans, and programs. The authorities must consider these comments and provide information on the final decisions and the reasons for them.
- **Access to Justice:** People can challenge public decisions that ignore the above rights or environmental laws. The Convention connects environmental rights to human rights, recognizes our duty to future generations, emphasizes the involvement of all stakeholders for sustainable development, and links government accountability with environmental protection. It promotes interactions between the public and authorities in a democratic context (UNITAR 2018).
- **The Aarhus Convention is not just about the environment; it's also about government accountability, transparency, and responsiveness.** It grants the public rights and imposes obligations on parties and authorities for information access, public participation, and justice. Additionally, it introduces a new process for public involvement in negotiating and implementing international agreements (UNECE 2019).

3.3.1 Kyiv Protocol

Ensuing from the Aarhus Convention, the Kyiv Protocol on Pollutant Release and Transfer Registers (adopted in 2003 and entered into force in 2009) is the first legally binding international agreement on PRTR. It is the only legally binding international instrument on pollutant release and transfer registers, meaning that once a country has ratified it, it must implement a PRTR at a national level. However, the number of reported chemicals is at the country's discretion. Its objective is *"to enhance public access to information through the establishment of coherent, nationwide pollutant release and transfer registers in accordance with the provisions of this Protocol, which could facilitate public participation in environmental decision-making as well as contribute to the prevention and reduction of pollution of the environment"* (Article 1). The Protocol covers 64 activities and 86 substances, as well as categories of substances that must be reported (EUR-Lex 2021). However, countries can add more chemicals to the list if they want. All UN Member States can join the Protocol, including those that have not ratified the Aarhus Convention and those that are not members of the United Nations Economic Commission for Europe (UNECE). It is, by design, an 'open' global treaty (UNECE 2011; UNITAR 2018).

The protocol requires that a PRTR is based on a reporting scheme that:

- is mandatory;
- is annual;
- covers different media, i.e., air, land, water;
- is facility-specific;
- is pollutant-specific for releases;
- is it pollutant-specific or waste-specific for transfers?

The protocol sets minimum requirements for pollutants and facilities, and parties can include additional elements (EUR-Lex 2021).

3.4 The Stockholm Convention on POPs

The Stockholm Convention (adopted in 2001 and in force since 2004) aims to safeguard human health and the environment from 32 Persistent Organic Pollutants (POPs) as of August 2023 (Chasek 2023; Stockholm Convention 2023).

POPs are long-lasting carbon-based chemicals released into the environment through human activities. They endure for years, spreading globally via air, water, and soil. POPs accumulate in living organisms, especially in the food chain, posing toxicity to humans and wildlife. This widespread contamination, spanning generations, leads to chronic health effects.

Bioaccumulation concentrates POPs in higher food chain organisms, facilitating their travel to distant regions like the Arctic. Exposure to POPs can result in severe health issues, including cancer, damage to the nervous and reproductive systems, immune disruption, and endocrine disruption, impacting both exposed individuals and their offspring (Chasek, 2023; Stockholm Convention, 2019).

Given their long-range transport, no single government acting alone can protect its citizens or its environment from POPs. In response to this global problem, the Stockholm Convention, adopted in 2001 and entered into force in 2004, requires its parties to take measures to eliminate or reduce the release of POPs into the environment (Chasek, 2023; Secretariat of the Stockholm Convention 2008).

3.4.1 Main Provisions of the Stockholm Convention

Key provisions of the Stockholm Convention include:

- Prohibiting/eliminating the production, use, import, and export of listed POPs (Article 3; Annex A).
- Restricting production and use of listed POPs (Article 3; Annex B).
- Reducing or eliminating releases from unintentionally produced POPs (Article 5; Annex C).
- Safely managing stockpiles and wastes containing POPs (Article 6).

Other provisions cover implementation plans, new listings, information exchange, public awareness, research, technical assistance, financial resources, reporting, effectiveness evaluation, and non-compliance (Stockholm Convention 2010).

3.4.2 PRTRs and the Stockholm Convention

Pollutant Release and Transfer Registers (PRTRs) are crucial tools for monitoring and reporting POPs and supporting compliance with convention requirements (Article 10).

Incorporation of the reporting on chemicals listed under the Stockholm Convention into the 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 SC can even become the initial chemicals for the establishment of PRTR in the country, as there are guidance documents for their inventories available (UNEP and Stockholm Convention 2013; UNEP 2017; UNEP 2017 a; UNEP 2017 b) and they may help to calculate their emissions and transfers from certain sources within the country. We tried to document the use of PRTR for these purposes in some examples using data from the Czech PRTR, particularly in one of the previous reports within the project in Thailand (Petrlik et al. 2018).

3.5 Minamata Convention on Mercury

The Minamata Convention (adopted in 2003 and enforced in 2017) targets mercury's adverse effects. Highlights include banning new mercury mines, phasing out existing ones, regulating mercury use, controlling emissions, addressing artisanal and small-scale gold mining (ASGM), and managing mercury storage and disposal. Parties report annually, exchange information, and update implementation plans.

Article 18 encourages using PRTRs for collecting and disseminating mercury data, emphasizing their importance in estimating annual quantities released, emitted, or disposed of through human activities (UNITAR 2018).

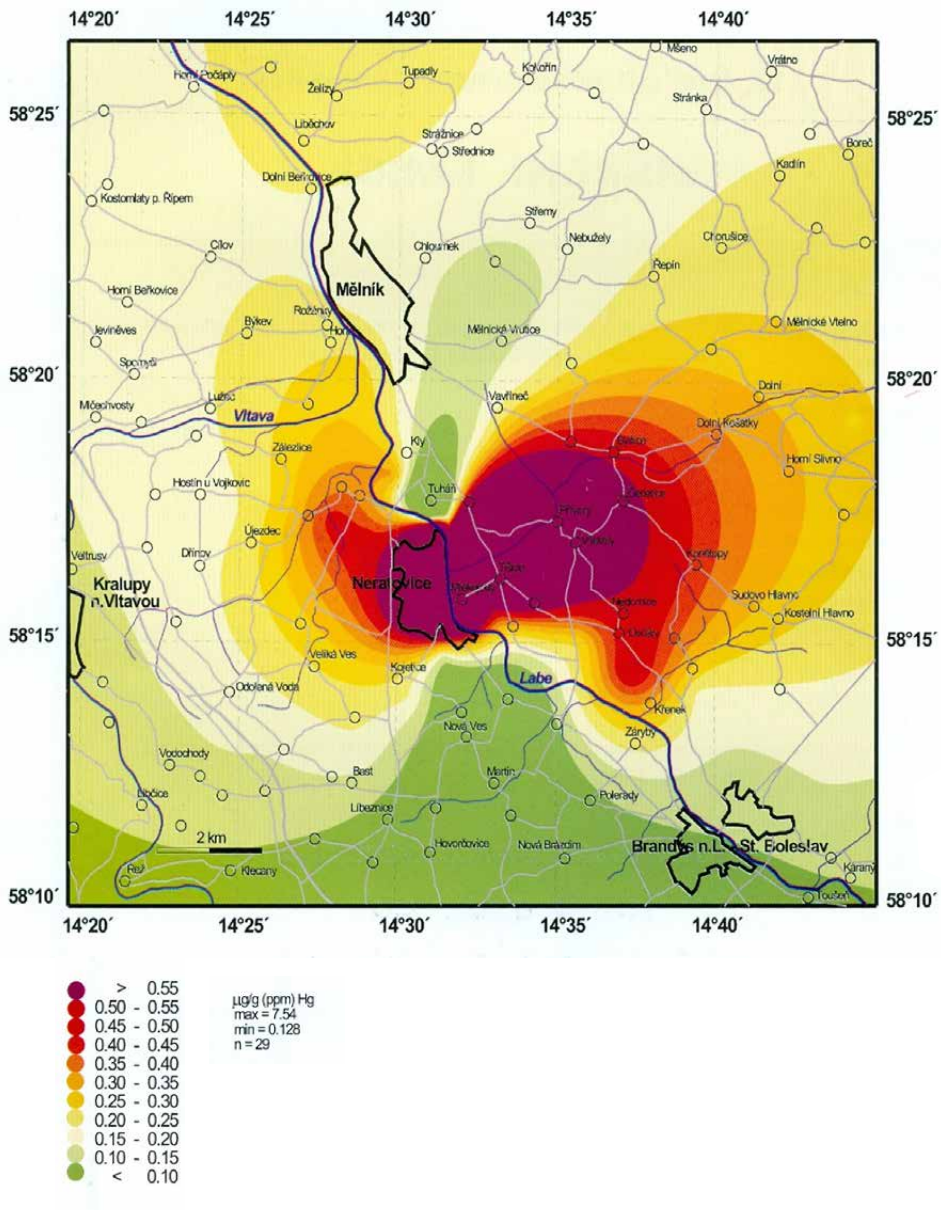
Photo 3.1

Photos 3.1 and 3.2: *A chlor-alkali plant in Pieve Vergonte, Italy was found to be a large source of mercury (Fantozzi et al. 2021).* PRTR can clearly demonstrate to the public large sources of mercury, and the Mercury Toolkit (UNEP Chemicals 2013) is an important tool developed within the framework of the Minamata Convention to support reporting into PRTRs about mercury releases and transfers in wastes. Photo: Legambiente, 2006*

* High values of gaseous elemental mercury concentrations (1112 ng/m3) up to three orders of magnitude higher than the typical terrestrial background concentration in the northern hemisphere were measured in the proximity of the chlor-alkali plant. Hg concentrations in lichens ranged from 142 ng/g at sampling sites located north of the chlor-alkali plant to 624 ng/g in lichens collected south of the chlor-alkali plant (Fantozzi et al. 2021).

Photo 3.3: *The largest Czech chlor-alkali plant, Spolana Neratovice, was flooded in August 2002. It used mercury for chlorine production until 2017. Many mercury residues were also present in the so-called old amalgam electrolysis site, which was contaminated with mercury (Kuncova et al. 2008; Šámánek et al. 2013).**
Photo: Archive of Arnika Association

Figure 3.1: *Determined and interpolated Hg concentrations in oak tree bark in the investigated area i surrounding the Spolana Neratovice chlor-alkali plant. Source: (Suchara and Sucharová 2008)*



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* During floods, a significant portion of the mercury undoubtedly entered the river. The reporting to the IRZ (Czech PRTR) helped reveal the extent of the mercury problem and clearly showed that its flows in waste were many times higher than those into the air. Fish in the Labe (Elbe) River and the nearby lake in Mlékojedy were also contaminated with mercury. The lake, formed in a former sand quarry, is a popular spot for sports fishermen (Šámánek et al. 2013).

Photos 3.4 and 3.5: *Mercury is especially ubiquitous in old chlor-alkali plants (Mach et al. 2016; Mach et al. 2023). In photograph 3.4, mercury contamination is shown in the bombarded Pancevo plant in Serbia in 1999 (photo 3.5) (Associated Press 2010; UNEP and UNCHS 1999). PRTR helps to keep records of mercury flows. Photos: UNEP archive*

Photo 3.5

3.6 United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC aims to combat climate change by limiting global temperature increases and dealing with its impacts. The goal is to stabilize greenhouse gas concentrations to prevent dangerous interference with the climate system. Parties report their emissions to monitor progress, aligning with principles of shared responsibility. This reporting parallels national Pollutant Release and Transfer Registers (PRTRs). The Convention also emphasizes education, training, and public awareness of climate change (UNITAR 2018).

3.7 2030 Agenda: UN Sustainable Development Goals (SDGs)

The 2030 Agenda outlines 17 SDGs to promote sustainable development. Existing reporting mechanisms, including PRTR data, are encouraged to measure progress. PRTR data aligns with specific SDG targets, such as reducing deaths from hazardous chemicals, improving water quality, promoting sustainable industrialization, upgrading infrastructure, achieving sustainable resource management, managing chemicals and wastes, reducing waste generation, and ensuring public access to information (UNITAR 2018).

3.8 Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean

In 2018, 24 Latin American and Caribbean countries adopted a binding regional agreement (Principle 10) to protect access to environmental information, public participation, and justice. The agreement mandates the establishment of a pollutant release and transfer register covering various pollutants in each party's jurisdiction. Similar to PRTRs, this register contributes to environmental protection and sustainable development. The agreement is open for signature by all 33 regional nations (UNITAR 2018).

4. PRTRs and Civil Society

4.1 Case Studies – Civil Society

There is quite a good report and overview by the Environment Directorate of OECD about the uses of PRTR data (OECD 2023e). On the OECD website, one can find a list of various uses of PRTR data by various stakeholders in a well organized database, but not much about uses by NGOs (OECD 2023f). We gathered examples of how civil society used data from PRTRs. You can find them in the following case studies. Links to some civil society websites dedicated to PRTRs can be found in subchapter 2.6, which lists existing PRTR websites. We gathered examples of how civil society used data from PRTRs. You can find them in the following case studies. Links to some civil society websites dedicated to PRTRs can be found in subchapter 2.6, which lists existing PRTR websites.

4.1.1 Use of TRI by Civil Society in USA

Citizens and civic associations hold the longest experience with the PRTR in the USA. A group of non-governmental organizations focused on working with the American TRI system emerged, later expanding its scope to various issues related to releasing toxic substances into the environment. It was named the "Working Group on Community Right-To-Know." This group published the "Working Notes" magazine every two months, from which the following examples of TRI utilization in the United States in the 1990s are derived (Working Group on Community Right-To-Know 1991; Working Group on Community Right-To-Know 1996a; Working Group on Community Right-To-Know 1996b; Working Group on Community Right-To-Know 1997).

The "Ozone Advocates" and the "Massachusetts Public Interest Research Group" (MassPIRG) used data obtained from TRI to advocate for the replacement of substances damaging the ozone layer and carcinogenic chlorinated solvents at Raytheon. Raytheon reported to TRI that it had released 1.6 million kilograms of CFC-113 and methyl chloroform during the years 1987 and 1988. After a campaign led by the "Ozone Advocates" and MassPIRG, Raytheon announced in 1992 that it would transition to ozone-friendly alternatives. This announcement was made in a joint press conference with MassPIRG (Wolf 1996; Working Group on Community Right-To-Know 1991). In 1991, seven more companies reported, compared to the previous year, and in 1990, only three substances damaging the ozone layer were reported to the American TRI.

The environmental association “Blue Ridge Environmental Defense League (BREDL)” from North Carolina, USA, took the opportunity in 1996 to publish summary data on the amount of chemical substances released by DuPont. Only with the introduction of TRI were they able to obtain an overview of the total amount of substances damaging the ozone layer or carcinogenic substances released into the environment from DuPont facilities in North Carolina. They released this data on the eve of the annual cycling race called the “Tour DuPont,” organized by DuPont to improve its image despite being one of the largest polluters in the country (Orum 1996).

Following the TRI and Community Right-To-Know law, the environmental movement CCE (“Citizens Campaign for the Environment”) in New York led a successful campaign for labeling wastewater discharges. Over 3,000 industrial facilities and wastewater treatment plants have had to label their wastewater discharges visibly since 1997. In combination with this, they also had to disclose quarterly summaries of hazardous substances discharged into the water. The environmental movement gained 5,000 supporting letters and collected a quarter of a million signatures on a petition demanding these measures (Working Group on Community Right-To-Know 1997).

Photo 4.1: *The civil society organization Citizens Campaign for the Environment, which in 1997 achieved a measure requiring visible labeling of wastewater discharges for over 3,000 industrial facilitie and wastewater treatment plants, is still active. In 2023, it advocated for legislation to protect bees and birds. Photo: Citizens Campaign for the Environment*

The Information Release Zone doesn’t have to be utilized only by citizens and civic associations. State environmental agencies in Massachusetts and New Jersey used it to reduce pollution effectively. In early 1997, these two states published reports revealing that major chemical processors had significantly reduced the content of toxic substances in waste and so-called non-product outputs from their operations. In contrast, the trend for these substance flows was the opposite throughout the USA. The EPA (Environmental Protection Agency) attributed this to the fact that, unlike other American states, these states had a better-developed system of supplementary information complementing TRI, which they required from companies. Chemical companies could, therefore, better calculate how many raw materials were escaping due to poor material flow management or by not utilizing chemicals contained in waste. Both states exerted pressure to reduce the release of toxic substances at the source.

Environmental organizations in Canada and the United Kingdom went even further than civic associations in the USA. Until 2002, Friends of the Earth in the UK operated an online guide called the “Chemical Release Inventory” (CRI). Visitors to their website could easily find information

Photo 4.2: *The Exxon Mobil Refinery in Baton Rouge, Louisiana, seen from the top of the Louisiana State Capitol. The petrochemical complex near New Orleans in Louisiana belongs to major polluters with various releases from the chlorine industry, including dioxins (Harden et al. 2005). Photo: W. Clarke via Wikimedia Commons, 5 March 2017*

Photo 4.3: *The Mossville community is a small, predominantly African American community suffering from PVC production in its neighborhood (Harden et al. 2005). Young residents of Mossville, Louisiana, play near PVC plants. Many families have been forced to relocate due to contamination and the expansion of industry surrounding Mossville (Toxic Free Future 2023). Photo: Gary Little, Greenpeace; Source: (Toxic Free Future 2023)*

about substances released from nearby factories or rankings of the largest polluters of a certain substance. They operated these pages until the state Environment Agency essentially began operating a similar guide. In 2015, Arnika has initiated similar application for the Czech Republic.

4.1.2 Factory Watch – Friends of the Earth UK Project in 1990s

The Factory Watch project, a pioneering Friends of the Earth UK (FOE UK) initiative, was crucial in promoting transparency and public awareness regarding industrial pollution (OECD 2000; Taylor 2004; UNITAR 2003). Unfortunately, the project has been officially closed, ending its impactful journey (UNITAR 2003).

Factory Watch, an award-winning website that monitored factory pollution, aimed to make pollution data accessible to the public. It stood out as a prominent vehicle for disseminating information from the Pollutant

Release and Transfer Register (PRTR) data. As the first website to provide the UK's Chemical Release Inventory data to the public, Factory Watch published detailed tables ranking the top 100 factories based on various pollutants such as carcinogens, dioxins, toxic waste, and acid rain gases (OECD 2000; UNITAR 2003). It started following the UK Environment Agency's release of the 1998 data (OECD 2000).

The project's significance was underscored by its commitment to transparency and accessibility. Factory Watch allowed users to conduct searches by chemical, health effects, industrial process, and parent company, providing a comprehensive and user-friendly interface for accessing critical environmental information (OECD 2000; Taylor 2004).

One of the notable impacts attributed to Factory Watch was its role in achieving a 40% reduction in releases of cancer-causing chemicals across England and Wales between 1998 and 2001. This reduction, from 15,100 to 7,800 tonnes, marked a substantial improvement in environmental conditions. Additionally, Factory Watch shed light on the disproportionate impact of pollution on the most deprived communities, with 80% of emissions concentrated in the 20% most deprived areas. Figure 4.2 (Taylor 2004; UNITAR 2003).

As the project ended, its legacy lives on in the improvements it catalyzed. While Factory Watch's website is no longer active, much of its data is now accessible through the Environment Agency's Pollution Inventory. The initiative sparked positive changes, prompting ongoing advocacy for better environmental practices, including improved league tables, monitoring of water and energy use, and disclosure of production volumes (UNITAR 2003).

Despite its closure, Factory Watch's impact remains evident in the broader context of increased public awareness, policy changes, and

Figure 4.1 *Photocopy of a newspaper article published in The Mirror, on Monday, February 8, 1999, in response to the top worst polluters published by FOE UK. Source: (Taylor 2004)*

** THE MIRROR, Monday, February 8, 1999 PAGE 19

REVEALED: 20 WORST POLLUTERS IN BRITAIN

WORST: Associated Octel Co Ltd, South Wirral

POLLUTION: Shell refinery at Stanlow, Wirral

Friends of the Earth Internet site: http://www.foe.co.uk/factorywatch/

	Operator	Area	Carcinogens in 1996 (Kgs)
1	Associated Octel Co Ltd	South Wirral	5,339,997
2	ICI Ltd (Runcorn)	Runcorn	2,150,499
3	Glaxochem Ltd	Ulverston	813,400
4	European Vinyls	Thornton-Cleveleys	761,430
5	ICI Ltd (North Tees)	Middlesbrough	575,000
6	ICI Ltd (Wilton)	Redcar/Middlesbrough	361,412
7	Courtaulds Chemicals	Lancaster	353,600
8	Zeneca Ltd	Huddersfield	276,264
9	Recticel Manufacturing	Derby	233,400
10	Dow Chemical Company	King's Lynn	117,601
11	Synthomer Ltd	Grimsby	95,000
12	Hodgson Chemicals Ltd	Hull	89,670
13	Montell Ltd	Manchester	87,400
14	ICI Ltd (Hillhouse)	Thornton-Cleveleys	85,050
15	Albright and Wilson UK	Whitehaven	67,400
16	Rhone-Poulenc Rorer	Dagenham	56,702
17	Ciba Geigy PLC	Cambridge	50,150
18	BASF PLC	Middlesbrough	47,583
19	Zeneca Ltd	Thornton-Cleveleys	39,000
20	Shell UK Ltd	South Wirral	37,041

By GRAHAM BROUGH and JEREMY ARMSTRONG

Factories' 13,000 tons of cancer fumes

HE 20 most dangerous ctories in the country are amed today in the first-ver league table of itain's dirtiest polluters. A list of offenders belching cancer-causing fumes

Pharmaceutical and chemical works pepper the league of shame, as do textiles and engineering firms.

Worst-hit areas are Runcorn.

factories in the top six. Friends Of The Earth spent months compiling the dossier.

The survey identified "recognised" cancer-causing agents.

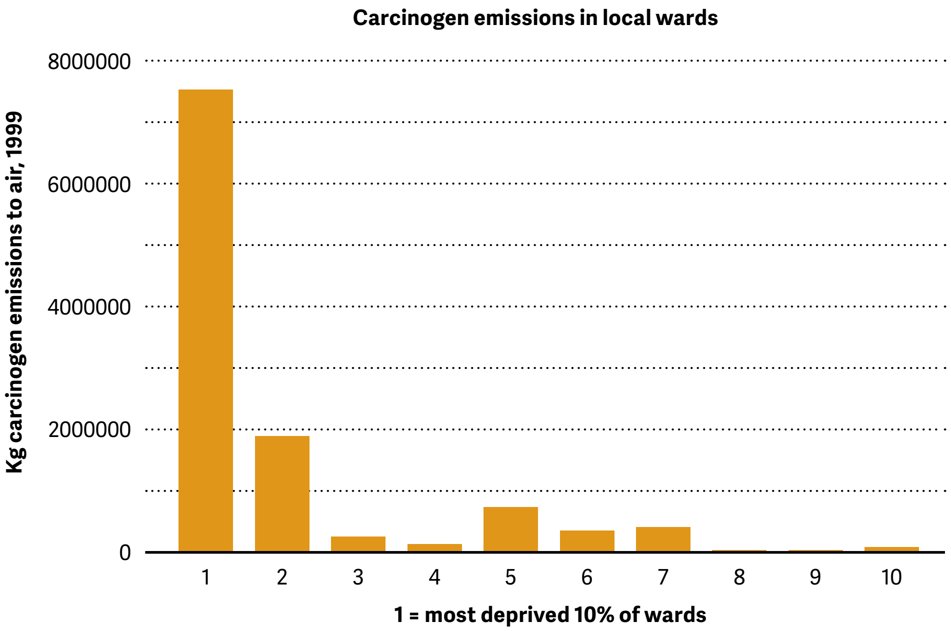
the kidney area. And a whole host of inhaled particles can lead to lung cancer. Benzene types are associated with leukaemia."

But Associated Octe spokesman said the firm "committed to continu improvement". Emissions due to fall during 1999 to than half those of 1996.

And ICI spokeswoman Pa Shields said: "Friends Of Earth's Factory Watch is a gurgitation of out-of-date establishing an Advisory Group for the UK's PRTR. The project catalyzed positive environmental change and contributed significantly to the discourse surrounding industrial pollution and accountability (Taylor 2004; UNITAR 2003).

FOE UK also prepared a guide to help active citizens use the data published in the PRTR. In its introduction, it was written: "*Friends of the Earth intends that this guide will assist people in becoming "active citizens," local watchdogs for the environment, empowered to act. It is not a comprehensive text on pollution - it gives the basics and refers you to other sources of information if you want more* "(Warhurst 1998).

Figure 4.2 *Factory pollution and deprivation. Source: (Taylor 2004)*



4.1.3 Polluters Application in the Czech Republic

Even if facilities already have a system for reporting to the PRTR, and the data is available to the public, it may not be a clear and easily accessible system. Therefore, for example, Arnika in the Czech Republic has developed its own web application using a map to manage publicly available data following examples of similar initiatives (projects) by civil society in other countries like the FOE UK Factory Watch project and/or similar project Pollution Watch (Environmental Defence and CELA 2004) by Environmental Defence and Canadian Environmental Law Association (CELA). Both these projects have already been closed.

Note: In 2022, the original spreadsheet application managed by the Ministry of Environment was replaced by an updated application, but it is still not user-friendly enough. Data from previous years are currently being added.

The Arnika web application is available at www.znecistovatele.cz (Figure 4.4) and contains identical data to the government database. In addition to current data, it provides information on all facilities that have reported to the system since 2004, along with an overview of their reporting history. At the annual level, it is possible to see the rank order of the largest polluters in the Czech Republic for particular groups of substances or specific substances. The great advantage of the map application is that it allows citizens to find out whether there is a polluting facility near their homes.

Arnika compiled rankings of the biggest polluters even before the znecistovatele.cz (as part of its Toxics-Free Future campaign) application was launched, but they were simple, non-interactive tables. For the reporting year 2009, for example, the Kronospan Jihlava wood processing plant (manufacturer of chipboards) was the largest producer

Photo 4.4: *Kronospan Jihlava, a manufacturer of chipboards, was the largest polluter with cancer-causing chemicals according to data published in IRZ (Czech PRTR system) for several years, e.g., for the reporting year 2009 (Petrlik 2013).*
Photo: Jan Losenický, Arnika, 2011

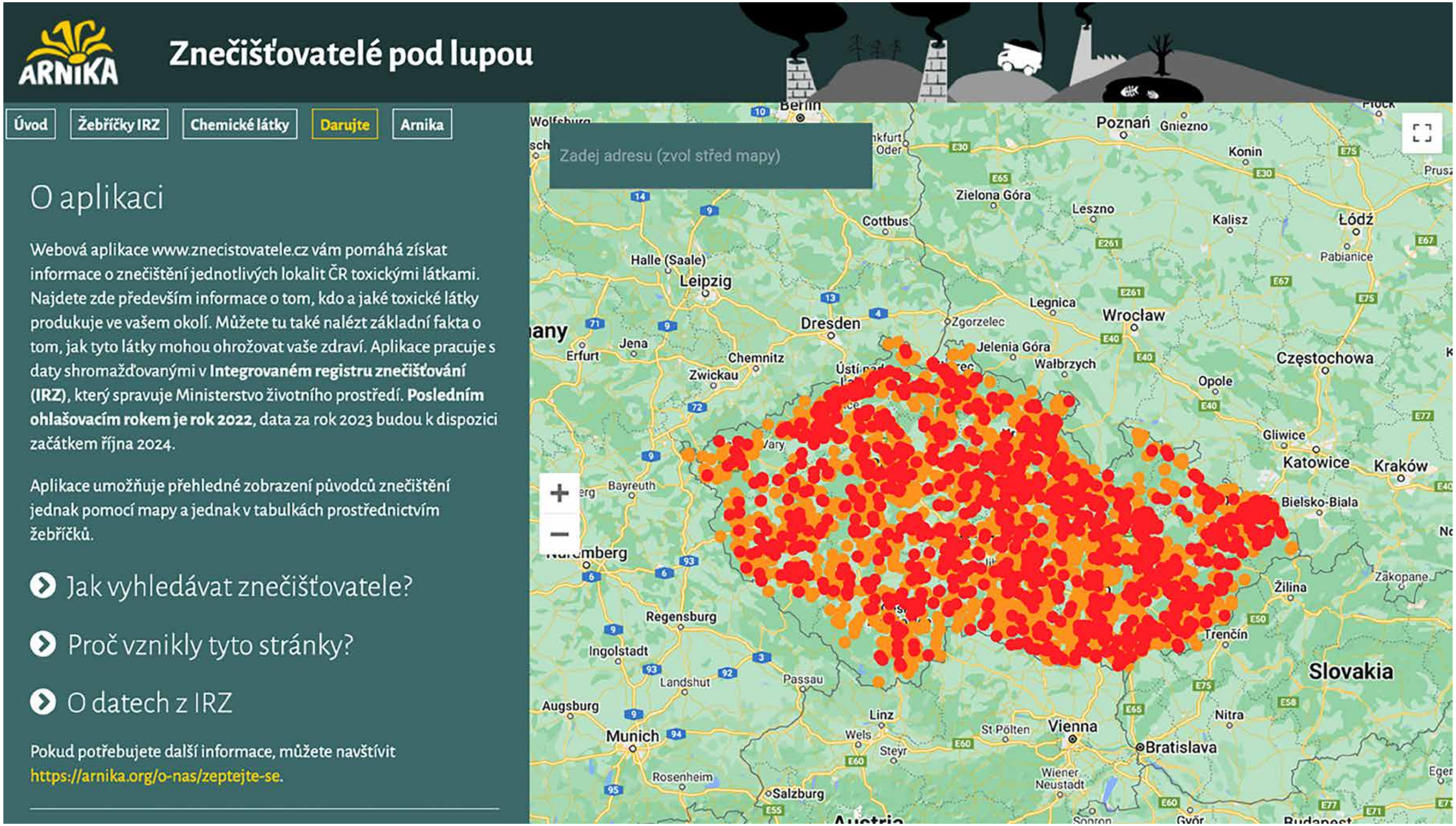
of cancer-causing substances due to high formaldehyde emissions (Petrlik 2013). Maršák (2008b) stated, *"Pollution rankings are widely utilized by the media. Industrial enterprises listed in these rankings, in most cases, respond with minimal publicly declared efforts to reduce emissions."* (Maršák 2008b)

Similar to FOE UK, Arnika also prepared a guide for active citizens on the use of data from PRTR (IRZ), called the "Integrated Pollution Register (IRZ) to help the public" (Petrlik and Man 2016).

A citizen may be interested in which facilities pollute the area around their point of interest (home, school, cottage, etc.) and which facilities pollute it the most. Simply put, the facilities are ranked within a certain radius of a given point. Again, the center can be the address or the center of the map on the screen, and the default is the year with the most recent data, but historical data can also be viewed to see if pollution is getting worse or better. A substance or group of substances must be selected. The groups of substances that can be viewed in the web application (Figure 4.5) are:

- Carcinogenic, probable, or possible carcinogenic
- Carcinogenic
- Reprotoxic
- Mutagenic
- Endocrine Disruptors
- Greenhouse Gases
- Acid deposition gases
- Ozone-Depleting Substances
- Substances harmful to aquatic organisms
- Persistent Organic Pollutants (POPs)
- Mercury and its compounds
- Styrene
- Formaldehyde
- Dioxins
- Dust (Particulate Matter, PM10)
- Heavy metals
- Carbon monoxide

Figure 4.4 *Homepage of the website znecistovatele.cz*



O aplikaci

Webová aplikace www.znecistovatele.cz vám pomáhá získat informace o znečištění jednotlivých lokalit ČR toxickými látkami. Najdete zde především informace o tom, kdo a jaké toxické látky produkuje ve vašem okolí. Můžete tu také nalézt základní fakta o tom, jak tyto látky mohou ohrožovat vaše zdraví. Aplikace pracuje s daty shromažďovanými v **Integrovaném registru znečišťování (IRZ)**, který spravuje Ministerstvo životního prostředí. **Posledním ohlašovacím rokem je rok 2022**, data za rok 2023 budou k dispozici začátkem října 2024.

Aplikace umožňuje přehledné zobrazení původců znečištění jednak pomocí mapy a jednak v tabulkách prostřednictvím žebříčků.

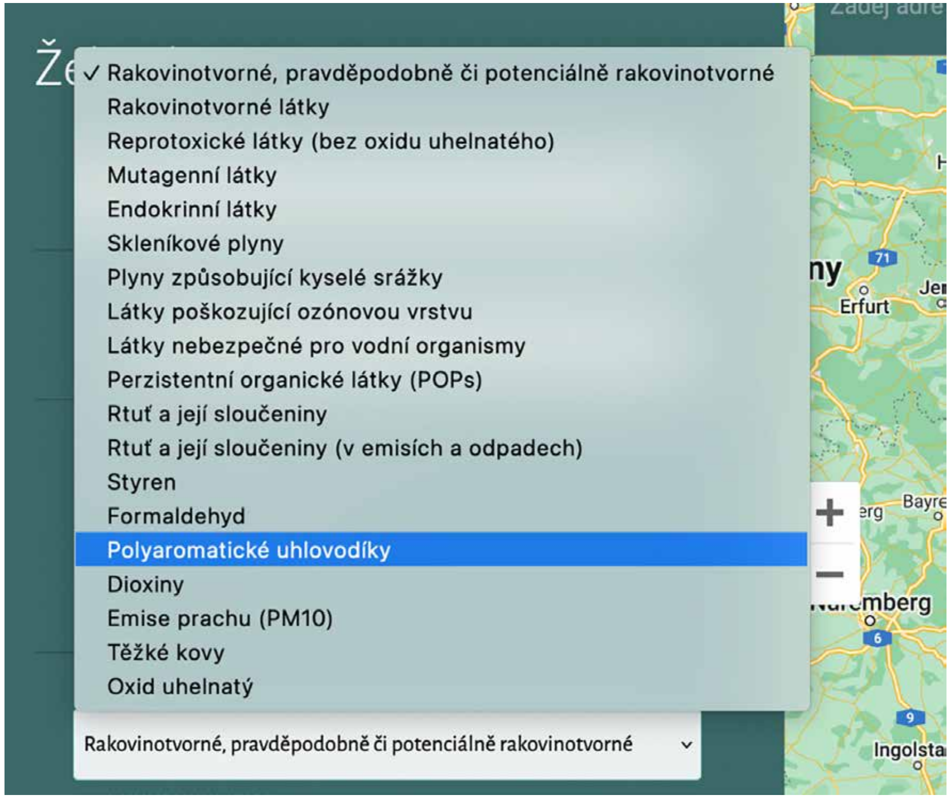
- Jak vyhledávat znečišťovatele?
- Proč vznikly tyto stránky?
- O datech z IRZ

Pokud potřebujete další informace, můžete navštívit https://arnika.org/o-nas/zeptejte-se.

Arnika processes this data once a year (for the previous year) and obtains an overview of the largest polluters in the Czech Republic. Each group has ten facilities (a specific substance or group of substances), as seen in Figure 4.6. If there are fewer, the ranking is shorter.

The ranking shows an arrow pointing up or down or a waveform showing the annual trend. The up arrow indicates an increase, the down arrow a decrease, while the waveform shows approximately the same amount of substances released into the environment.

Figure 4.5 *List of groups of substances or individual substances. Translation of the groups is in the text of subchapter 4.13, just before reference to this figure.*



The displayed facilities list can be exported directly to Excel for further processing on your computer. Several graphs can be displayed:

- a pie chart of all the facilities contributing to the emissions, where the first ten are distinguished by color (Figure 4.7)
- the development of total pollution over the years (Figure 4.8)

Figure 4.6 *Top ten polluters in particulate matter (PM10) in 2022. Translation of the items in the figure: Pořadí = ranking, Organizace/ firma = company, Provozovna = facility, Město = city, town, Kraj = administrative region, Množství látek v kg = amount of released chemical/compound in kg/year, Trend = trend.*

Exportovat do Excelu

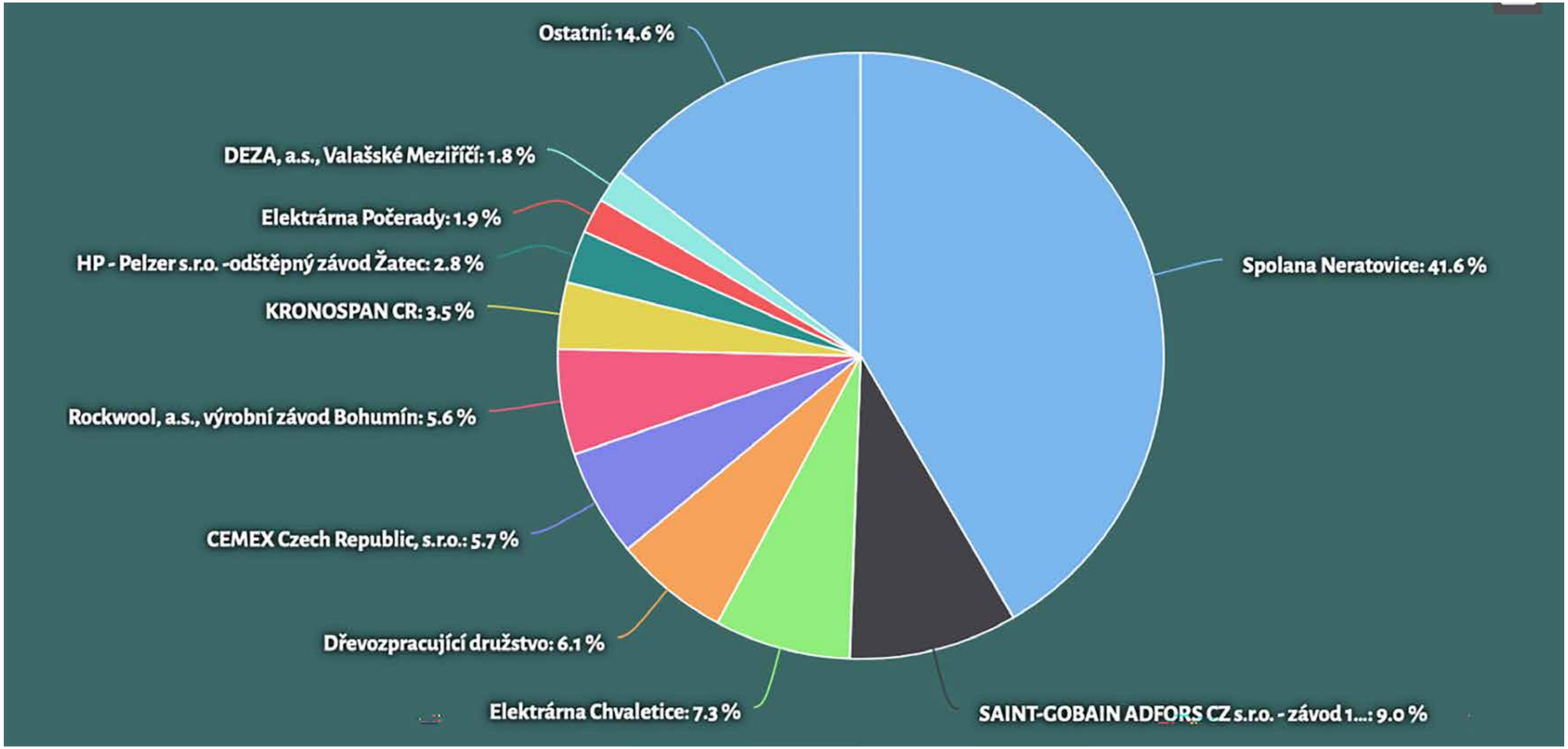
Žebříček za rok 2022 pro skupinu emise prachu (pm10)

Pořadí	Organizace/firma	Provozovna	Město	Kraj	Množství látek v kg	Trend
1	Liberty Ostrava a.s.	Liberty Ostrava a.s.	Ostrava	Moravskoslezský kraj	322 050,09	↓
2	Elektrárna Počerady, a.s.	Elektrárna Počerady	Výškov	Ústecký kraj	271 817,59	↓
3	Elektrárna Chvaletice a.s.	Elektrárna Chvaletice	Chvaletice	Pardubický kraj	126 775,19	↑
4	ČEZ, a. s.	Elektrárny Prunéřov	Kadaň	Ústecký kraj	114 098,39	~
5	Energotrans, a.s.	Elektrárna Mělník	Horní Počaply	Středočeský kraj	106 363,18	↑
6	TŘINECKÉ ŽELEZÁRNY, a. s.	Provozovna Třinec	Třinec	Moravskoslezský kraj	97 602,00	~
7	ČEZ, a. s.	Elektrárna Ledvice	Bílina	Ústecký kraj	89 500,50	↓
8	BASALT s.r.o.	BASALT s.r.o. provozovna Měrunice	Měrunice	Ústecký kraj	17 861,00	↑
9	CS CABOT, spol. s r.o.	CS CABOT	Valašské Meziříčí	Zlínský kraj	11 105,00	↑
10	Zemědělské družstvo Radiměř	Hospodářství Paseka	Paseka	Olomoucký kraj	4 725,00	×

It is also possible to view historical data for individual facilities (Figure 4.9) by clicking on the facility's name in the previous view (in the top 10) or finding the facility using the search field.

Znecistovatele.cz is a user-friendly web application for Czech citizens that provides easy access to information about polluting facilities in the country. It offers a clear view of the largest polluters, categorized by pollutant, allowing users to identify nearby sources of pollution. The application includes historical data showing trends in pollution levels over time. It also provides visual aids such as charts and graphs for better understanding and allows users to export data for analysis.

Figure 4.7 *Pie chart of all the facilities contributing to the emissions of carcinogenic, probable, or possibly carcinogenic. The first ten are distinguished by color. "Ostatní" stands for "others".*



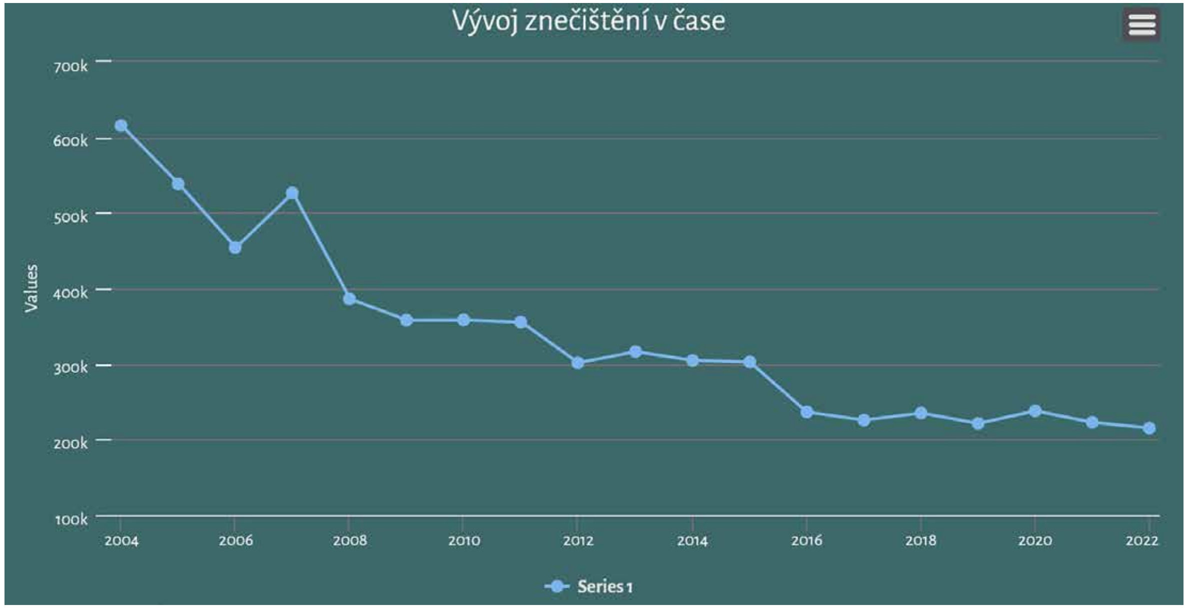


Figure 4.8 *Evolution of total particulate matter (PM10) emissions in the Czech Republic as reported by industrial sources into the Czech PRTR from 2004 until 2021.*

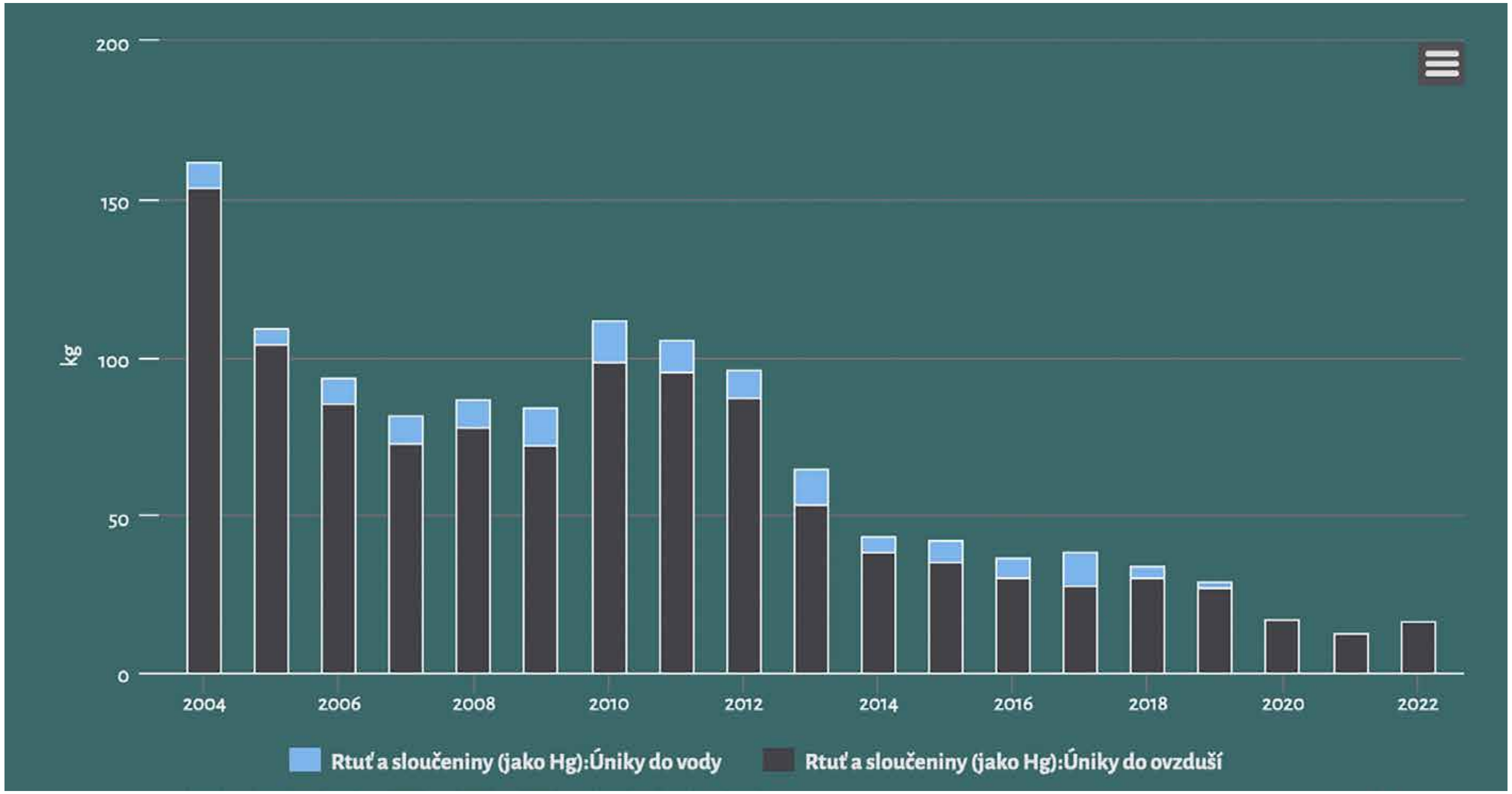


Figure 4.9 *Historical data for an individual facility for mercury (blue–water emissions, black–air emission).*

Photo 4.5: *Air pollution in Zenica triggered a large demonstration by local residents in December 2014. Photo: Adnan Dzolic, Eko Forum Zenica*

Photo 4.6: *Concentrations of sulfur dioxide and other substances in the air exceeded high values. Photo: Eko Forum, Zenica, 2014*

Photo 4.7: *In 2014, the Kakanj brown coal power plant was among the largest sources of pollution in the Zenica area. Photo: Martin Plocek, Arnika, 2014*

4.1.4 Top Ten Biggest Polluters for Bosnia and Herzegovina and Kazakhstan

Civil society organizations Eko Forum Zenica and Arnika published .three reports highlighting the top ten biggest polluters of Bosnia and Herzegovina for the reporting years 2011-2013, 2015 and 2016, based on the published data of national PRTR (Arnika and Eko Forum Zenica 2019; Arnika et al. 2016).

Values exceeding safe threshold limits for Bosnia and Herzegovina are related to only 38 and 28 factories in Bosnia and Herzegovina and cover only 13 and 11 substances (cadmium, lead, benzene, PAH, HCl, HF, SO_2/SO_x, NO_2/NO_x, CO, methane, CO_2, PM10, PCDD/F) for the reporting years 2015 and 2016 respectively, according to the data from PRTR (Arnika and Eko Forum Zenica 2019).[11]

Photo 4.8: *The main source of pollution in Zenica was the Mittal Steel factories (Petrlik and Behnisch 2015; Zahumenská et al. 2015). Photo: Martin Plocek, Arnika, 2014*

A similar approach was taken by CSOs for Kazakhstan, although the available data allowed for a much more scarce evaluation as it was only possible to use data for air pollution for any evaluation. The result was presented at PRTR Protocol MOP3 in Budva in 2017 (Mogilyuk 2017) and is available in Russian on Arnika's website.[12]

4.1.5 Thailand: CSOs as a Driver for PRTR Implementation

Thailand has experienced rapid economic development since the 1980s, but adequate environmental regulation has been lacking and absent for a long time. As a result, factories have been able to operate for decades without limits, technology requirements or audits to reduce pollution. In this situation, factories dump millions of tonnes of hazardous waste annually and release huge emissions into the air and water. Consequently, pollution often remains invisible in the environment.

Despite adopting the Sustainable Development Goals by the United Nations, the Thai government favors investors, not the environment. While the BAT/BEP approach was still not in place, demonstrations and petitions against pollution grew. The government's lack of response gave rise to citizen campaigns to protect community health and the environment and address the issue of citizens' right to know (RTK) about the pollutant release from industrial sources. In 2001, the Thai civil organization CAIN (Campaign for Alternative Industry Network,

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[11] https://arnika.org/en/events/download/1213_e4025d8bbf633486f5600867a137e2a1

[12] https://arnika.org/en/events/download/1213_e4025d8bbf633486f5600867a137e2a1

Photo 4.9: *Penchom Saetang, Director of EARTH, observes one of the local sources of pollution, the aluminum plant in Kao Hin Sorn. Photo: Ondřej Petrlík, Arnika, 2016.*

the former name of EARTH) called for a need to have the Pollutant Release and Transfer Register (PRTR) legislation in Thailand to solve the problem of industrial pollution that was intensifying in many areas. In adddition, a lawsuit by citizen groups in Rayong province in 2009 aiming to halt the new investment of 76 petrochemical projects in Map Ta Phut and its vicinity areas had pressured the Thai government to set up a pilot PRTR system with the technical assistance of the Japan International Cooperation Agency (JICA) (Saetang 2022).

In 2012, the civil society organization EARTH helped detect chemical contamination in Loei Province around a gold mine. Samples collected with the community's help included soil, water (including drinking water), sediment, paddy seeds and rice. The results showed that some samples exceeded the limits for arsenic. Mercury and lead were also found, but in minimal amounts. Arsenic was also found in drinking water and rice (Bystriansky et al. 2018; Mach et al. 2018).[13] The results led to a public campaign against the second phase of the mine expansion and also to the investigation of heavy pollution by the citizens of the affected area themselves. As of 2022, EARTH has worked with over 40 communities across Thailand (in 15 provinces). EARTH has developed the knowledge and technical skills to empower local people to protect the environment and believes that this will benefit not only the communities in the contaminated areas, but also civil society in Thailand and neighboring countries, academics and industry who can benefit from dialogue with the community. Furthermore, this approach can lead to a sustainable future for Thailand and other countries facing similar problems (Saetang 2022).

EARTH uses a concept of work called Citizens' Science. Citizens' Science is a specific term used for science-based observations by

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[13] Arnika also helped with some chemical analyses from Loei in a joint project with EARTH in 2015-2019 (Mach et al. 2018).

Photo 4.10: *Sampling in Loei. Photo: Ondřej Petrlík, Arnika, 2016*

Photo 4.11: *Landscape in Loei area. Photo: Ondřej Petrlík, Arnika, 2016*

local citizens and/or activists to back their demands on authorities or industrial companies regarding pollution caused by industrial estates across Thailand or other countries (Teebthaisong et al., 2022). Citizens' Science was used as recently as 2015 by the Thai organization EARTH. They believed that the community they were training would be able to generate strategic evidence to combat pollution. However, Saetang gained experience in 2004-2005 when she collaborated with Greenpeace Southeast Asia (GP SEA) to map air conditions around a petrochemical industrial zone in the Map Ta Phut area, receiving technical support from Global Community Monitor (GCM).

The local community collected five samples in which 20 substances were identified. These results served as evidence of what the local community breathes daily. Among the substances identified, the carcinogen benzene was found to exceed U.S. standards by more than 60 times, while other carcinogens were found to exceed standards by more than 80 times to 3,000 times. Even with this limited set of results, it was significant in convincing the National Environment Board to issue an Announcement on the Annual Ambient Air Screening Level of 9 Volatile Organic Compounds in 2007, and in 2009, the PCD issued another announcement about VOCs regarding a 24 hour-Ambient Air Screening Level of 19 Volatile Organic Compounds.

This was followed by the PCD's newly established continuous monitoring of VOCs in air and water in Map Ta Phut. One of the sites included in the PRTR pilot project that EARTH has been working on since 2011 was Map Ta Phut. Part of that was also the start of the sampling and analyses for POPs (Petrlik 2011).

Photos 4.12 – 4.15: *Photos from Map Ta Phut's broader area, taken in 2016. Pollution originating mostly from the petrochemical industry was described in the reports by EARTH and Arnika (Bystriansky et al. 2018; Mach et al. 2017; Mach et al. 2018; Teebthaisong et al. 2022; Tremlova et al. 2017), and by others (Chusai et al. 2012; Pinyochatchinda 2014; Rangkadilok et al. 2015). Photo: Ondřej Petrlík, Arnika*

The Citizens' Science project in Thailand has a real impact on the regulation of polluters. EARTH delivered a proposal for a new national law on the Pollutant Release and Transfer Register (PRTR) in 2022, for example (Teebthaisong et al. 2022).

4.1.5.1 Campaign for PRTR Act in Thailand

In 2014, EARTH and Enlaw Foundation started to formulate a PRTR draft act after years of study of the experiences of the United States' Toxic Release Inventory (TRI) and PRTR systems implemented in the European Union and Japan. EARTH's PRTR draft act was submitted to the parliament by 20 members of the House of Representatives by

Photo 4.13

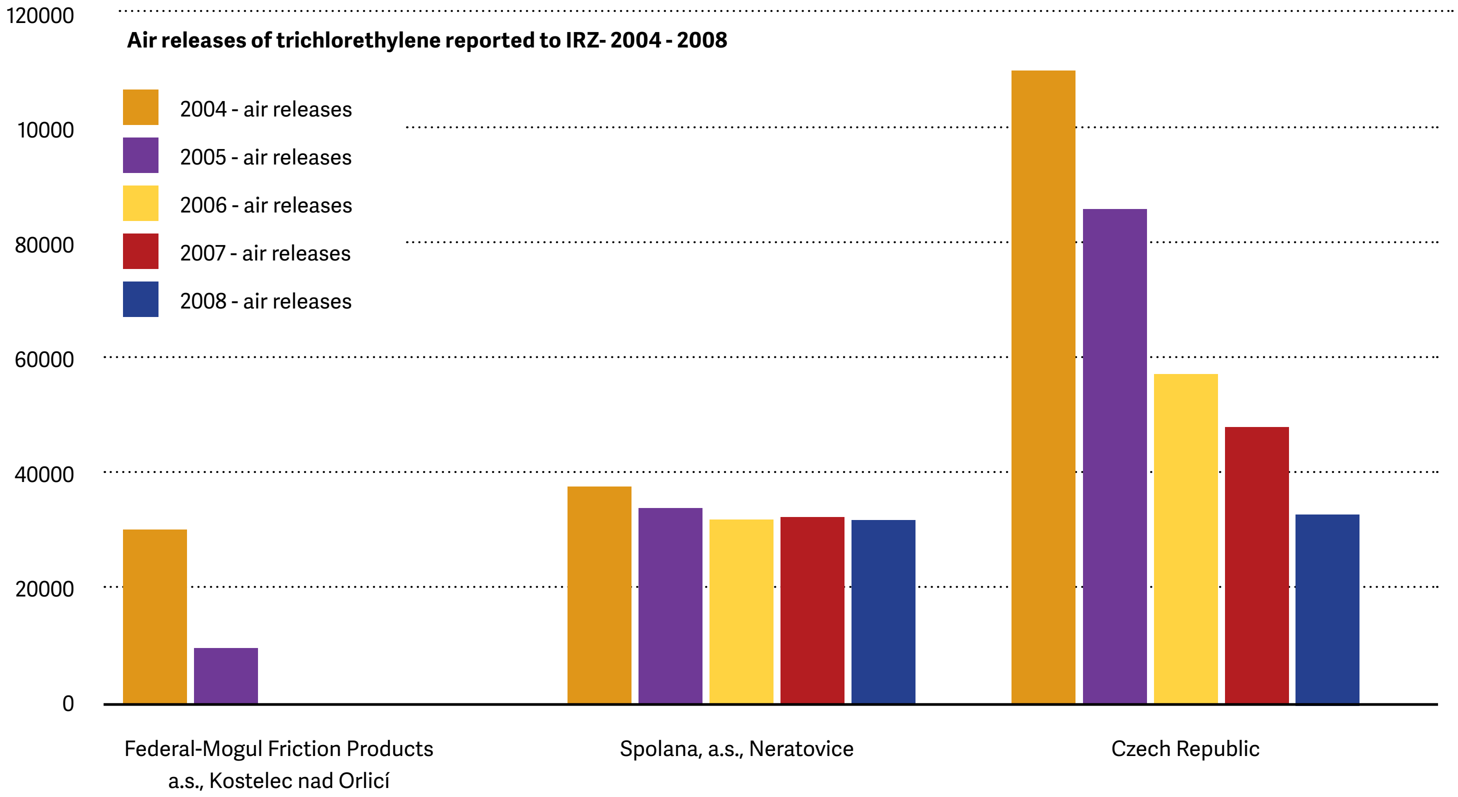
Photo 4.14

Photo 4.15

the Move Forward Party in December 2020. The Parliament brought the Draft out for public hearing in February 2021, but it failed to be endorsed by the Prime Minister in June 2021.

In 2022, EARTH, EnLaw and Greenpeace – Thailand launched a joint PRTR law campaign to engage Thai citizens' awareness of the impact of pollution and participation in the introduction process of a bill to the Parliament of Thailand. The campaign aims to collect up to or more than 10,000 eligible voters' names and signatures supporting the citizen-initiative PRTR bill. In January 2022, EARTH and Enlaw organized a hearing of the bill with the participation of key stakeholders from the Ministry of Industries (MOI), Ministry of Natural Resources and Environment (MONRE), Federation of Thai Industries (FTI), environmental lawyers and academics. The overall result of the hearing was a positive response with no deprecation to the PRTR bill initiated by the NGOs. The bill was introduced to the Speaker of the Parliament for preliminary consideration in July 2022. EARTH, Enlaw and Greenpeace – Thailand had a joint press conference to kick off the Thai PRTR website (www.thaiprtr.com) to start collecting citizen signatures to endorse the PRTR bill. The campaign achieved 10,000 names of endorsements in the middle of December 2023, which will be submitted to the whole pack of endorsements to the Parliament in early 2024.

Figure 4.10: *Figure shows the trend of total reported trichloroethylene emissions to the IRZ into the air for the entire Czech Republic, compared to the emissions reported by the two largest polluters from 2004, Federal-Mogul Friction Products, a.s. in Kostelec nad Orlicí, and Spolana Neratovice, over the years. Source: (Petrlík 2010; Petrlik et al. 2018)*



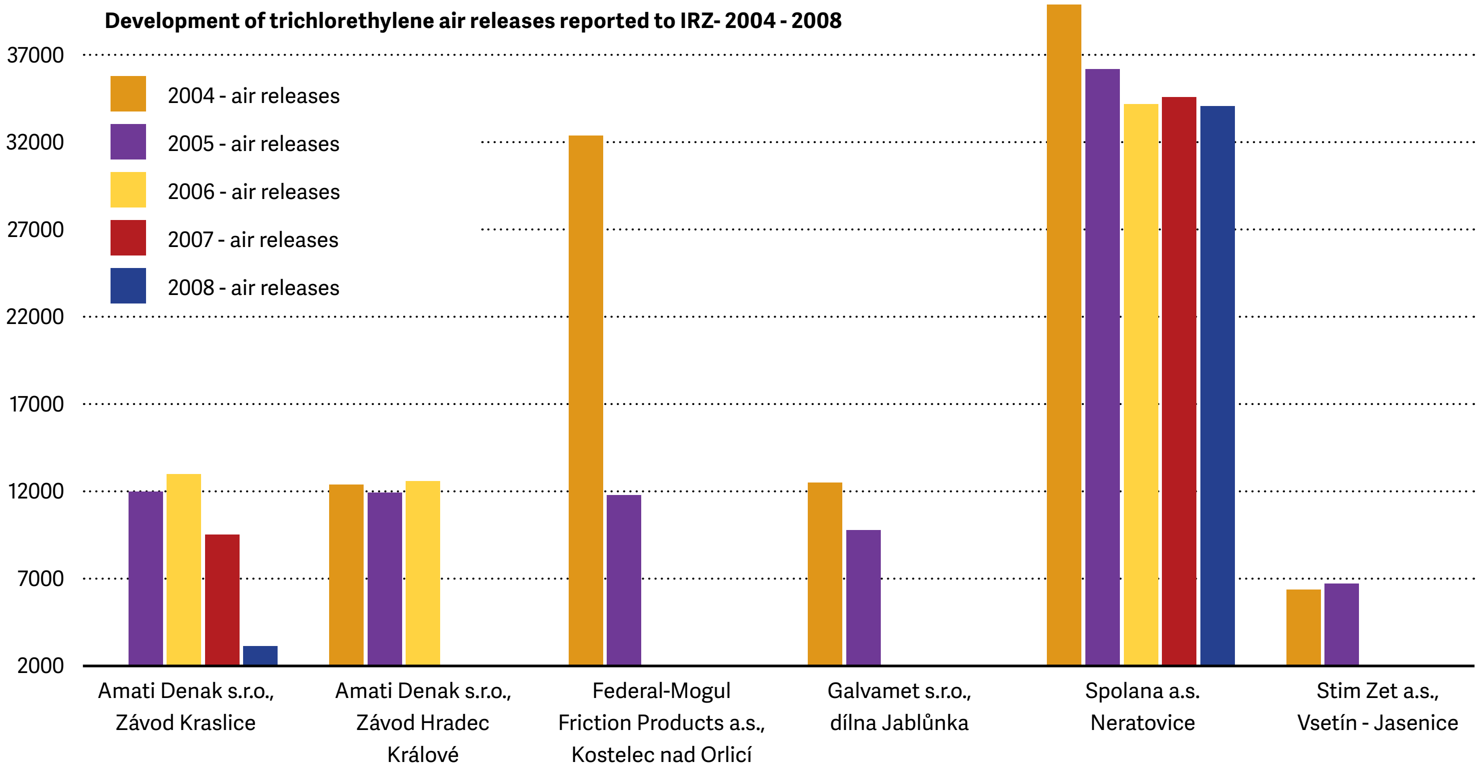
4.1.6 Case Studies on Volatile Organic Compounds (VOCs)

4.1.6.1 Case Study: Trichloroethylene in Czech PRTR (IRZ)

Trichloroethylene and tetrachloroethylene were used as solvents in dry cleaning and engineering commonly, and they are still used to a limited extend. Over 80 % of trichloroethylene is used to degrease and clean metal parts. It is also present in some household products, such as correction fluids for typewriters, paint removers, adhesives, and stain removers. Additionally, it serves as a raw material in chemical industries and as a substitute for CFCs, HCFCs, and HFCs. Trichloroethylene has had limited use as an anesthetic in medicine and dentistry, and in the past, it was used as a fumigant pesticide for grains (Válek and Petrlík 2010).

Trichloroethylene is classified as a probable human carcinogen (Group 2A according to IARC assessment) and has mutagenic effects (IARC Working Group on the Evaluation of Carcinogenic Risk to Humans 2014). Like tetrachloroethylene, it has been a common cause of groundwater contamination in the Czech Republic (Broulík 2009; Tůmová 2007). The trend in reported releases to air is illustrated in Figure 4.10.

Figure 4.11 *Figure shows the trichloroethylene emissions reported to the IRZ by major air polluters in the Czech Republic between 2004 and 2008. All major polluters except Spolana Neratovice were already below the reporting threshold in 2008. Amati Denak reported 1180 kg for its Hradec Králové plant in 2008. The reporting threshold for trichloroethylene emissions is 2000 kg, set as the baseline on the graph's vertical axis. Source: (Petrlík 2010; Petrlik et al. 2018)*



After being major polluters in 2004, Federal-Mogul Friction Products a.s. in Kostelec nad Orlicí, Amati-Denak a.s. in Kraslice, and Galvamet s.r.o. achieved the most significant decrease in trichloroethylene emissions between 2004 and 2008 (refer to Figure 4.11). The Mayor of Kraslice responded to a report on the largest polluters of mutagenic substances, based on data from the IRZ, which resulted in Amati-Denak, a musical instrument manufacturer in Kraslice, installing new technology in response to pressure from the local government. The company publicly announced the installation of this new technology in 2007. In 2008, only Amati-Denak in Hradec Králové, besides Spolana, reported trichloroethylene emissions, which were below the reporting threshold of 1180 kg (Petrlík 2010; Petrlik et al. 2018).

If the reporting obligations were limited in the Czech IRZ to the current level of the E-PRTR, only Spolana Neratovice, among the major air polluters with this substance, would report to the registry. Limiting the reporting obligations could potentially reduce the impetus for polluters to take necessary measures, as the trend in emissions would appear different without a significant comparison.

4.1.6.2 Case Study: Styrene in Czech PRTR (IRZ)

Styrene is a crucial monomer widely used in chemical manufacturing. It is featured in various products such as rubber, plastics, insulation, and automotive components due to its ability to create long chains, which is vital in making polystyrene (Kleger and Válek 2010). The Czech

Photo 4.16: *Even manufacturers of wind instruments can be regarded as big polluters according to the PRTR report, but Amati Denak Kraslice reduced its contribution to emissions of toxic trichlorethylene. Amati-Denak factory in Kraslice is in the photo. Photo: ChickSR via Wikimedia Commons, 2020*

Photo 4.17: *Amati-Denak manufactures wind musical instruments. Trichloroethylene was used as a cleaning substance. The tenor saxophone with mother-of-pearl keys in the photo is a gift from Czech President Václav Havel to Bill Clinton and was also manufactured at Amati-Denak in Kraslice. Photo: William J. Clinton Presidential Library via Wikimedia Commons*

Republic has seen an upward trend in styrene consumption. However, workers exposed to high short-term concentrations of styrene face neurological risks. Additionally, the International Agency for Research on Cancer (IARC) has classified it as a probable carcinogen (Group 2. A) (IARC 2023).

Concern about the potential carcinogenicity of styrene stems largely from the ability of its metabolite, styrene-7,8-oxide (SO), to bind covalently to DNA and its activity in a variety of genotoxicity test systems. SO has been classified by IARC in group 2A as probably carcinogenic to humans. Styrene exposure has been reported to cause an increase in DNA and hemoglobin adducts and the frequency of chromosomal aberrations (Rueff et al., 2009).

Between 2004 and 2008, reported air emissions in the Czech Republic increased, which correlates with the rise in reporting facilities from 42 in 2004 to 66 in 2008. Total emissions also increased, peaking at 125.5 tons in 2007, up from over 68 tons in 2004 (Petrlík 2010).

Figure 4.12 *Overview of the reported trend in styrene emissions by major air polluters to the IRZ throughout its existence. The graph includes the largest emitter of styrene emissions for each monitored year. Source: (Petrlík 2010)*

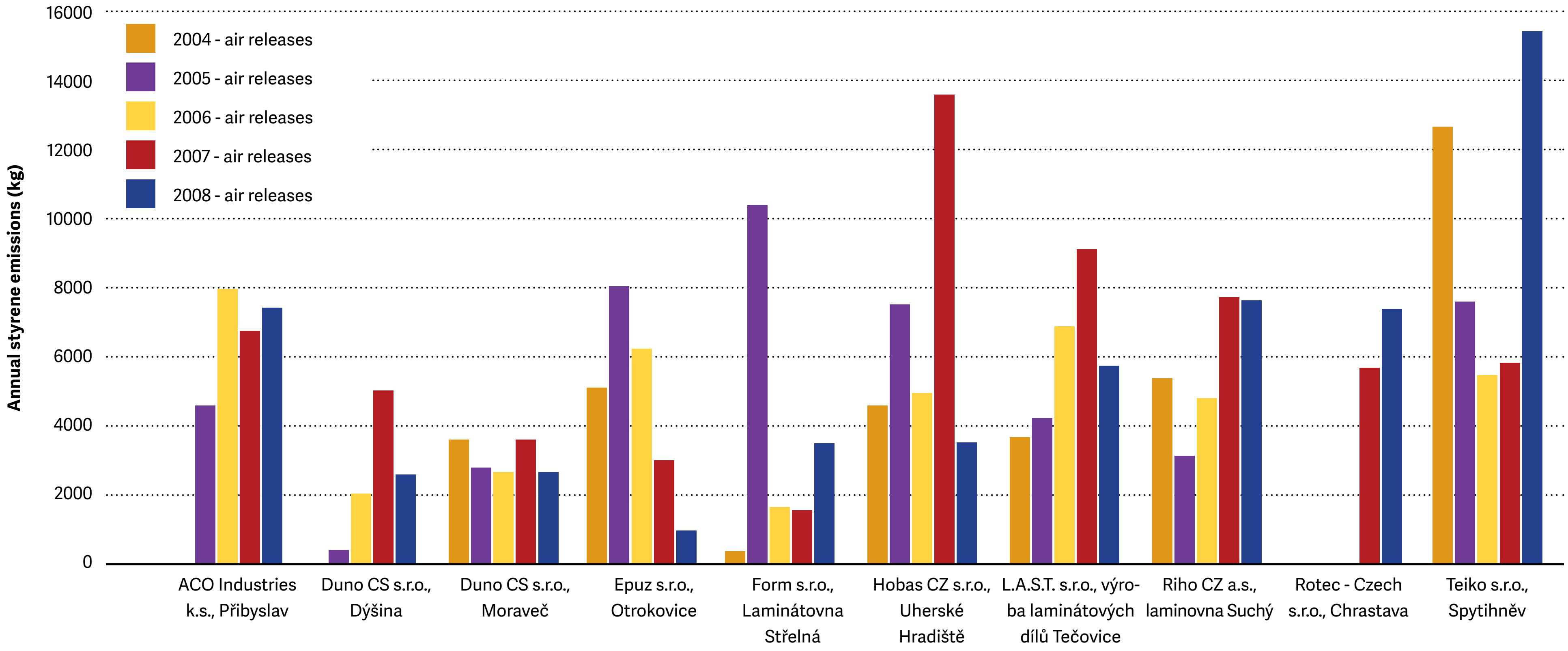
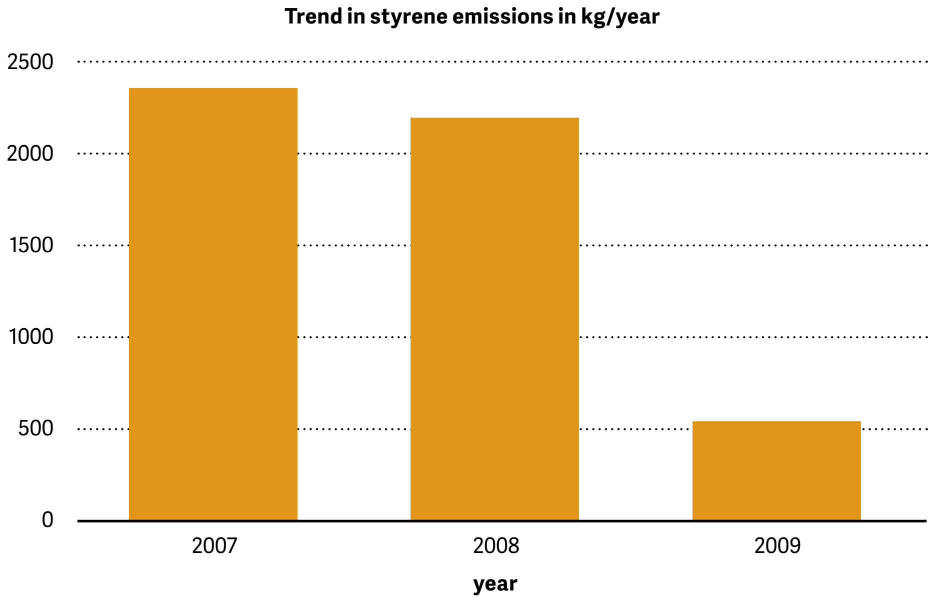


Figure 4.13 *Trend in styrene emissions reported to the IRZ by the Laminates Klimeš facility in Benešov u Semil. Source: (Petrlík 2010)*



Emissions from selected facilities, mostly among those that are polluting the air with styrene the most, have shown significant fluctuations over the five years, with few exceptions. It is impossible to determine whether the different reported values are primarily linked to output or if they stem from one-time styrene measurements or calculation methods due to the absence of reported annual performances (production volumes) from individual facilities to the IRZ. The graph shows that new facilities can significantly pollute with this substance from the start.

The increasing use of styrene in recent years suggests a rise in emissions of this substance into the air. Therefore, the government administration should pay close attention to this issue, especially given the negative health impact of styrene, which could make it a significant local hazard. In this regard, the IRZ serves as an essential source of information.

If the Czech system were limited to the level of the E-PRTR, only the holder of an integrated permit, who is one of the top ten polluters in this case, would have to report emissions of styrene. This would cause the vast majority of styrene emitters to vanish from the registry, depriving governmental authorities, local administration, and the public of a valuable source of information on emissions of this substance.

Although the technology changes are not too complex, there have not been many cases of styrene emission reductions. Figure 4.12 shows that the Epuz s.r.o. plant in Otrokovice achieved significant emissions reduction. A well-documented example of emission reduction is demonstrated at the Laminates Klimeš facility in Benešov u Semil. At this plant, installing a catalytic unit for continuous VOC oxidation, coupled with a high-pressure supply fan, resulted in a substantial decrease in styrene emissions. The project received support from the European Union and the State Environmental Fund (SFŽP) and cost a total of approximately 6.5 million CZK. (SFŽP 2008). Figure 4.13 shows the reduction achieved. The reduction was not only due to reporting to the IRZ but also in response to community feedback and the proactive approach of the facility operator. However, the IRZ prompted this change.

4.1.6.3 Case Study: Naphthalene in an Industrial Facility Adjacent to the River

The cleanliness of the Jizera River in Central Bohemia (photo 4.22) is important not only for the wildlife that inhabits it, but also for the purity of drinking water for Prague, the capital of the Czech Republic. The river flows in the accumulation zone of the drinking water source for Prague.

Photo 4.18

Photo 4.19

Photo 4.20

Photos 4.18 – 4.21: *From the gallery of styrene polluters in the Czech Republic (4.18 - L.A.S.T. Tečovice; 4.19 – BV Plast Klášterec nad Ohří; 4.20 – Hobas Uherské Hradiště), only Synthos in Kralupy nad Vltavou (photo 4.21) appears at first glance to be a significant polluter; the others have only small ventilation chimneys. Nevertheless, large volumes of potentially carcinogenic styrene can pass through them in one year, and some of these operations bother the surroundings with the sweet smell of styrene. Photos: Jan Losenický, Arnika, 2011 (4.18 – 4.20) and Skvor, Creative Commons license (4.21)*

Photo 4.21

Photo 4.22: *The Jizera River near Benátky nad Jizerou in spring. Photo: Jindřich Petrlík, Arnika, 2020*

Photo 4.23: *Carborundum Electrite in Benátky nad Jizerou in January 2015. The small vent at the hall's beginning is the preliminary unit's chimney for the discs' production using naphthalene. It is no longer there today, just like the planned production with naphthalene. Photo: Jindřich Petrlík, Arnika, 2015*

Photo 4.24: *View of the Carborundum Electrite complex across the Jizera River, clearly showing its proximity to the watercourse. Photo: Jindřich Petrlík, Arnika, 2013*

Between 2012 and 2016, there was a threat that Carborundum Electrite, a branch of Tyrolit in Benátky nad Jizerou (photo 4.23), would establish the production of abrasive wheels using naphthalene, which would be stored in the facility right next to the river (photo 4.24). In the event of an accident, if naphthalene were to reach the river, it would significantly jeopardize its cleanliness. Arnika used data from the IRZ to argue during the environmental impact assessment of the planned operation. The proposal also faced strong opposition from the citizens of this Central Bohemian town. In 2012, when the plan came to light, a petition campaign was launched, supported by approximately a quarter of the town's residents. The company abandoned the proposal after a four-year campaign by local residents supported by the Arnika association (Arnika 2016).

Naphthalene is possibly carcinogenic to humans (2B) (IARC 2023). It is toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment. Bioaccumulation of this chemical may occur along the food chain, e.g., in fish (National Center for Biotechnology Information 2024). Naphthalene belongs to the group of polycyclic aromatic hydrocarbons (PAHs) as well as to the VOCs.

4.1.7 Case Studies on Toxic Chemicals in Waste Transfers

The following case studies are based on experiences using data from the Czech PRTR (IRZ) because, in other European countries, transfers of chemical substances in waste are not reported. These case studies have been previously published in Arnika's studies (Havel et al. 2011; Petrlik et al. 2018) and have been shortened, modified, or supplemented with more recent data for the purposes of this guide.

4.1.7.1 Case Study: Arsenic in Waste Transfers

Arsenic, a well-known poison, is considered a critical substance in water pollution, particularly affecting drinking water sources. It has a notable tendency to accumulate in river sediments. In some cases, the adsorption and release of arsenic from sediments into the liquid phase can significantly impact its concentrations in the water.

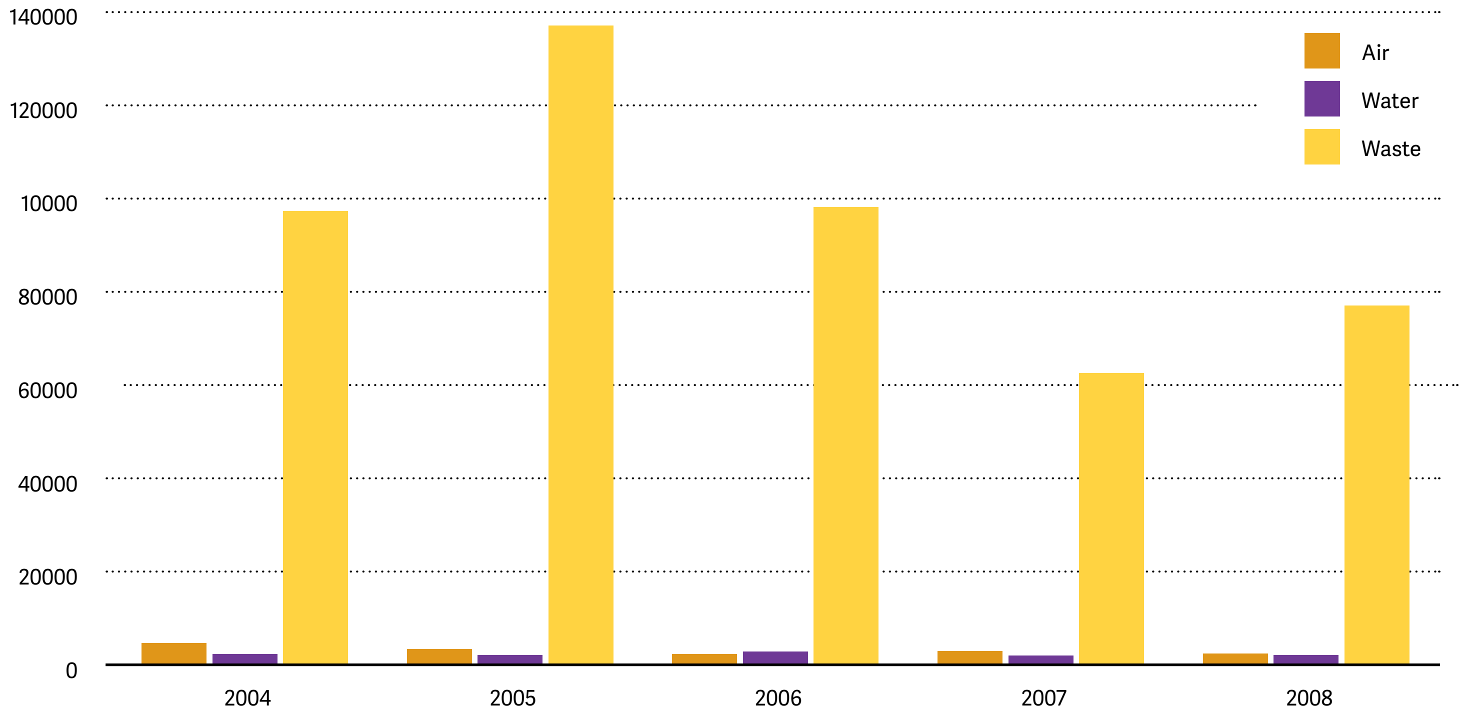
Arsenic is known for its carcinogenic, neurotoxic, and mutagenic properties, oxidative stressors, endocrine system disruption, and inflammatory action. The source, species, and concentration of arsenic affect the toxicity limit (Kaur et al. 2024; Ratnaike 2003). Even low-level exposure to inorganic arsenic has been associated with an increased risk of several cancers, including skin, lung, bladder, and kidney cancers. Emerging research suggests that chronic exposure to low levels of arsenic may contribute to cardiovascular disease, including hypertension and atherosclerosis (Drobna et al., 2009; Hughes et al., 2011; Kaur et al., 2024).

Unlike mercury, arsenic is highly mobile. Fortunately, it doesn't accumulate much in fish, reducing the risk of poisoning through fish consumption.

Persistent use of water with low arsenic concentrations can lead to chronic diseases. Historical instances in the 1930s and 1940s reported arsenic poisoning from unsuitable drinking water, with arsenic concentrations reaching several mg/l. The toxicity of arsenic depends on its oxidation state, with As^{III} compounds being approximately 5 to 20 times more toxic than As^{V} compounds (Hughes 2015).

Human activities, such as fossil fuel combustion, metallurgical processes, dye manufacturing, and more, contribute to arsenic pollution (Zevenhoven et al. 2007). Arsenic is also present in leachate from power plant fly ash, with drainage water from sludge-drying beds containing arsenic in concentrations up to several mg/l. Research indicates that lignite combustion can impact soil contamination by arsenic,

Figure 4.14 *Total amounts of arsenic and its compounds reported into the IRZ concerning the individual years, according to the type of releases and transfers in 2004 – 2008.*



and in the Czech Republic, areas around Chomutov and Most show the highest values (Ustjak 1995).

Major contributors to arsenic transfers in waste, reported in the IRZ from 2004 to 2008, include the power plant Elektrárna Mělník I (Energotrans a.s.), ranking first, and the heating plant Teplárna Otrokovice a.s., ranking second over these years. The facility Kovohutě Příbram a.s., is the third-largest source of arsenic and its compounds in wastes during this period (Figure 4.15).

Figure 4.14 illustrates that arsenic transfers in waste significantly exceed reported releases into the air and/or water. This discrepancy is more pronounced than in the case of mercury and cadmium despite higher reporting thresholds for waste transfers. Canceling the duty to report chemical substances in wastes would result in the loss of crucial information about the flow of arsenic and its compounds into the Czech Republic's environment (Petrlík 2010).

The heating plant Teplárna Otrokovice a.s., emerges as the second-largest source of arsenic and its compounds in wastes, as seen in Figure 4.15. This information is crucial for understanding the plant's waste management practices. The waste is utilized for landscape reclamation, including the sludge-drying bed for fly ash in Bělov. In 2010, plans were made to use residues from lignite combustion

Photos 4.25 - 4.26: *The ash storage facility near Bělov (photos 4.25 and 4.26), where Teplárna Otrokovice a.s. deposited waste for many years, has destroyed the water ecosystem (Nejeschlebová 2013), and according to local residents, it is also a source of dust (Přecechtěl 2022). A similar fate threatened wetlands and water bodies in Vážany. The use of data from the PRTR (IRZ) regarding the amount of arsenic in waste (ashes) helped to halt this project and thus save the habitat of endangered species (see photos 4.27 – 4.32).*

Photos 4.27 – 4.32: *Endangered species from wetlands and water ecosystems in Vážany that were endangered by a plan to back-fill a clay pit in Vážany. (Bílý 2010)*

Photo 4.27: *European sparhawk (Accipiter nisus L.).*
Photo: Castelletto Merli via Wikimedia Commons

Photo 4.28: *Common rosefinch (Carpodacus erythrinus L.).*
Photo: Adam Kumiszcza via Wikimedia Commons

Photo 4.29: *Great reed warbler (Acrocephalus arundinaceus L.).*
Photo: Dirk-Jan Kraan via Wikimedia Commons

Photo 4.30: *Common kingfisher (Alcedo at this L.).*
Photo: Andy Morffew via Wikimedia Commons

Photo 4.31: *Grass snake (Natrix natrix L.). Photo: Isiwal via Wikimedia Commons*

Photo 4.32: *Eurasian marsh frog (Rana esculenta L.). Photo: Manfred Heyde via Wikimedia Commons.*

in Otrokovice to back-fill a clay pit near Vážany (Kroměříž). The surrounding areas include pools and wetlands with protected species, raising concerns about potential contact with subsurface water (Bílý 2010). Without data from the IRZ, vital information about up to 7.5 tons of deposited arsenic compounds per year in the area would be unavailable, highlighting the importance of such data in environmental impact assessments (Havel et al. 2011).

Even though arsenic is naturally present in all lignite from the coal field Podkrušnohorská pánev, certain large combustion sources, such as Teplárna Otrokovice, report considerably higher amounts of arsenic and its compounds in wastes compared to others. Teplárna Otrokovice, in addition to burning lignite, also combusts light heating oil and, since 2006, biofuel, as outlined in Table 4.1.

Table 4.1 *Summary of fuel consumption in Teplárna Otrokovice (in tons/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					2,061	4,965	5,741

Figure 4.15 *Development of amounts of arsenic and its compounds in waste transfers reported by selected facilities into the IRZ concerning the period 2004 – 2008 (expressed on a logarithmic scale). The values concerning the two biggest sources of arsenic in wastes, in the individual years, are given in the graph heading.*

Values at Mělník I - 2004: 45,300; 2005: 73,500; 2006: 40,600; 2007: 17,600; 2008: 34,800
Values at Teplárna Otrokovice - 2004: 16,400; 2005: 19,700; 2006: 13,600; 2007: 17,300; 2008: 17,400

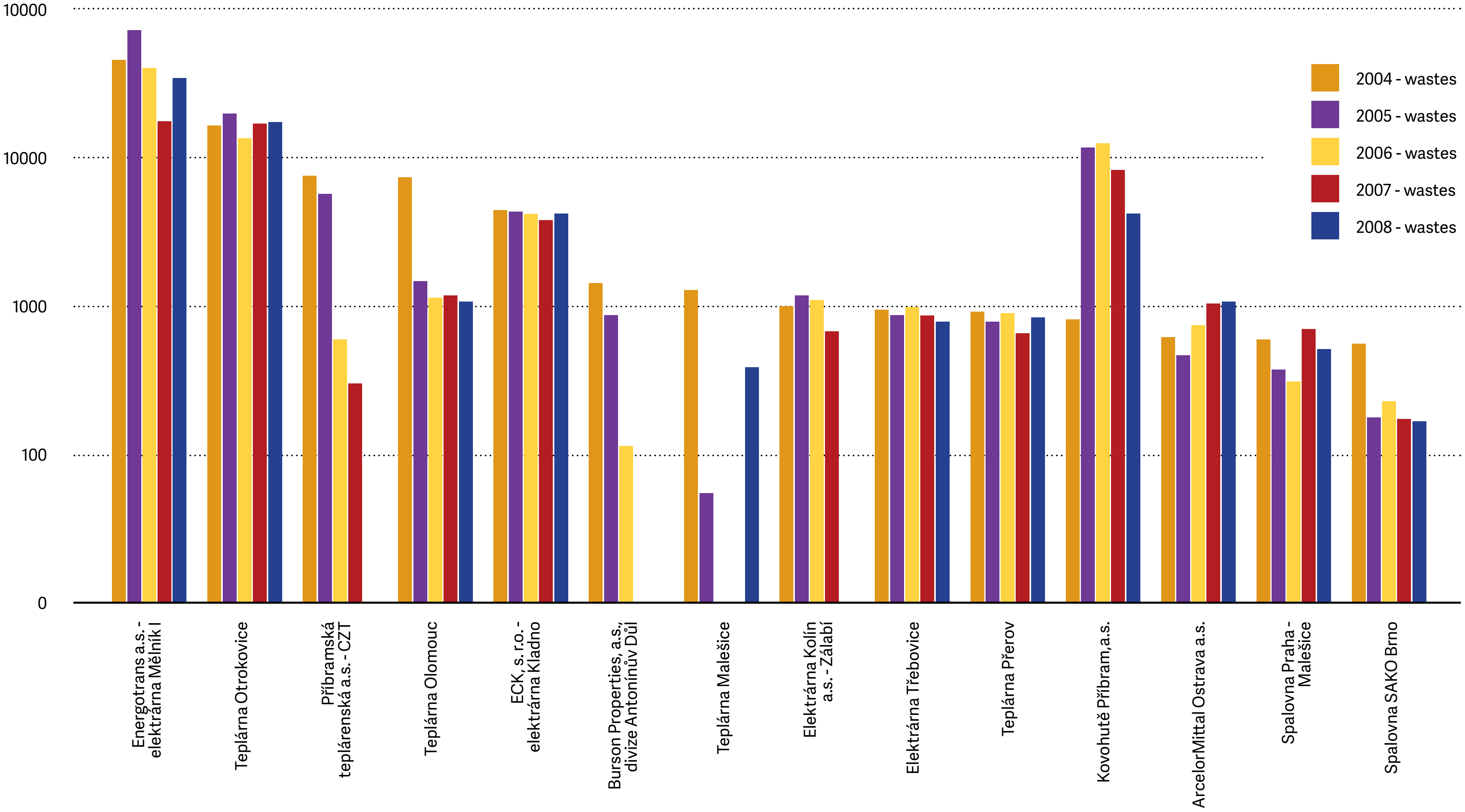
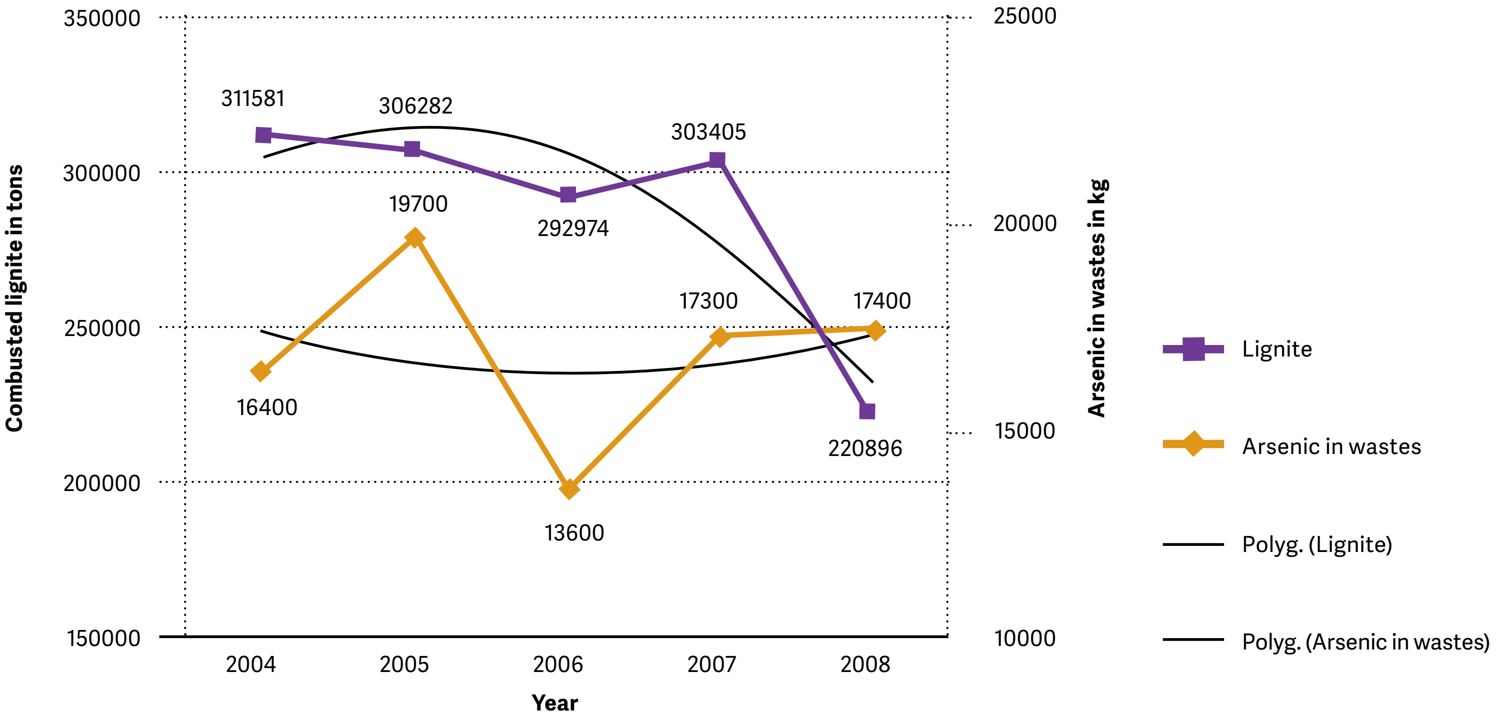


Figure 4.16 *Graph showing a correlation between arsenic amounts reported in wastes from Teplárna Otrokovice and amounts of combusted lignite concerning 2004 – 2008, including the trend curves.*



Graphs in Figure 4.16 and Figure 4.17 illustrate a potential correlation between the amounts of combusted lignite and light heating oil and the total reported arsenic in wastes. The graphs suggest that fluctuations in arsenic amounts in wastes are likely linked to variations in the amounts of combusted fuels. While biofuel amounts were negligible in 2004 and 2005, ruling out a correlation with arsenic in wastes, a correlation with the combusted amounts of lignite and heating oil couldn't be conclusively proven. Unfortunately, available sources do not provide information on fluctuations in arsenic presence in fuels or whether such monitoring occurred. It is also unclear if the fuel source, such as different lignite mines, changed. Although an interesting correlation, future analyses may face challenges due to the limited availability of information on arsenic transfers in wastes.

4.1.7.2 Case study: Hexachlorobenzene and similar POPs

Hexachlorobenzene (HCB), in high doses, is lethal to some animals and, at lower levels, adversely affects their reproductive success. Researchers have also found that HCB, like other organochlorinated compounds, undergoes transplacental transfer (Sala et al. 2001). Pentachlorobenzene (PeCB) is highly toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment (POP RC 2007). Hexachlorobutadiene (HCBD) is also highly toxic to aquatic organisms, causing kidney damage and cancer in animal studies, as well as chromosomal aberrations in occupationally exposed humans (Balmer et al. 2019; POP RC 2012).

HCB, PeCB, and HCBD fall under Annexes A and C of the Stockholm Convention on POPs due to their historical use as pesticides, technical substances, and unintentional by-product status in various industrial processes (Stockholm Convention 2017). Currently, in the Czech Republic, they pose a significant issue as unintentional by-products, making it crucial to monitor both their air and water releases and the amounts transferred in wastes.

However, reporting thresholds for HCB releases into the air, as established in the European Register (E-PRTR), are either too high, leading to few facilities exceeding them, or the total emissions are notably underestimated in EU states. The E-PRTR reported HCB emissions into the air by only a few facilities from the entire EU for 2007 and 2008. E-PRTR data from 2007 indicated only four operations reporting air emissions and five in 2008 across Europe. For instance, in 2007, one chemical plant in Finland and three Belgian cement plants co-incinerating waste reported emissions. In 2008, one Belgian smelter, one cement plant, one Finnish chemical plant, one German chemical plant, and a Spanish operation for metal surface treatment reported air emissions. In terms of water discharges, 11 operations reported in 2007 and six in 2008 in Europe, mostly from municipal wastewater treatment plants (Petrlík 2010).

The USA had a reporting threshold of 10 pounds (4.5 kg), and Scotland had an even stricter threshold of 1 kg (Petrlík 2010).

Figure 4.17 *Graph showing a correlation between arsenic amounts reported in wastes from Teplárna Otrokovice into the IRZ and amounts of combusted light heating oil, concerning the period 2004 – 2008, including the trend curves.*

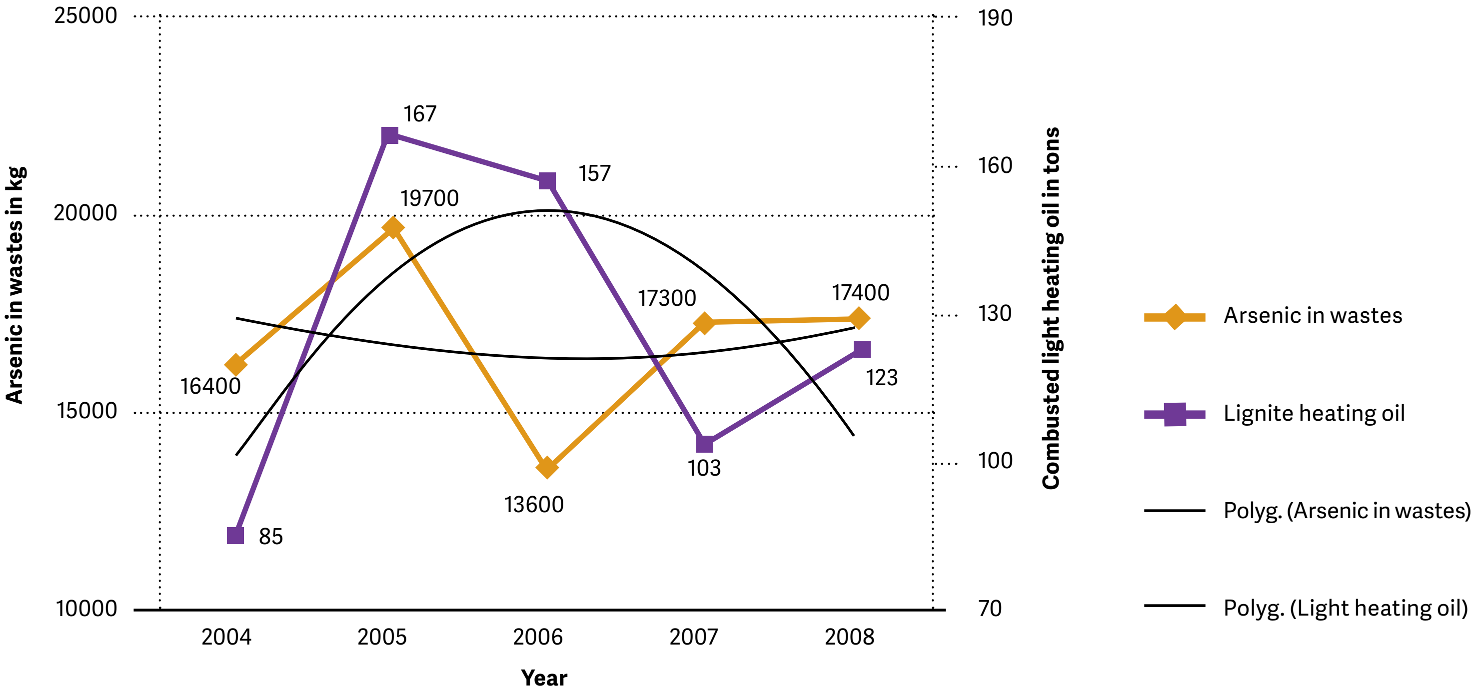
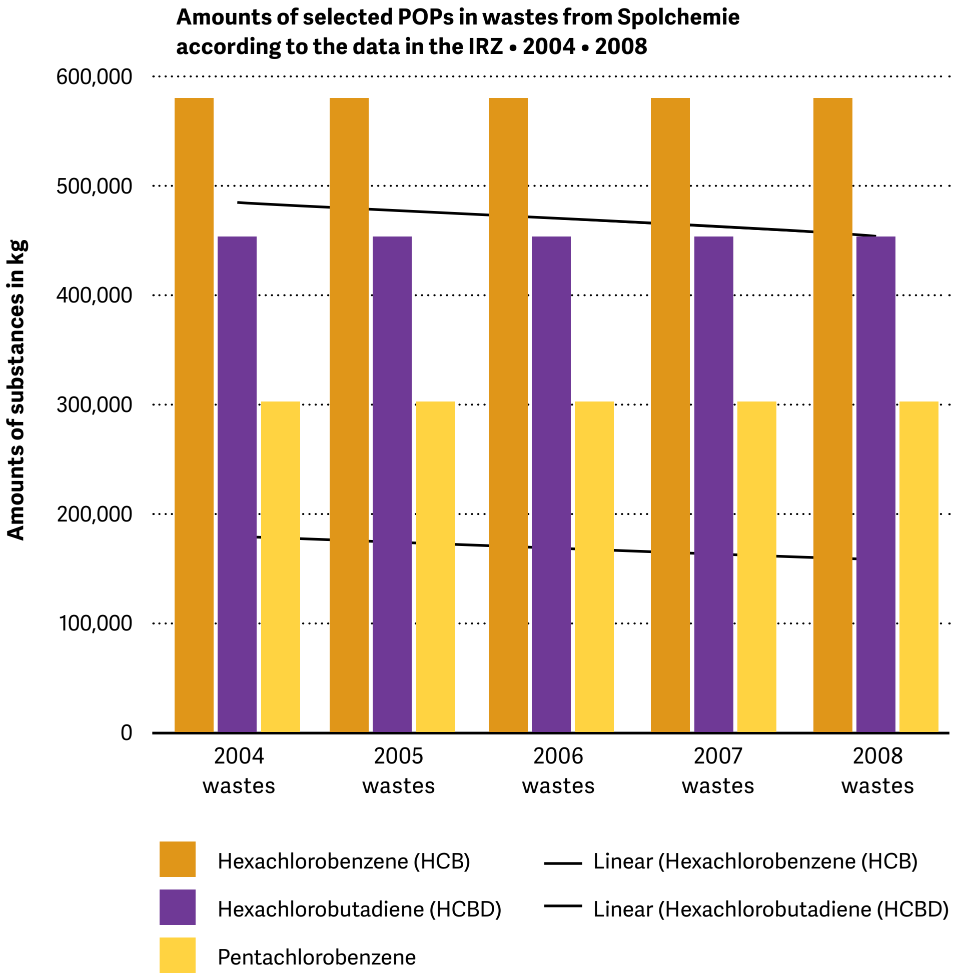


Figure 4.18 *Graph depicting the development of the amounts of hexachlorobenzene (HCB), hexachlorobutadiene (HCBD), and pentachlorobenzene (PeCB) in wastes, according to the reports of Spolek pro chemickou a hutní výrobu (Spolchemie) in Ústí nad Labem into the IRZ. Source: (Petrlik et al. 2018)*



Due to high reporting thresholds and inconsistent detection of wastes, the Czech IRZ lacks comprehensive data on HCB. Notably, a few reports on HCB transfers in wastes from specific facilities, such as Spolek pro chemickou a hutní výrobu in Ústí nad Labem, are available (Petrlik et al. 2018).

Total HCB emissions in the EU (assessed in 25 states), including transfers in waste, were estimated at 4,000 kg according to data in the Implementation Plan of the Stockholm Convention of the European Community. However, this estimation contradicts reports from the Spolek pro chemickou a hutní výrobu in Ústí nad Labem, consistently reporting hundreds of kg to the Czech PRTR from 2005 to 2008, indicating a potential order of magnitude error in the estimate for the Community Implementation Plan. Lowering reporting thresholds and introducing a duty to report HCB in wastes, similar to other POPs, could provide more accurate and objective data (Petrlík 2010).

In addition to HCB, other POPs, such as hexachlorobutadiene (HCBD) and pentachlorobenzene (PeCB), are unintentionally produced at Spolchemie in Ústí nad Labem. The decreasing trend in reported amounts for these substances over the IRZ's existence is depicted in Figure 4.18. While their total amounts have decreased, the sum reported in 2008 remained a serious concern for POPs in the Czech Republic (Petrlik et al. 2018). The duty to submit chemically specific reports on transfers of HCBD and PeCB in wastes was eliminated, resulting in the loss of valuable information on the amounts of these substances in the wastes of Spolek pro chemickou a hutní výrobu and/or its accessor. From 1992 until 1999, HCB, PeCB, and HCBD-containing wastes were stored in plastic containers with sandy material and covered by a layer of mixed ash and cement at Všebořice hazardous waste landfill (Kuncová et al. 2006).

Table 4.2 *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; in kg/year. Source: (Petrlik et al. 2018)*

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

4.1.7.3 Estimation of Dioxins in Waste Based on PRTR Data

Arnika and IPEN used data about transfers in wastes from national PRTRs for the estimation of dioxins (PCDD/Fs) in waste incineration residues for their study focused on waste incineration fly ash global control (Petrlik et al. 2021). We calculated an average of PCDD/Fs reported in WI residues by waste incineration companies to the Czech PRTR system in 2012 – 2019. An average of 15 g TEQ/year and 20.7 g TEQ/year were reported for WI ashes from Municipal solid waste incineration (MSWI) and Hazardous waste incineration (HazWI) (including Medical waste incineration - MedWI), respectively. It is more than estimated previously for HazWI and MedWI from the Czech Republic. It is obviously more than estimated in a collective inventory from 2004, which estimated total releases in waste incineration residues from HazWI and MedWI to be 5 g I-TEQ and 28 g I-TEQ, respectively, per year for 13 EU candidate countries (Pulles et al. 2005). In 2006, the Hungarian hazardous waste incinerators released more than 11.5 g I-TEQ/annum (Ministry of Environment and Water 2009) PCDD/Fs into waste residues. Calculation based on PRTR data has shown that only 2 of 13 former EU candidate states count for the total level estimated for all 13 countries.

Also, Japan reported 1,514 g TEQ of PCDD/Fs in wastes transferred or buried, such as particulates and burnt residues, according to data from PRTR for 2018 (Government of Japan 2020).

These examples show that more emphasis should be given to chemically specific reporting about POPs listed under the SC in waste flows (transfers) in PRTR systems. The obligation to report PCDD/Fs in waste to the European PRTR could fill the data gap about PCDD/Fs in WI residues for many EU states (EEC of SC 2016).

Using data from the national PRTR systems of the Czech Republic and Japan, the worldwide balance of dioxins in waste is calculated in Arnika and IPEN's 2021 study. It reaches 14 - 15 kg TEQ of PCDD/Fs. This seems to be a bigger share of total PCDD/Fs releases into the environment than estimated from inventories obtained by the SC Secretariat from individual countries (EEC of SC 2016).

Another opportunity to utilize data reported to IRZ on dioxin transfers in waste was mentioned in the context of the update to the National Implementation Plan of the Stockholm Convention in the Czech Republic in 2023 (Bláha 2023).

Among the largest producers of PCDD/Fs in waste in the Czech Republic, according to IRZ data, are metallurgy and waste incineration, as evident from the table below (see Table 4.3), with some transfers reported as recycling. Two studies by the IPEN network and Arnika addressed the issue of dioxins in ashes from waste incineration, highlighting potential dioxin leaks into the surrounding areas where these wastes are managed (Katima et al. 2018; Petrlik and Bell 2017). Global studies monitoring dioxins and similar substances in free-range eggs from domestic farming in various locations, including those where ash from waste incineration or their surroundings is handled, also document this concern (Jelinek et al. 2023a; Petrlik et al. 2022a; Weber et al. 2015).

According to data reported to IRZ, nearly 120 g TEQ PCDD/Fs were transferred in waste between 2014 – 2021, several times more than the emissions into the air. However, not all data on PCDD/Fs transferred in waste is included in IRZ. For example, data on PCDD/Fs in waste from the chemical industry is missing (Bell et al. 2021).

The reported data about dioxins reveal an interesting aspect concerning the municipal waste incineration plant in Liberec (Petrlik et al. 2006). Despite its exemption from reporting obligations to the PRTR, the incinerator became a significant source of dioxins in waste when it temporarily halted its practice of converting waste into a product for European REACH regulation compliance in 2011. This revealed that 8.8 g TEQ of dioxins ended up in the incinerator's waste (Petrlik 2013).

Table 4.3 *Summary of information on dioxins transferred in waste based on IRZ data; in g TEQ/year. Source: (MŽP 2022)*

Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Average**
Municipal Waste Incineration	14.77	7.42	8.39	28.99	13.87	18.08	8.11	8.74	13.63
Hazardous and Medical Waste Incineration	10.67	23.7	17.4	18.98	31.89	39.43	45.16	9.13	22.01
Metallurgy	25.8	48.6	37	199.25	171.43	129.78	106	70.7	83.37
Total	51.24	79.72	62.79	247.22	217.19	187.29	159.27	88.57	119.01

The European Food Safety Authority (EFSA) established a tolerable daily intake of 0.25 picograms of TEQ (toxic equivalent) per kilogram of body weight in 2018 (EFSA CONTAM 2018). Extrapolating this to a yearly intake for 1.25 billion people, the tolerable amount is determined to be 8 grams of TEQ. In a city with 100,000 inhabitants, like Liberec, it would be considered harmful if just 0.008% of this specified amount of dioxins were to enter the food chain. This underscores the significance of closely monitoring and controlling the presence of dioxins in the food supply to safeguard the population's health (Petrlik, 2023).

In 2016, reporting obligations to the IRZ were waived for small medical waste incinerators (MV ČR 2016). However, data from previous years indicates that these incinerators were significant sources of dioxins in waste, a characteristic shared by small medical waste incinerators in general (Arar et al. 2019; Jelinek et al. 2023b; Khwaja and Petrlik 2006; Skalsky et al. 2006). For Indonesia, reporting dioxins and heavy metals, especially mercury, in effluents from small medical waste incinerators to the PRTR system would be beneficial.

Data from the Czech PRTR confirm that metallurgical operations are significant sources of dioxins in waste and air emissions. This aligns with findings of high dioxin and dioxin-like PCB concentrations in eggs from backyard chickens near metallurgical operations (Jelinek et al., 2023a; Petrlik et al., 2022a). The examples of Alaverdi in Armenia (Grechko et al. 2021) or the Beihai metallurgical complex in China (Petrlik 2016), and the earlier discovery of high dioxin concentrations in eggs from Helwan, Egypt (DiGangi et al. 2005), along with the inclusion of metallurgical operations in the list of significant sources of dioxin and other POPs in Annex C of the

Photo 4.33

Photo 4.34

Photos 4.33 – 4.35: *A small abandoned medical waste incinerator near a hospital in Accra, Ghana. A pile of ash residues from waste incineration showed relatively high concentrations of dioxins. Leaving it accessible to chickens resulted in elevated levels of dioxins in their eggs. Analyses of samples taken by Arnika in 2018 confirmed this hypothesis (Hogarh et al. 2019; Petrlik et al. 2019a). Photo: Martin Holzknecht, Arnika*

Photos 4.36 – 4.37: *Small medical waste incinerators built in Asia are not very different from those in Africa. In the photos taken in 2005, there are two such waste incinerators in Pakistan; Peshawar and Islamabad (Khwaja and Petrlik 2006). Photo: Jindřich Petrlík, Arnika*

Photo 4.37

Stockholm Convention (Stockholm Convention 2008; Stockholm Convention 2010), underscore the relevance of PRTR for tracking dioxin releases from metallurgical processes (UNEP and Stockholm Convention 2013).

In summary, the previous text discussed various studies and data related to the estimation of dioxins in waste, emphasizing the importance of specific reporting within PRTR systems to address data gaps and provide accurate information about the presence of persistent organic pollutants in waste.

4.2 Beyond NGOs: Expanding Horizons of PRTR Data Utilization

Data from Pollutant Release and Transfer Registers (PRTRs) serve not only governments (or ministries or environmental agencies) or NGOs, but also individuals, communities (Bui and Mayer 2003), local associations, scientists, and potential investors (Abashidze et al. 2019). They also serve society as a whole (Skårman and Sjödin 2013), which places high demands on the usability of the available data. For the companies themselves, it can serve to evaluate progress in implementing new, cleaner production technologies (identifying opportunities, creating a set of input data for design, implementation and monitoring) (Kolominskas and Sullivan 2004).

One of the most visible results of PRTR implementation is the reduction of toxic emissions. For example, pharmaceutical companies in the U.S. saw a more than 60% reduction between 2002 and 2011, which can be attributed to emissions reporting and the implementation of green chemistry practices. The PRTR is uniquely suited to assess the progress that different industrial sectors, or specific facilities within them, have made in adopting green chemistry practices and the effectiveness of these practices in preventing pollution. Furthermore, the results suggest that other emission and pollutant transfer registries outside the USA also have potential for similar purposes (DeVito et al. 2015). In the U.S., access to publicly available data not only significantly reduced overall pollution but also transformed the role of the Environmental Protection Agency into a facilitator of information sharing and voluntary pollution reduction (Jobe 1999).

Photo 4.38: *An example of a smaller-capacity hazardous waste incinerator in Strakonice in the Czech Republic burns mostly medical waste. These waste incinerators have been exempted from reporting to the Czech PRTR (IRZ) since 2016 despite the high levels of dioxins in their fly ash (Mach 2017). Photo: Jindřich Petrlík, Arnika*

Photos 4.39 – 4.40: *Copper smelter in Alaverdi, a source of POPs pollution and contamination of free-range chicken eggs in the surrounding area (Grechko et al. 2021; Petrlik and Strakova 2018). Photo: Ondřej Petrlík, Arnika, 2010*

Photo 4.39

Photo 4.40

Information reported by companies often appears in academic articles. The use of what is considered one of the most comprehensive data sets available through the PRTR has resulted in numerous studies that (despite the limitations of the PRTR) have examined the relationship between toxic releases and their impact on human health (Osornio-Vargas et al. 2011). Special articles have also examined real estate prices affected by the disclosure of emission information in PRTRs in specific locations (von Graevenitz et al. 2016). PRTR data are generally valuable for research and have significant potential for identifying priority research needs that can influence policy, management, and, ultimately, human health. Despite its inherent limitations, the PRTR represents a perfect and uniquely valuable resource, yet its use in human health research seems underutilized (Wine et al. 2014).

An article by Berthiaume, A., in 2021, looked at the use of data from the Canadian PRTR (NPRI) (Berthiaume 2021). It was found that the use of NPRI in peer-reviewed research has steadily increased since 1997. Information derived from the NPRI appeared in 225 articles in academic journals from 1994 to 2019. These data were used primarily by users from the Canadian government and Canadian universities and users outside these institutions or outside Canada. Studies focused on socio-economic issues, waste treatment and remediation, climate change, indigenous groups, or biomonitoring (Berthiaume 2021).

Ji & Lee (2016) undertook an interesting study in South Korea. In summary, traditional methods for testing drinking water have limitations, leading to delays in responding to water incidents. To overcome this, global trends suggest using risk analysis systems. This study used a data system (PRTR) to assess the potential risk of harmful chemicals in drinking water facilities. By looking at factors like the total amount of chemicals, distance to a city, and chemical toxicity, they identified the riskiest city using a calculated approach and a statistical method. The study found that PRTR data helps understand and prevent risks in water supplies. Although the method may not capture all types of chemical accidents, it provides a useful way to compare risks between cities, helping prioritize efforts to reduce potential risks for drinking water facilities (Ji and Lee 2016).

5. Crucial Elements of Good PRTR

5.1 OECD Recommendations

The OECD played a pivotal role by developing recommendations for governments to implement PRTR systems. In 1996, the OECD Council officially adopted the "Recommendation of the Council on Implementing Pollutant Release and Transfer Registers," which was revised in 2018 (OECD 2023c). Its full version is in Annex 1 of this Guide (subchapter 6.1). This recommendation urges OECD Adherents to transparently establish PRTRs, incorporating principles such as international comparability, public accessibility, data quality assurance, and continuous evaluation. OECD's ongoing efforts focus on providing practical tools, guidance, and support to countries for PRTR installation, emphasizing data quality improvement, exploring applications, and harmonizing PRTRs globally (OECD 2023b; OECD 2023c; UNITAR 2018).

5.1.1 Key Points of the Recommendation

1. **Establishment of PRTR Systems:** Member countries are encouraged to take steps to establish, implement, and make publicly available PRTR systems. The guiding document for this endeavor is the OECD Guidance to Governments Manual for PRTRs.
2. **Principles for PRTR Systems:** In setting up PRTR systems, member countries are advised to consider a set of principles outlined in the Annex to the recommendation.
3. **Data Sharing:** Member countries should consider periodic sharing of the results of PRTR system implementations among themselves and, notably, with non-member countries, with a particular focus on sharing data from border areas.
4. **Core Elements of PRTR Systems:** When establishing a PRTR, Member countries should incorporate essential elements into the system. These include listing pollutants, integrated multi-media reporting, reporting by source, periodic reporting (preferably annually), and the imperative to make data available to the public.

The Annex of the Recommendation enumerates specific principles that should guide the establishment of PRTR systems. Some of these include:

- **Identification and Assessment of Risks:** PRTR systems should furnish data supporting the identification and assessment of potential risks to humans and the environment.
- **Prevention of Pollution:** Utilize PRTR data to promote pollution prevention at the source, such as by encouraging the implementation of cleaner technologies.
- **Cooperation with Stakeholders:** Governments should collaborate with affected and interested parties to establish goals and objectives for the system.
- **Involvement of Public and Private Sectors:** PRTR systems should encompass both public and private sectors, including facilities that may release or transfer substances of interest and, if relevant, diffuse sources.
- **Integration with Existing Sources:** PRTR systems should be integrated to the extent possible with existing information sources such as licenses or operating permits to minimize duplicative reporting.
- **Data Accessibility:** Results of PRTRs should be promptly and regularly accessible to all affected and interested parties.
- **Mid-Course Evaluation and Flexibility:** PRTR systems should allow for mid-course evaluation and be flexible to adapt to changing needs.
- **Transparency:** The entire process of establishing the PRTR system and its implementation and operation should be transparent and objective.

These principles underscore the importance of transparency, cooperation, and the use of PRTR data for informed decision-making in the realm of environmental policy and sustainable development (OECD 2023c).

5.2 Public Access to All Data about Releases from Individual Industrial and Agricultural Sources

In its recommendations, the OECD emphasizes making PRTR data accessible to the public (OECD 2023c). Numerous examples demonstrate that civil society organizations have played a crucial role in presenting PRTR data to the public in an understandable format. Their activities are instrumental in exerting pressure on industrial operations to reduce the release of toxic substances into the environment (DiGangi 2011; Jobe 1999; Maršák 2008b; Petrlik et al. 2018; Taylor 2004). In the implementation of PRTR in Thailand, we encountered a recommendation from Japanese experts suggesting that the government only disclose aggregated data for specific territorial units rather than information on the quantities of substances released or transferred by specific industrial facilities. Such a form of disclosure effectively shields industrial enterprises from natural pressure to reduce emissions of toxic substances, which is a significant unintended consequence of introducing PRTR. Consequently, these industrial entities lack a basis for comparing their environmental performance relative to "competitors" and the effectiveness of their technologies in environmental protection.

The first PRTR system, namely the Toxics Release Inventory (TRI) in the USA, was legislated hand in hand with the rule that data must be made accessible to the public. The law was named the "*Emergency Planning and Community Right-To-Know Act*" (Jobe 1999). The U.S. Environmental Protection Agency (USEPA) stated, *"Information also can serve as a way to reduce risk without using command-and-control regulations. For example, the information requirements of the Emergency Planning and Community Right-to-Know Act of 1986 have encouraged companies to take voluntary actions to reduce their inventories and emissions of toxic substances"* (USEPA 1990).

5.3 PRTR as a New Database: Complementary Rather Than Competitive or Cancelling Existing Ones

In most countries where reporting to the PRTR is newly established, other databases where polluters report information about pollutants already exist or have existed. In the Czech Republic, for example, these included the Registry of Air Pollution Sources (REZZO) (CHMI 2023) and the Hydroecological Information System (HEIS) (TGM WRI 2023), among others. A similar situation is documented in the development of the PRTR in Moldova (see subchapter 2.5.6). Managers of industrial facilities often have to repeatedly report similar or identical data to these databases, leading to resistance against the introduction of another system like PRTR. Based on our experience at Arnika, it was challenging to explain to operators of databases like REZZO or HEIS that PRTR would neither eliminate nor jeopardize their databases.

REZZO and HEIS in the Czech Republic continue to operate even after almost twenty years of the Integrated Register of Pollutant Releases (IRZ), the Czech PRTR. They still contain data that cannot be found in the IRZ. On the other hand, even if we were to combine REZZO and HEIS under one header (entry page), we would not obtain an equivalent replacement for the IRZ. No other system, except PRTR, gathers information in one place on the annual total emissions (releases) of a certain set of substances hazardous to human health and the environment, both into the air and into water and soil, and additionally transferred as waste outside of operations.

The situation in Moldova appears to be similar to that in the Czech Republic when the introduction and initial years of operation of the IRZ system faced challenges in coordinating the reporting of environmental data into various inadequately coordinated databases (such as the air pollution register REZZO, hydrological register HEIS, etc.). The issue was only resolved by a separate law on integrated reporting system on the environment (ISPOP), which interconnected the databases and eliminated the potential for double reporting of data into state-established registries focused on environmental data (Maršák 2008a; MV ČR 2008). The solution wouldn't be some inconsistent mixture of existing databases, as it would not be navigable nor comply with the requirements of the PRTR Protocol. Creating a unified reporting system at the national level is therefore crucial for a user-friendly PRTR system for reporters and users. Using Moldova as an example, it can be seen that the failure to address this issue may hinder the further functioning of PRTR itself.

Coordination with reporting obligations within international conventions is also important, as demonstrated by a study from Sweden (Skårman et al. 2014). "*The study shows that there are synergies regarding operations, substances, receiving medium, public participation and capacity building between the PRTR and those regulations that are included in the project. At the same time, the study also shows that although common traits can be identified, the same information is not required by any two regulations, but each regulation is unique*" (Skårman et al. 2014).

As evident from the UNITAR handbook from 1998 (UNITAR 1998), the duplicity of reporting to various databases has been a problem since the inception of PRTRs: "*Much of the information which will be used to generate the PRTR reports are data that are collected by various departments and for reasons other than PRTR reporting. Thus, these departments/personnel may need to provide a duplicate data set to be stored with the PRTR coordinator. In some cases, the data collection forms used by various departments may have to be redesigned to include new data elements needed for PRTR reporting* "(UNITAR 1998).

5.4 Civil Society Organizations as Stakeholders of PRTR Design Process

Pollutant Release and Transfer Registers (PRTR) have become an essential information tool for driving toxics use reduction by making emissions information from industrial facilities public (DiGangi 2011). Policy-makers stand to gain valuable insights from an in-depth analysis of aggregate PRTR data, enabling them to discern trends in specific substances and substance groups, such as carcinogens, persistent bio-accumulative toxins, VOCs, contributors to smog formation, ozone depleters, and more. Additionally, the analysis can shed light on the performance of various industrial sectors, geographical distribution, including ecosystem analysis, and the effectiveness of specific environmental policies. This comprehensive approach facilitates informed decision-making and the development of strategies that address the multifaceted aspects of environmental concerns (OECD 2000).

The Kyiv PRTR protocol of the Aarhus Convention explicitly mentions that each Party shall design the PRTR in a way that "Allows *for public participation in its development and modification* "(UNECE 2003).

Engaging in consultations with potential audiences or users of PRTR data, including the public, industry, and NGOs, is crucial in identifying the information needs a PRTR could effectively address. This process aids in directing resources and efforts toward approaches that best align with the public's requirements. A meticulous examination of goals, target audiences, and specific information needs may suggest tailored delivery mechanisms, ensuring data availability in diverse formats to cater to various objectives (OECD 2000).

Photo 5.1: *Arnika actively participated in several Aarhus Convention and PRTR Protocol meetings. This photo comes from the meeting in Maastricht in 2014. Photo: Arnika*

Engagement of the civil society is indirectly listed among basic guiding principles for the establishment of PRTR, as mentioned earlier in this guide: *"In designing or modifying a PRTR system, the government should consult with affected and interested parties to develop a set of goals and objectives for the system"* (OECD 1997).

Through strategic coalitions, Mexican environmental NGOs successfully influenced the government to switch from voluntary to mandatory reporting for RETC (Mexican PRTR system). These groups employed effective pressure methods, making a lasting impact on RETC's design and implementation. Many NGO representatives who advocated for mandatory reporting are now part of the Mexican consultative group for RETC. They regularly meet with the RETC team at SEMARNAT, showcasing a successful collaboration between environmental NGOs and the government. Many see this as a notable success story in environmental advocacy (Pacheco-Vega 2015).

Czech NGOs Children of the Earth (Děti Země), and since 2001 also Arnika, participated extensively in the design and implementation of PRTR in the country beginning in the 1990s, long before the country became an EU Member State. To help instigate the process, Arnika worked to generate more than 10,000 signatures on a petition that called for PRTR and included local authorities and scientists as signatories (DiGangi 2011). The chemical industry initially opposed the process, but eventually conceded that the PRTR could cover more substances than the European Pollutant Emission Register (EPER), which was the predecessor of the E-PRTR.

Civil society organizations have become advocates for presenting PRTR data to the public in an easily understandable format, eliminating the need for extensive navigation between pages. Examples of such systems include FactoryWatch (Taylor 2004), PollutionWatch (Environmental Defence and CELA 2004), and Czech NGO Arnika's Znecisovatele.cz. Their examples have influenced the official presentation of data, including the new design of the E-PRTR.

5.5 Concerns of Industrial Companies

Industrial enterprises and their associations generally do not welcome the implementation of the PRTR. Their concerns were well summarized by a case study of a petrochemical complex in the Map Ta Phut Industrial Estate, Rayong, Thailand: "*The petrochemical industry expressed their concerns on the PRTR such as cost increases, overlaps in reporting systems, manpower needs, the lack of governmental feedback, and the lack of knowledge on chemical substances among stakeholders*" (Kondo and Limjirakan 2013).

A common worry of industrial firms is that disclosing the quantities of consumed and emitted substances through such specific reporting will reveal their trade secrets. However, this is an unfounded concern. A robust PRTR system allows them to keep sensitive data confidential for trade secret reasons. However, they usually must demonstrate to the state administration authorities collecting data for the PRTR that the request for confidentiality is genuinely due to trade secrets and not for other reasons, such as concerns about public reactions.

Regarding the possibilities of keeping certain data confidential, the publication "PRTR System in Questions and Answers" (Nadace Partnerství - Právo vědět, 1997) states: "*The reporter has the right to request the confidentiality of identifying a specific substance if they prove that the information is sensitive in terms of protecting the production process. However, they cannot request an exemption from the reporting obligation. Confidentiality cannot relate to data on the release of the substance into the environment but only to other data, such as the processed quantity or retention of the substance in the production facility. Experiences from other countries prove that manufacturers rarely request data confidentiality. An alternative name for the substance is provided in the public PRTR register outputs.*"

Before the launch of PRTR, there are usually significant concerns among reporters, leading to exaggerated demands for data confidentiality options. Foreign experiences show that the proportion of requests for confidentiality in various systems ranges from a few percent to a few thousandths of reports submitted.

5.5.1 Benefits of PRTR for Industry

The systematic data collection required for PRTR reporting serves regulatory purposes and offers various advantages to industrial facilities (UNITAR 2018). These benefits encompass:

1. **Identifying Opportunities for Release Reduction:** PRTR data enables industrial facilities to pinpoint opportunities for reducing releases.
2. **Enhancing Safety and Efficiency:** Utilizing PRTR data helps maintain the safety of workers, industrial facilities, and production units, leading to improved processes, reduced costs, and increased overall efficiency. Pollution prevention initiatives, such as employing alternative chemicals, implementing better chemical use controls, enhancing equipment efficiency, refining manufacturing processes, and reducing point source and fugitive emissions, contribute to this improvement.
3. **Incentivizing Innovation:** Implementing PRTR encourages industries to find innovative solutions and adopt cleaner technologies to enhance their environmental performance.
4. **Monitoring Progress Towards Sustainable Development:** PRTR data serves as a metric to evaluate an industry's progress towards sustainable development, recording trends over time.
5. **Accessing Markets with Higher Environmental Standards:** Industries with robust PRTR practices gain access to markets with higher environmental requirements, demonstrating their commitment to environmental responsibility.
6. **Community Engagement for Environmental Protection:** Collaborating with communities based on PRTR data fosters partnerships to improve environmental protection.
7. **Mitigating Public and Government Concerns:** PRTR implementation allows industries to identify mitigation actions that are more likely to gain public and government acceptance.
8. **Building Corporate Image and Trust:** Dissemination of PRTR data strengthens the corporate image and enhances relations with society and communities, fostering trust and confidence among community members.
9. **Benchmarking Industry Performance:** Comparing industry performance against peers facilitates benchmarking, potentially leading to the transfer of technology and knowledge within and among companies.

A U.S. Environmental Protection Agency study utilized data on 370,000 source reduction activities reported to the U.S. Toxics Release Inventory over 25 years. The study found that these projects prevented the release of between 5 and 15 billion pounds of chemicals, showcasing the tangible impact of such initiatives (UNITAR 2018).

Literature on the implementation of PRTRs provides numerous examples highlighting the benefits of such systems for companies, further emphasizing the positive outcomes of PRTR adoption.

Richard Royall, a representative of Xerox, emphasized the transformative impact of publicly accessible integrated pollution registries, particularly citing the American TRI. He asserted that since 1988, these registries contributed to a notable 50% reduction in harmful substance emissions in the USA. According to Royall, the TRI exposed unforeseen emission sources across various facilities, resulting in substantial savings for these enterprises. Specifically, between 1998 and 1999, Xerox achieved a commendable 27% reduction in total reported emissions to the TRI (Royall 2000).

During a lecture in the Czech Republic, Royall (2000) highlighted several benefits of implementing the PRTR for industrial enterprises beyond economic savings. These advantages included improvements in reputation, elimination of communication barriers with the surrounding community, demonstration of a commitment to environmental protection, engagement of local residents, a basis for technological improvements, scaling of production efficiency and emission reduction, better resource management, and inspiration for technological innovation.

The magazine "Chemical and Engineering News" reported that introducing the TRI system in the USA in 1987 initially shocked many managers. The transparency brought by the TRI revealed significant chemical emissions, prompting awareness and action within industries.

Another case illustrating the positive impact of integrated registries on industry savings is exemplified by 3M, an American company. Implementing the "Pollution Prevention Pays" (3P) employee program across its facilities, 3M achieved a remarkable 50% reduction in waste production, resulting in total savings of nearly $600 million. The company initiated 2,500 projects globally, leading to substantial achievements, such as a 92% reduction in solvent use in the Netherlands, a 95% decrease in air emissions in Ribas, Spain, and a 75% reduction in solid waste production in Geroinon, Wales (Muir et al. 1995).

Inspired by the introduction of the integrated pollution registry system and free access to information through the Toxics Release Inventory, 3M went further by adopting an ambitious program, 3P Plus. This program aimed to reduce releases into water, air, and solid waste by 90% (compared to 1987), aiming to achieve the lowest technically achievable levels (Muir et al. 1995). Anyway, 3M still has a lot of work to do. They are currently trying to settle thousands of lawsuits over contamination of drinking water with toxic PFAS chemicals (Reuters 2023).

In 1988, the US EPA announced the so-called 33/50 Program, which is further explained in an excerpt from the publication by W. R. Muir et al. (1995).

In the "33/50 Program," the EPA selected 17 priority toxic chemicals and requested the industry to voluntarily join the program and meet its goals – a 33% reduction in targeted chemical emissions by the end of 1992 and a 50% reduction by the end of 1995. The baseline values were determined in 1988. The program intended to achieve even greater reductions beyond

Table 5.1 *Examples of the highest reduction in releases of toxic substances in the USA between 1988 and 1993 as a result of the implementation of the TRI system and the subsequent activities, particularly the "33/50 Program" by the US EPA. Source: (Muir et al. 1995)*

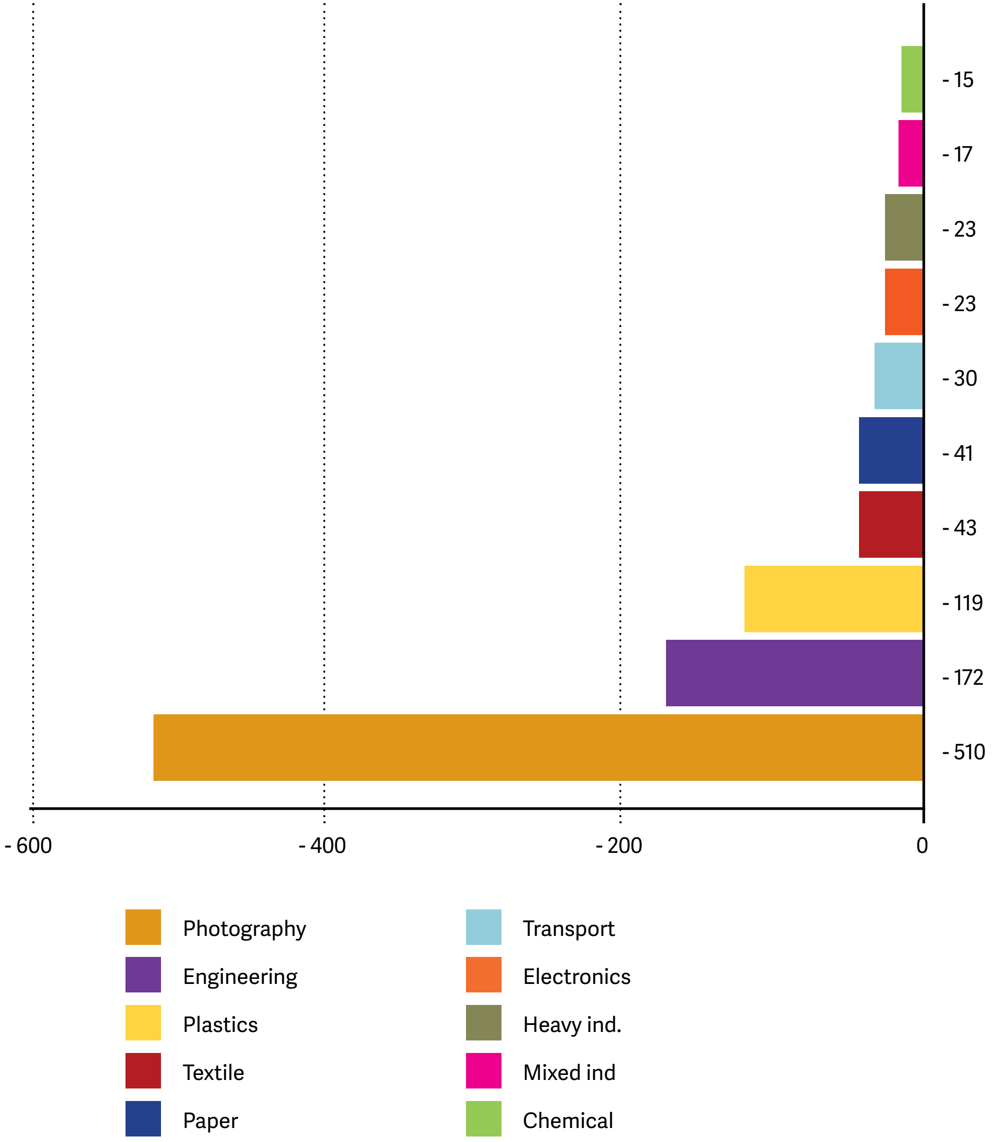
REDUCTION IN RELEASES OF TOXIC SUBSTANCES 1988 - 1993	
10 substances with highest reduction in releases	**Percentage**
Ammonium sulphate	-98.0
Hydrochloric acid	-53.1
Toluene	-40.4
1,1,1- Trichloroethane	-64.3
Acetone	-39.4
Methanol	-26.9
Dichloromethane	-50.0
Chlorine	-46.0
Freon 113	-86.1
Methyl ethyl ketone	-39.2
Overall reduction (-677 001 tun)	**-58.0%**

the obligations required by legal regulations and to do so more rapidly and operationally than is possible through regulatory mechanisms.

After the program was announced, more than 1,200 industrial companies committed to voluntarily reducing emissions of priority chemicals. Many businesses pledged more substantial reductions, often reaching 90% or more. Overall releases and transfers of priority chemicals significantly decreased from the initial 1.47 billion pounds (665 million kg) in 1988 to 973 million pounds (441 million kg) in 1991, representing a total reduction of 34% compared to the baseline. The first goal of the program, a 33% reduction, was achieved one year earlier than expected (Muir et al. 1995).

The examples of savings or emission reductions provided here come from the industrial sector. We have not mentioned any from the agricultural sector, even though agricultural enterprises will also have to report emissions of toxic substances from their operations to the PRTR. In the USA, the TRI system initially applied only to selected industrial sectors. Therefore, examples of savings and emission reductions come from the industrial sector. If TRI were not limited to certain industrial sectors, there would undoubtedly be examples of savings in resources and finances from large agricultural enterprises. Royall (2000) warned against limiting the obligation to report to the PRTR only for certain economic activities precisely because this system helps uncover unforeseen sources of emissions of toxic substances.

Figure 5.1 *Ten industrial sectors in the USA with the greatest emissions reduction for 1988-93. Data are in millions of kilograms.*
Source: (Muir et al., 1995)



5.6 Chemically Specific Reporting About Waste Transfers

In the Czech Republic, data on amounts of chemical substances in wastes are not centrally summarised 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 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 waste was not introduced generally in the EU.

Usually, reporting of transfers of chemical substances does not give rise to the duty of new measurements. From the very nature of the problem, the chemical composition of wastes leaving the premises of industrial facilities has to be found, given limitations valid for the individual facilities for waste disposal or utilization. The IRZ required that substances in wastes are to be reported in 72 cases of the total list, which had 93 items in 2008 (Petrlik et al. 2018). However, the number of the reported substances is even much lower, a bit more than half, as shown in Table 5.2.

Table 5.2 *Numbers of substances really reported according to the release/transfer type. Source: (MŽP 2022)*

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 waste is the statement that it is a duplication. However, proponents of this opinion have not yet proved that similar data could be found in any other central database. In the CEHO (Center for Waste Management) system, which they mention when arguing by duplication, the amount of waste that a facility produces in individual waste catergories may be found. However, the system does not contain any data on the contents of specific substances.

The state administration has no other available database where information on, for example, mercury or hexachlorobenzene amounts in wastes may be found easily. In fact, both these substances belong to 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 waste 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 high mercury amount.

The importance of waste monitoring in the IRZ may be well documented by the case of mercury and other heavy metals and/or persistent organic pollutants, as is obvious from the corresponding chapters of this study. Both cases will illustrate the importance of reporting chemical substances in waste from the standpoint of monitoring compliance with international conventions and strategies at the EU level (Petrlik et al., 2018). From this point of view, the IRZ data are an underestimated information source.

Ji & Lee (2016) used a data system (PRTR) including data about chemicals in waste transfers to assess the potential risk of harmful chemicals in drinking water facilities in Korea. Also, the Japanese PRTR finds specific reporting about chemicals in waste transfers valuable: *"The volume of targeted chemicals contained in the wastes was one of the most important types of data, yet was not always available"* (Yamaguchi 1999).

Some systems, like the European PRTR, need companies to report what chemicals they send to public sewerage facilities. But when it comes to other scenarios like recycling, the focus is on whether the transfer is hazardous or not. It was concluded one very recent study focused on PRTR data (Hernandez-Betancur et al. 2023). The problem is, if we only collect data on chemicals going to sewerage systems and not all End-of-Life scenarios, it could create a skewed picture (imbalanced data) for future models. This can make it tough to build accurate models, potentially causing mistakes when categorizing End-of-Life activities (Hernandez-Betancur et al. 2023).

This problem aligns with a broader concern highlighted in a recent European Court of Auditors review addressing hazardous waste (ECA 2023). The review notes that, despite decontamination efforts, recycled materials, including paper, plastics, rubber, and textiles, still contain a range of hazardous substances (Behnisch et al. 2023; DiGangi et al. 2011; ChemSec 2021; Strakova et al. 2023a; Straková et al. 2018; Strakova et al. 2022). The lack of information on the chemical composition of the waste treated by recyclers is a key factor contributing to this issue (BiPRO 2017).

We propose that addressing this knowledge gap could be achieved by enhancing reporting on the flows of toxic chemicals, as outlined in the PRTR reporting scheme. Specifically, focusing on POPs in chemically specific reporting for waste transfers, both in the E-PRTR and the Kyiv PRTR Protocol, could significantly contribute to bridging the gap in information on the chemical composition of waste treated by recyclers. It agrees with a suggestion by Article 10 of the Stockholm Convention, which declares that PRTRs serve as crucial tools for monitoring and reporting POPs, supporting compliance with convention requirements (Stockholm Convention 2010).

We believe that increased knowledge about the flows of toxic chemicals (listed in the PRTR reporting scheme) in waste transfers could significantly fill the gap in *"lack of information on the chemical composition of the waste"* treated by recyclers. Especially POPs should be covered in chemically specific reporting on waste transfers in E-PRTR and the Kyiv PRTR Protocol.

5.7 Estimation of the Releases - Tools

For the determination of annual releases and transfers of substances for reporting to the PRTR, there are essentially three basic options: 1) direct measurement and calculation based on it; 2) estimation using emission factors determined (calculated and published) for a specific type of industrial activity and level of technology; and 3) expert estimation (OECD 2005). Most laws implementing the PRTR allow for all three options. It is not always possible to measure the relevant substances and calculate the annual volume of the release/transfer based on the measurements. This system of three methods for estimating the annual quantity of released/transferred substances is described for the Czech PRTR in subchapter 2.3.1.3 in this guide.

Handbooks have been created to assist in the calculation of national inventories of emissions and transfers of certain substances for the purposes of international conventions. These handbooks establish emission factors for relevant substances (such as mercury or dioxins) based on scientific literature specific to a type of activity and the level of technology used. These emission factors serve as a substitute for direct emissions measurement or transfers from individual sources. For reporters, finding their technology in these handbooks and entering the annual production volume or utilized capacity, such as the quantity of waste burned in the respective year, is sufficient.

Examples of such handbooks include international ones for dioxins (UNEP and Stockholm Convention 2013) or mercury (UNEP Chemicals 2013), as well as national ones, for example, from the Netherlands (Honig et al. 2021).

A clearinghouse on estimation techniques is also very broadly presented on the OECD website (OECD 2023d) and includes links to various national guides and/or handbooks, e.g., from Australia, Canada, Chile, EU, or USA.

In 2005, the OECD released a guide on the selection of estimation techniques. It provides a procedure for deciding which estimation technique to choose and describes details about their usage. The guide also discusses the uncertainty that cannot be avoided in determining and estimating annual releases/transfers. This document is certainly recommended for everyone starting with PRTR, whether they are involved in creating the register or are reporters (OECD 2005).

5.8 Setting Good Thresholds for Reporting Obligation

In Germany, in 2021, a detailed analysis of their PRTR, essentially a replica of the E-PRTR, was conducted. Among other findings, it was concluded that the set reporting thresholds fail to capture a sufficient amount of major sources of toxic substance emissions in the country. The necessity to lower the reporting thresholds or adjust them to reflect approximately 90% of the total industrial emissions of the respective pollutant emerged from a questionnaire campaign and interviews as the most pressing need for adjustment in terms of the meaningfulness of PRTR data. The need for adjustments in this regard also arose from an analysis of the coverage of PRTR emission data, comparing air and water data for specific pollutants with emissions reports according to the 11th BImSchV and eKomm data. For only 19% of the tested pollutants, it was possible to determine a coverage level of 80 - 100% of the total emissions of the respective pollutant into the air. For the remaining 36 tested pollutants, the detection level was either higher than 100% or significantly lower (Zettl et al. 2021).

The inadequacy of reporting thresholds, essentially determined by political decisions during the negotiation of the Kyiv PRTR Protocol, was also highlighted in earlier studies by Arnika analyzing data from the Czech PRTR. A case study in subchapter 4.1.6.2 of this guide examined the issue of reporting thresholds using hexachlorobenzene as an example. Lowering reporting thresholds and introducing a duty to report HCB in wastes, similar to other POPs, could provide more accurate and objective data (Petrlík 2010).

5.9 Coverage of the Most Important Pollutants and Modifications of Their List

The PRTR should not be a static system because the use of chemical substances in industry is rapidly evolving, and some already prohibited substances are slowly disappearing. From this perspective, for example, the list of substances in the Kyiv PRTR Protocol of the Aarhus Convention is very conservative, reflecting the situation in the 1990s when it was created. Since then, however, several new pollutants have emerged, and the problem of substances released during the production, use, and disposal of plastic waste has grown. The current state of knowledge is not reflected in the reporting thresholds for releasing (emission) chemical substances into the air or water in the Kyiv PRTR Protocol.

This recommendation reflects the need to revise the list of substances in PRTR systems at the international and national levels (Zettl et al. 2021). Ideally, such revisions should be conducted by a commission established by the Ministry of Environment and/or government at the national level with representation from all stakeholders, including industry and civil society organizations. The involvement of the academic community is crucial for assessing the risks associated with individual substances.

One study evaluating the functionality of the Canadian NPRI concluded: *"While relative pollutant release levels have decreased, overall toxicity has increased. Coupled with the omission of toxicity factors and pollutant thresholds from the NPRI, this creates a false sense of progress for stakeholders"* (Johnston Edwards and Walker 2019). Its analysis shows that early PRTR systems focused on substances emitted in large volumes but omitted substances released into the environment in small volumes, yet more toxic.

Most PRTR systems other than the U.S. TRI and Czech IRZ[14] lack substances like PFAS (Audrlická Vavrušová et al. 2022; MŽP 2021b; USEPA 2022a), whose flows would be important to monitor due to their toxicity even at low concentrations (Chang et al. 2016; Strakova et al. 2023b; Szilagyi et al. 2020). Although PRTR systems track chlorinated dioxins (PCDD/Fs) (Petrlik et al. 2018), they have omitted similar brominated dioxins (PBDD/Fs), which are equally toxic substances (Behnisch et al. 2023; Birnbaum et al. 2003). PRTR systems appear inflexible in reflecting the most toxic substances released into the environment (Johnston Edwards and Walker 2019).

The global list of substances monitored in PRTR systems compiled by the OECD contains 1,274 items (OECD 2021). OECD describes the list as follows: *"The OECD examined the pollutants and reporting sectors covered by PRTRs around the world to develop a harmonized list of pollutants/reporting sectors common to most PRTRs. The findings are presented in the Harmonised List of Pollutants/Sectors. It describes the*

Table 5.3 *Numbers of substances in various PRTRs – overview based on previous subchapters. Sources: (Australian Government 2022; CELA 2023; European Parliament and Council 2006; French Republic 2012; Ministerio del Medio Ambiente 2022; MoE-GoJ 2007; Mogilyuk 2017; MŽP 2021b; Nakachi 2010; USEPA 2023c; Wever et al. 2023)*

Country	**Number of substances in PRTR**
Europe (E-PRTR)	91
Czech Republic (IRZ)	97
France (IREP)	191
Netherlands	375
USA	794
Canada	320
Australia	93
Japan	477
South Korea	388
Chile	121
Kazakhstan	86

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[14] PFASs will be reported into the Czech PRTR from 2025 (MŽP 2021b).

Photos 5.2 and 5.3: *Various pollutants released or deposited by industry into the environment can induce or contribute to cancer development (being potential or proven carcinogens). Therefore, the most hazardous substances need to be listed in the PRTR. In the photographs are two men from different corners of the world, both suffering from cancer at the time the photos were taken. Of course, we do not know to what extent industrial activities in their vicinity contributed to this, but in the vicinity of steelworks, chemical plants and waste incinerators, cases of cancer may be more frequent (Domingo et al. 2020; Garcia-Perez et al. 2013; García-Pérez et al. 2010; Garcia-Perez et al. 2016; Jirik et al. 2021; Li et al. 2011; López-Abente et al. 2012). TRI in the USA was used as an important source of information in a study focused on the association between six environmental chemicals and lung cancer incidence in the United States (Luo et al. 2011).*

Photo 5.2: *The man in the photo lived when it was taken in 2016 in the vicinity of the petrochemical complex in Map Ta Phut, Thailand. Map Ta Phut was found to be contaminated with POPs, heavy metals, and VOCs (Bystriansky et al. 2018). The incidence rates of all types of cancer and leukemia in Rayong's Muang district, where Map Ta Phut is located, were higher than those of other districts of the province (Hassarungsee and Kiatiprajuk 2010). Photo: Ondřej Petrlík, Arnika*

Photo 5.3: *Pastor R. L. Gundy of Mount Sinai Missionary Baptist Church, who has been diagnosed with prostate cancer, lived in 2009 in Jacksonville, USA, in the vicinity of a waste incineration ash dumps. According to the 1990 U.S. census, more than 30 thousand inhabitants lived in four sites contaminated with ash. Sources: (Morrison 2009; Petrlik and Bell 2017; USEPA ROD 2006)*

methods used and the resulting lists. It provides the harmonized lists in a format that others can use to develop their own pollutant/sector lists or conduct multi-country analyses "(OECD 2021). The Global PRTR also presents statistics for certain pollutants collected from various PRTRs from 2008 to 2017.

The new study attempted to evaluate the toxicity of emissions based on the E-PRTR and identified a limited number of substances, numbering less than a hundred, as a limiting factor (Erhart and Erhart 2023): *"The obstacles to the toxicity impact potentials analysis based on the E-PRTR are numerous. One obstacle to our approach is that the number of substances in the E-PRTR is limited, as less than 100 pollutants are on the E-PRTR reporting list, which is well below the 100,000 chemical products listed in the Swedish System of Environmental and Economic Accounting (Persson et al. 2019). The E-PRTR list itself is also being revised currently (Erhart and Erhart 2022)."*

5.10 Small and Medium-sized Enterprises and Other Recommendations by the Toxic Watch Network, Japan on PRTRs in Asian Countries

When introducing PRTR systems to countries where there are often many small and medium-sized enterprises, governments should adopt a system for estimating releases from such smaller sites, similar to the approach taken by the Japanese government. Governments may need on-site inspections to calculate the quantities in use and releases from those sites. The results can then serve as a basis for estimating releases from small and medium-sized enterprises nationwide.

Additionally, independent research conducted by the Toxic Watch Network has affirmed the necessity of including small-scale business operators employing fewer than 21 individuals, who are currently not obligated to report the quantity of any chemicals they release. (Mizutani et al. 2021). That study also "*estimated the distribution of emissions from small-scale businesses. Depending on the chemical substance and industry, the estimated distribution of the released chemicals differed from that in the PRTR. This finding suggested that the reported release in PRTR was insufficient in assessing the risk of chemical leakage during a natural disaster"* (Mizutani et al. 2021).

Before implementing a PRTR system, governments should conduct pilot programs for approximately three years. The Japanese government initiated a three-year PRTR pilot program in 1998, before the system's official launch in 2001. In the last year of the pilot program, the Japanese government asked approximately 2,000 sites in 30 prefectures to report their releases voluntarily. This amounted to 5% of all sites with reporting requirements, and the number of persons in charge and involved in the program was rather limited. Nevertheless, it is considered that the pilot program greatly facilitated the full implementation of the PRTR system (Nakachi 2010).

There are many subsidiary companies of European or Japanese group companies in Asian countries. When introducing PRTR systems in Asian countries, they should be designed to require corporations to satisfy the same standards as their parent corporations in Europe or Japan to avoid double standards. Such standards should be applied not only to reported releases of chemical substances, but also to environmental reports and MSDS (Nakachi 2010).

In Japan, quantities being handled at a site are not disclosed due to strong opposition by industry. However, information about handling amounts is crucialto assess appropriately per unit whether the

Photos 5.4 - 5.5: *Tofu factories in Tropodo replaced wood with plastic waste as fuel and became a serious threat to public health. High levels of POPs, including dioxins and/or BFRs, were measured in local food sources (Ismawati et al. 2021; Petrlik et al. 2019b). Such pollution sources should be somehow included in a future PRTR in Indonesia. Photo: Jindřich Petrlík, Arnika, 2019*

reported data are accurate and whether a reduction of releases has been promoted. These handling amounts should be reported in addition to the released amounts (Nakachi 2010).

The official South Korean PRTR site in English contains aggregated data for 2001 – 2012 only (NICS 2014). More specific data on various industrial sectors can be downloaded in PDF format from that website.

Photo 5.5

5.10.1 Small and Medium-sized Enterprises and Industrial Productions in Indonesia

The discussed small and medium-scale industrial productions are abundant in Indonesia.

Those mentioned above small and medium-scale industrial productions are numerous in Indonesia, as we confirmed during joint projects with Nexus3 and Arnika. These operations can be significant sources of pollution, with toxic substances such as dioxins, brominated flame retardants, and mercury. For instance, several dozen small aluminum smelters in Kendalsari are significant sources of dioxin emissions, as are several dozen tofu factories in Tropodo or

Photo 5.6

Photo 5.7

Photos 5.6 – 5.9: *Similar to the tofu factories in Tropodo, a series of small aluminum foundries in Kendalsari is a somewhat analogous source of pollution. They also emit dioxins while simultaneously producing waste residues containing relatively high concentrations of dioxins. Moreover, these residues are provided to the villagers for constructing road reinforcements and river embankments (photo 5.9) (Petrlik et al. 2020). Photo: 5.6 – 5.8 Jindřich Petrlík, Arnika; 5.9 Ecoton* lime kilns in Karawang that burn plastics instead of traditional wood as fuel (Ismawati et al. 2021; Ismawati et al. 2022; Petrlik et al. 2022b). It's airborne emissions and the transfer of dioxins in waste in the form of ash used in villages for road and river embankment stabilization (Petrlik et al. 2020).

5.10.1.1 Artisanal and Small-Scale Gold Mining (ASGM)

The extraction of gold in ASGM is carried out with mercury, leading to significant environmental pollution in both water and air. In areas where ASGM is practiced in developing countries, high concentrations of mercury have been detected in both fish and the hair of people working and living there (Evers et al. 2013; Fernandez 2013; Gerson et al. 2018; Gonzalez et al. 2013; Ismawati et al. 2013; Mng'anya et al. 2013; Sherman et al. 2015; Trasande et al. 2016). At some Indonesian ASGM sites, people experience a disease very similar to one called Minamata disease, caused by mercury poisoning (Price and Price 2015). More than two thousand gold mining locations exist in present-day Indonesia. Artisanal and small-scale gold mining (ASGM) sites are spread out across thirty provinces in Indonesia (Meutia et al. 2022).

At gold processing sites where mercury is burned, BaliFokus found ambient air mercury concentrations greater than 51,000 nanograms per cubic meter, the highest level their meters could measure, or more than 50 times the safe level established by the World Health Organization.

Photo 5.8

Photo 5.9

Photo 5.10

Photo 5.11

Photo 5.12

Photos 5.10 – 5.13: *In Karawang, where a series of lime kilns are located, experts from Nexus3 and Arnika collected samples of ash from kilns, soil, and free-range chicken eggs from local poultry farms: "Very serious contamination of the environment and food chain with POPs as a result of using plastic and rubber waste as fuel in lime kilns in Karawang Regency was confirmed by measurements of samples of ash, soil, and free-range chicken eggs" (Petrlik et al. 2022b). The contamination of eggs with dioxins was among the highest ever measured levels in Asia and globally. (Petrlik et al. 2022a). Photo: 5.10 - 5.12 Ondřej Petrlík, Arnika, 2022 and 5.13 Nexus3, 2022*

Photo 5.13

Photo 5.14: *Poboya, Central Sulawesi. Block A mining site. The photo was taken in June 2011. Over 20,000 miners from different areas of Indonesia work under the 40 - 100-meter-deep shafts. Photo: Yuyun Ismawati, Nexus3*

Photo 5.15: *The pond's surface in Kasepuhan Adat Cisitu, Lebak Regency. The ASGM site is so contaminated with mercury that mercury bubbles have formed on the local pond's surface. Photo: Yuyun Ismawati, Nexus3*

Photo 5.16

Photo 5.17

Photos 5.16 and 5.17: *ASGM is not only a problem in Indonesia. ASGM sites in Tanzania and Nigeria.*
Photos: Agenda, Tanzania and Dame Yinka via Wikimedia Commons.

Soil and water samples also had high mercury concentrations, ranging from 600 to 3,000 times the acceptable limits established by the WHO. Rice tested in Cisitu had mercury contamination that ranged from 0.81 ppb to 241.90 ppb (Price and Price 2015).

In 2008, ASGM was identified as the second-largest source of global atmospheric mercury pollution (UNEP Chemicals Branch 2008). The estimated mercury releases from ASGM should also appear in the PRTR as estimates from small and medium-sized enterprises in Indonesia. However, it cannot be expected that operators of these small artisanal operations will estimate and report their toxic substance releases to the PRTR on their own. Therefore, it is necessary to introduce a tool to assist PRTR-managing institutions or regional administrative authorities in calculating and entering the data into the reporting system. For example, the Mercury Toolkit includes the calculation of mercury releases from ASGM (UNEP Chemicals 2013).

5.11 PRTR and Water Pollution

PRTR is often the sole accessible and comprehensive source of information on substances released into water. Consequently, various institutions and researchers utilize it for water protection purposes. Similarly to other cases, the crucial factor here is how sensitively the reporting thresholds are set, both for reporting substances in water discharges and their transfers in wastewater and waste.

In a study conducted by Yamagata et al. (2006), the focus centered on selecting 30 chemical substances, specifically those identified or nominated within environmental criteria and recognized as endocrine disrupters. The researchers meticulously gathered data on the volume of discharged chemical substances from public and industrial wastewater treatment plants, relying on information from the Pollution Release and Transfer Register (PRTR). The investigation extended to observing the behavior of these substances within the river located in the designated model area.

The outcomes revealed that while the PRTR reported the discharge of 12 chemical substances, the river actually manifested the presence of 17 substances. Notably, certain inorganic compounds exhibited intensive detection near the discharge sites documented in the PRTR. Intriguingly, some organic compounds and endocrine disrupters, such as oestrone, were detected even though their discharge had not been reported in the PRTR for the model area (Yamagata et al. 2006).

The study's conclusion by Yamagata et al. (2006) emphasized the utility of PRTR information in identifying hot spots. However, it also highlighted the imperative for further investigation to comprehensively understand the discharge patterns of chemical substances, particularly from smaller entities such as businesses, farmland, and houses.

In a related study by Miho et al. (2015), a comprehensive monitoring initiative was undertaken involving 359 PRTR chemicals (388 including isomers) over three years. This represented the first large-scale monitoring effort of PRTR chemicals in Japan. Of the monitored chemicals, 232 were detected, with most exhibiting very low concentrations and low detection ratios. Interestingly, only ten industrial chemicals were found to have high detection ratios and concentrations. Some chemicals were discerned solely at specific sites or during specific seasons. The study conclusively confirmed the usefulness and necessity of environmental monitoring for PRTR chemicals. It suggested that multiple monitoring points would likely be necessary to thoroughly evaluate the presence of PRTR chemicals in a given river (Miho et al. 2015).

Ji & Lee (2016) undertook an interesting study in South Korea. In summary, traditional methods for testing drinking water have limitations, which can lead to delays in responding to water incidents. To overcome this, global trends suggest using risk analysis systems. This study used a data system (PRTR) to assess the potential risk of harmful chemicals in drinking water facilities. By looking at factors like the total amount of chemicals, distance to a city, and chemical toxicity, they identified the riskiest city using both a calculated approach and a statistical method. The study found that PRTR data helps understand and prevent risks in water supplies. Although the method may not capture all types of chemical accidents, it provides a useful way to compare risks between cities, helping prioritize efforts to reduce potential risks for drinking water facilities (Ji and Lee 2016).

5.11.1 Cyanide Accidents, River Poisoning and PRTR

5.11.1.1 Cyanides

Cyanides are white crystalline substances containing carbon and nitrogen in the molecule. Various elements, such as sodium, potassium, and others, may be present as cations. Cyanides may also contain toxic metals as cations. These can include cadmium, lead, and many other metals. Sodium cyanide and potassium cyanide are the most common compounds in this group. Cyanides are soluble in both water and alcohol. Cyanides are used in metallurgy, the chemical and photographic industries, and in plastics (nylon) production. They can also be found in manufacturing rubber, explosives and fuel. Sodium and potassium cyanide are important agents in the electrochemical plating and hardening of steel. Cyanides can also be used in the mining industry to extract gold and silver from minerals. Cyanides are produced in combustion processes and used in several industries (Botz 2001; MŽP 2021a). Cyanides are unstable when they enter water or soil, so bioaccumulation in aquatic organisms is unlikely. They can evaporate rapidly

Figure 5.2: *The entire Tisza river and part of the Danube were poisoned by a cyanide spill from a gold mine in Baia Mare, Romania in January 2000 (Cunningham 2005). Source: (EEA 2009)*

Date of cyanide spill
30.01.2000

	Measurement place:	Date:	Max. concentration:	
1.	Szamos at Csenger	01.02.	32.6 mg/l	cyanide
2.	Tisza at Lonya	03.02	13.5 mg/l	cyanide
3.	Tisza at Tiszalök	05.02	3.7 mg/l	cyanide
4.	Tisza at Kisköre	08.02	3.8 mg/l	cyanide
5.	Tisza at Szolnok	09.02	3.2 mg/l	cyanide
6.	Tisza at Tape	11.02	2.2 mg/l	cyanide
7.	Tisza at Tiszasziget	11.02	1.49 mg/l	cyanide

Sanitary level: 0.1 mg/l cyanide

The spill reached Belgrade:
14.02.2000

Figure 5.3: *Cover page of newspapers showing Baia Mare mine.*

Photo 5.18: *Tisza cyanide spill from Baia Mare gold mine in Romania killed fish Photo:* https://www.delmagyar.hu/szeged_hirek/azonnal_olt_a_cian_a_tiszaban/2415983/ *via Wikimedia Commons*

from water and soil into the air as hydrogen cyanide, especially at low pH. They are subject to microbial degradation. Cyanides do not bind to soil particles and may leach into groundwater.

Cyanides are highly toxic to fish and other aquatic life. All cyanides are toxic to aerobic organisms, including humans, by interfering with oxygen fixation by respiratory enzymes (MŽP 2021a). The presence of cyanide ions in food and their use in the industry are dangerous to people's health and safety. Compounds containing cyanide ions are rapidly acting poisons that mainly interfere with the process of cellular respiration, which results in several ailments and illnesses and even death (Jaszczak et al. 2017). Cyanides are a frequent source of fish poisoning in surface waters of long reaches of rivers (Arnika 2020a; Cunningham 2005; Svobodová and Sehonová 2021).

In January 2000, a retaining wall failed at the Aurul gold processing plant in Romania, releasing a wave of cyanide and heavy metals that moved quickly from one river to the next through Romania, Hungary, the Federal Republic of Yugoslavia and Bulgaria, killing tens of thousands of fish and other forms of wildlife and poisoning drinking-water supplies (Cunningham 2005).

5.11.1.2 Two Cyanide Accidents and PRTR

The information from the Czech PRTR proved crucial in connection with two river accidents. In 2006, there was a cyanide leak from the chemical plant LZ Draslovka Kolín into the largest Czech river, the Elbe (see map in Figure 5.4). An eighty-kilometer stretch of the river was contaminated (Svobodová and Sehonová 2021), and despite the responsible party not admitting fault for several days, the IRZ data clearly indicated the likely culprit. Similarly, in the basic navigation of those who could be responsible for the cyanide poisoning on the Bečva River in September 2020 (Svobodová and Sehonová 2021), the registry

Figure 5.4: *Part of the Labe (Elbe) River was affected by a cyanide leak from LZ Draslovka in Kolin 2006.*

AFFECTED AREA	LENGTH IN KM
Kolín	5
Nová Ves	5
Poděbrady	13
Nymburk	11
Čelákovice	6
Brandýs nad Labem	11.5
Kostelec nad Labem	6
Neratovice	6
Obřistvi	7
Mělnik	4
Lysá nad Labem	9

could have been useful. However, it did not display all entities handling cyanides due to the high reporting threshold for cyanide transfers in waste. In response, Arnika issued a call for "Rivers without Poisons," demanding tightening the reporting threshold for cyanide transfers in waste from 500 to 50 kg/year. This was prompted by the incident on the Bečva River, where a cyanide leak resulted in massive fish mortality over a 40 km stretch of the river (Čtk 2023). The call garnered support from more than 7,000 people (Arnika 2020b). The requirement was also endorsed by committees of the Parliament of the Czech Republic (Čtk 2023).

5.11.2 PRTRs and Fishermen

Fishing communities, recreational anglers, and their families belong to parts of the human population that are highly vulnerable to water pollution and aquatic ecosystem degradation. Pollution of rivers and waters affects them in several ways: 1) leaks of substances toxic to fish destroy their food source or the object of their interest; 2) accumulation of toxic substances, which do not kill the fish but accumulate in them, can also accumulate in the bodies of anglers or people consuming the fish, and 3) accidental spills can be a disaster for entire communities. Despite this, the use of data in relation to

Photos 5.19 – 5.20: *The chemical plant LZ Draslovka Kolín (photo 5.19), which produces hydrogen cyanide and related products such as sodium cyanide, potassium cyanide, diphenylguanidine, and others, became the source of one of the largest cyanide accidents in the Czech Republic in January 2006 (photo 5.19). Photos: 5.19 – Michal Gregor via Wikimedia Commons; 5.20 – Arnika's archive.*

fishing has not been the focus of many scientific studies, except for exceptions that studied, for example, certain substances in PRTR systems in connection with the development of ecotoxicity releases (Erhart and Erhart 2022).[15]

Photo 5.20

However, fish are evidently the first victims of the leakage of certain substances into water, as we have shown in subsection 5.11.1.2, which focuses on river poisoning by cyanides. Their poisoning, however, is caused by various other substances, and not all of them are monitored, for example, in the E-PRTR. In the case study from the Czech Republic (see subsection 4.1.7.1), it is evident that fish poisoning is not only a result of the direct discharge of toxic substances into the water, but also improper handling of waste containing toxic arsenic or other metals and their compounds.

Endangered fishing communities also include those in Map Ta Phut or Douala, where industry takes precedence (Fonge 2011; Hassarungsee and Kiatiprajuk 2010; Kuepouo and Petrlik 2013; Saetang 2022). These two places are just a couple examples of the many that are spread globally.

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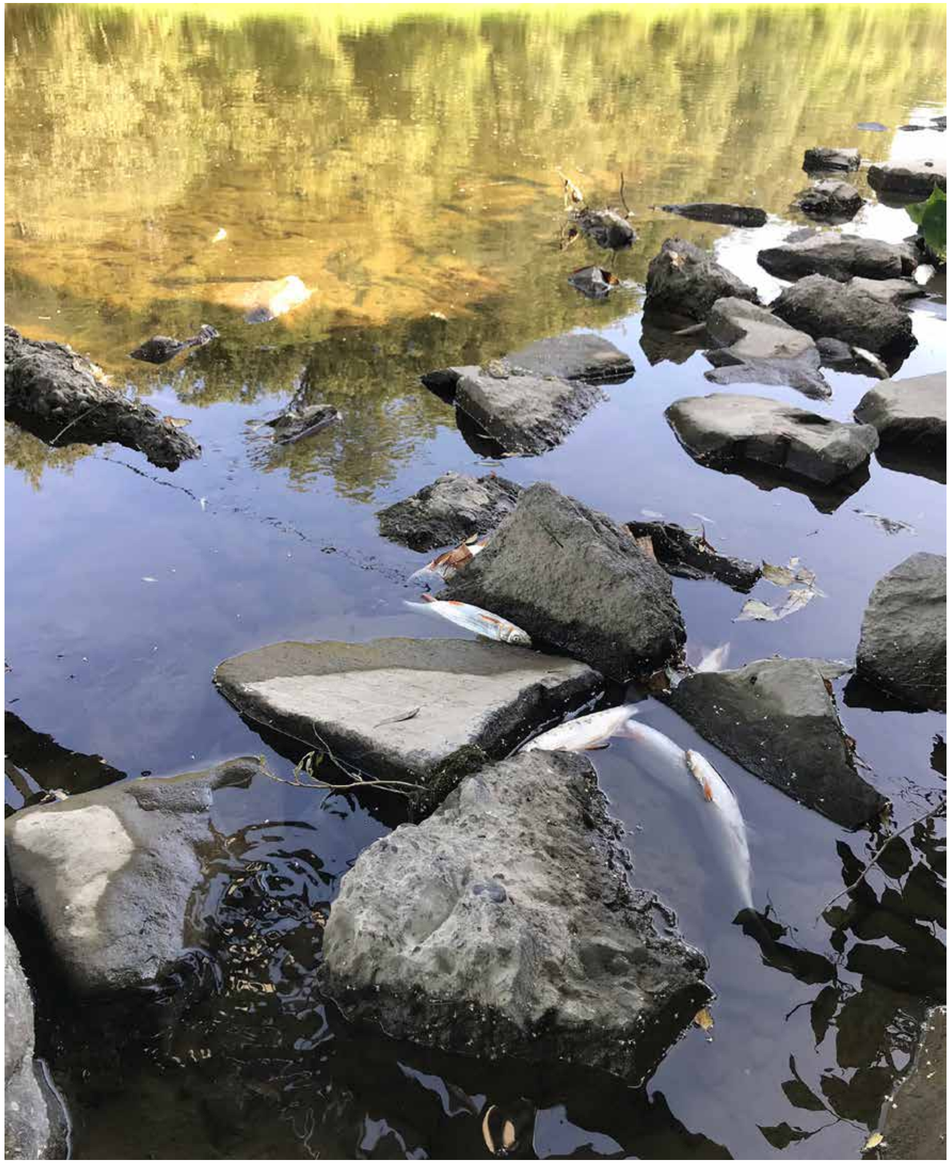
[15] Recent Swedish study observed *"The downward trend of human toxicity is more obvious for zinc and arsenic than for mercury or lead. Ecotoxicity impacts have been also decreasing in total, in particular in early 2000s and less dynamically recently"* (Erhart and Erhart 2022). This covers also toxicity through the releases to water to certain extend, and applies to Sweden.



Photos 5.21 – 5.22: *Cyanide poisoning on the Bečva River in September 2020. Photos: 5.21 – Michal Berg, Green Party Czech Republic; 5.22 - Stanislav Pernický, Czech Fishermen Association*

Photo 5.22

Photo 5.23: *Industrial plants in the bay with mangrove swamps near Gladstone, Queensland, Australia. Toxic substances affect fishermen fishing in rivers and those along the coast near industrial facilities. High concentrations of PFASs were found in the port of Gladstone (GPC 2020). Photo: Jindřich Petrlík, Arnika, 2022*

5.11.2.1 How Can PRTR Help Fishing Communities?

PRTR does not regulate industrial activities but collects valuable information from them for fishermen. At the same time, PRTR, in combination with public data accessibility, puts pressure on industrial operations to better monitor and reduce their releases of toxic substances. In the case of accidents, PRTR helps to quickly identify the polluters (see Chapter 5.11.1).

Photo 5.24: *Discharge of wastewater from a canal of paper mills in Khon Kaen, Thailand. Photo: Jindřich Petrlík, Arnika, 2016*

5.11.2.2 PFASs, Mercury and Other Persistent Pollutants Contaminate Fish

Research in the USA found that: 'an individual's consumption of freshwater fish is potentially a significant source of exposure to perfluorinated compounds. The median level of total targeted PFAS in fish fillets from rivers and streams across the United States was 9,500 ng/kg, with a median level of 11,800 ng/kg in the Great Lakes' (Barbo et al. 2023). However, when we look at PRTR systems, we find that only two require reporting of some substances from the large group of PFASs.

Photos 5.25 – 5.27: *Sampling in Tha Tum, Thailand in 2012 and 2016. Sediment sampling in 2016 (photo 5.25), analysis of fish caught in 2012 (photo 5.26) for mercury, as well as hair analysis of the local community (photo 5.27) that frequently consumes fish. Photos: 5.25 – Ondřej Petrlík, Arnika, 2016; 5.26 – 5.27 EARTH, 2012 (Saetang et al. 2013)*

Photo 5.25

Photo 5.26

Photo 5.27

Photo 5.28

Photo 5.30

Photo 5.29

Photos 5.28 – 5.30: *The chemicals released into the waters often affect Thai fishermen. Photos: Ondřej Petrlík, Arnika, 2016*

Photos 5.31 – 5.33: *Fishing communities near the large city of Douala in Cameroon are also affected by mercury, as found in a study by CREPD, IPEN, and Arnika in 2013 (Kuepouo and Petrlik 2013). Photos: CREPD, 2012*

Photo 5.31

Photo 5.32

Photo 5.33

For example, E-PRTR does not include this group (OECD 2021). In the case of BFRs, on the other hand, there is not much reporting in E-PRTR (EEA 2022), even though these substances are widely present in the environment and in fish.

Mercury is also among the significant pollutants accumulating in fish. Monitoring not only emissions into the air and direct discharge into the water, but also the handling of waste containing mercury and soil contamination is important, as documented by examples of chlorine chemicals, smelters, or coal-fired power plants and contamination of fish in their vicinity (Mach et al. 2016).

As the USEPA states: “Nearly all fish and shellfish contain traces of mercury, no matter what body of water they come from” (USEPA 2023a). However, fish advisories do not only track mercury: *“Most advisories are based on contamination from five toxins that persist for long periods in sediments at the bottom of certain water bodies: 1) Mercury; 2) Polychlorinated Biphenyls (PCBs); 3) Chlordane; 4) Dioxins; 5) Dichloro-Diphenyl-Trichloroethane (DDT)” (USEPA 2023a). PFASs have recently been added to this list (Pickard et al. 2022). However, there is a problem with this group, as there are thousands of substances to monitor: “Fish consumption advisories are primarily being developed for perfluorooctane sulfonate (PFOS), but this work reinforces the need for risk evaluations to consider additional bioaccumulative PFAS, including perfluoroalkyl sulphonamide precursors”* (Pickard et al. 2022). How PRTR systems will deal with them will hopefully be seen soon. Chemical analyses of PFASs are a rapidly developing field of analytical chemistry (Al Amin et al. 2020; Weiss et al. 2015), including bioassay methods that are usually more cost-efficient and help indicate problematic locations (Behnisch et al. 2021; de Schepper et al. 2023).

Annexes

ANNEX 1: OECD RECOMMENDATIONS

Background Information

The Recommendation on Implementing Pollutant Release and Transfer Registers as adopted by the OECD Council on 20 February 1996 on the joint proposal of the Environment Policy Committee (EPOC) and the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology (today under the responsibility of the Chemicals Committee). The Recommendation is an important initiative that helped promote (both within and outside OECD) the establishment of PRTRs and provide general principles to guide the design of such systems. Only four PRTR programs were in operation when the Council Recommendation was adopted. The Recommendation was abrogated on 10 April 2018. (OECD 2023c)

THE COUNCIL,

HAVING REGARD to Article 5 b) of the Convention on the Organisation for Economic Co-operation and Development of 14 December 1960;

HAVING REGARD to Principle 10 of the Report of the United Nations Conference on Environment and Development of 3-14 June 1992 (Agenda 21) to which all OECD Member countries have subscribed, and which states that *“each individual shall have appropriate access to information concerning the environment that is held by public authorities, and the opportunity to participate in decision-making processes and that countries shall encourage public awareness and participation by making information widely available”;*

HAVING REGARD to Chapter 19 of Agenda 21, which states, among other things, that governments, with the cooperation of industry, should improve databases and information systems on toxic chemicals, such as emission inventory programs and that the broadest possible awareness of chemical risks, is a prerequisite for chemical safety;

NOTING that several Member countries and the European Community are acting to collect data concerning pollutant releases and transfers from various sources and to make these data publicly accessible;

NOTING that many individual enterprises and industrial sectors within the OECD area are voluntarily providing information about pollutant releases and transfers;

NOTING that a number of non-member countries are also exploring ways to obtain and make available national data about pollutant releases and transfers;

NOTING that the OECD Secretariat, with the aid of Member governments and other affected and interested parties, has prepared a Guidance for Governments Manual specifically to assist governments wishing to institute a Pollutant Release and Transfer Register;

RECOGNISING that reducing potentially harmful releases and transfers of pollutants while promoting economic progress is a foundation for achieving sustainable development;

On the joint proposal of the Environment Policy Committee (EPOC) and the Joint Meeting of the Chemicals Committee and the Working Party on Chemicals, Pesticides and Biotechnology;

I. RECOMMENDS:

1. That Member countries take steps to establish, as appropriate, implement and make publicly available a pollutant release and transfer register (PRTR) system using as a basis the principles and information set forth in the OECD Guidance to Governments Manual for PRTRs.

2. Member countries, in establishing PRTR systems, should take into account the set of principles contained in the Annex to this Recommendation, of which it forms an integral part.

3. Member countries should consider periodically sharing the results of the implementation of such systems among themselves and with non-member countries, with particular emphasis on sharing of data from border areas among relevant neighbouring countries.

II. FURTHER RECOMMENDS:

That member countries in establishing a Pollutant Release and Transfer Register should take into account the following core elements of a system:

1. A listing of chemicals, groups of chemicals, and, if appropriate, other relevant categories, all of which are pollutants when released or transferred;

2. Integrated multi-media reporting of releases and transfers (air, water and land);

3. Reporting of data by source where the reporting sources are defined;

4. Reporting periodically, preferably annually; and 5. Making data available to the public.

III. INSTRUCTS:

1. The Environment Policy Committee is to review actions undertaken by Member countries and to report to the Council three years from the date of this Recommendation and periodically after that concerning progress.

2. The Environment Policy Committee to consider how OECD can aid other international organizations and bodies, upon their request, in helping non-member countries that may be contemplating the establishment of PRTR systems.

ANNEX

PRINCIPLES CONCERNING ESTABLISHMENT OF PRTR SYSTEMS

1. PRTR systems should provide data to support the identification and assessment of possible risks to humans and the environment by identifying sources and amounts of potentially harmful releases and transfers to all environmental media.

2. The PRTR data should be used to promote the prevention of pollution at source, e.g., by encouraging the implementation of cleaner technologies. National governments might use PRTR data to evaluate the progress of environmental policies and to assess to what extent national environmental goals are or can be achieved.

3. In devising PRTR systems, governments should cooperate with affected and interested parties to develop a set of goals and objectives for the system and estimate potential benefits and costs to reporters, the government, and society as a whole.

4. PRTR systems should include coverage of an appropriate number of substances that may be potentially harmful to humans and/or the environment which are released and or transferred.

5. PRTR systems should involve both the public and private sectors as appropriate and include those facilities that might release and/or transfer substances of interest, as well as diffuse sources, if appropriate.

6. To reduce duplicative reporting, PRTR systems should be integrated to the degree practicable with existing information sources such as licenses or operating permits.

7. Both voluntary and mandatory reporting mechanisms for providing PRTR inputs should be considered with a view as to how best to meet the goals and objectives of the system.

8. The comprehensiveness of any PRTR in helping to meet environmental policy goals should be considered, e.g., whether to include releases from diffuse sources should be determined by national conditions and the need for such data.

9. The results of a PRTR should be made accessible to all affected and interested parties on a timely and regular basis.

10. Any PRTR system should allow for mid-course evaluation and have the flexibility to be altered by affected and interested parties in response to changing needs.

11. The data handling and management capabilities of the system should allow for the verification of inputs and outputs and be capable of identifying the geographical distribution of releases and transfers.

12. PRTR systems should allow comparison and cooperation with other national PRTR systems as far as possible and possible harmonization with similar international databases.

13. A compliance mechanism to best meet the needs of the goals and objectives should be agreed upon by affected and interested parties.

14. The entire process of establishing the PRTR system and its implementation and operation should be transparent and objective. (OECD 2023c)

ANNEX 2: LIST OF SUBSTANCES INCORPORATED IN THE MONITORING PROGRAMME IN THE NETHERLANDS IN 1997

Following list of sbustances/wastes was part of the reporting in the Netherlands for 1997 (Evers 1997).

1. ANORGANIC COMPOUNDS

1.1. Metals and metalloids (10)

Antimony, Arsenic, Cadmium, Chromium, Copper, Mercury, Lead, Nickel, Selenium, Zinc.

1.2. Anorganic compounds (13)

Ammonia, Nitrogen oxides, Dinitrogen oxide, Asbestos, Chlorides, Fluorides, Hydrogen sulfide, Sulphur dioxide, Carbon dioxide, Carbon monoxide, Cyanides, Fine dust, Coarse dust.

2. ORGANIC COMPOUNDS

2.1. Specified non-halogenated organic compounds (17)

Acrolein, Styrene, Acrylonitrile, Ethene, Ethylbenzene, Formaldehyde, Benzene, Phenols-total, Toluene, Methane, Methyloxirane, Oxirane, Xylene, Isopropylbenzene, Dibutylphthalate, Dioctylphthalate, Phthalates total, Phenols total.

2.2. Specified halogenated organic compounds (24)

1,2-Dichloroethene, 1,2-Dichloroethane, Dichloromethane, Epichlorohydrin, Hexachlorocyclohexane, Tetrachloroethene, Tetrachloromethane, 1,1,1-Trichloroethane, Trichloroethene, Trichloromethane, Vinylchloride, Methylbromide, Hexachlorobutadiene, Chloroanilines, chlorobenzenes non-specified, Chloronitrobenzenes, Hexachlorobenzene, Trichlorobenzenes, 2-Chlorotoluene, 4-Chiorotoluene, 1,4-Dichlorobenzene, Dioxines, Pentachlorophenol, Chlorophenols nonspecified.

2.3. PAH, CFC, HCFC, HFC, and halones (31)

Polycyclic aromatic hydrocarbons (Ministry of VROM selection), Polycyclic aromatic hydrocarbons (Borneff selection), Naphthalene, Phenanthrene, Anthracene, Fluoranthene, Chrysene, Benzo(a) anthracene, Benzo(a)pyrene, Benzo(k)fluoranthene, Benzo(g,h,i) perylene, Chlorofluorocarbons non-specified, CFC 11, CFC 12, CFC 13, CFC 113, CFC 114, CFC 115, Halones

non-specified, Halon 1211, Halon 1301, Halon 2402, HCFC non-specified, HCFC 22, HCFC 123, HCFC 124, HCFC 141b, HFC non-specified, HFC 125, HFC 134a, HFC 143a.

2.4. General mixtures (7)

Volatile organic compounds, Non-methane volatile organic compounds, Halogenated organic compounds, Non-halogenated aliphatics, Non-halogenated aromatics, Halogenated aliphatics, Halogenated aromatics.

3. PESTICIDES, HERBICIDES AND FUNGICIDES (26)

DDT, Drins non-specified, PCB's~ non-specified, Azinphos-ethyl, Azinphos-methyl, Dichlorovos, Endosulfan, Fenitrothion, Fenthion, Malathion, Parathion-ethyl, Parathion-methyl, Atrazine, Bentazon, Simazine, Trifluralin, Organic tin compounds, DNOC, 2,4-D, Diuron, Chloridazon, Dimethoate, Mevinphos, Aldicarb, Dithiocarbamates, Pesticides non-specified.

4. OTHER SUBSTANCES (3)

Phosphorus-total. Nitrogen-total, Mineral oil non-specified.

5. Miscellaneous (6)

Radiating substances non-specified, Radon, Smell, Noise, Black smoke, Water consumption

6. SOLID WASTE (30)

Waste oil, Car tires, End of life vehicles, Dredging sludge, Batteries, Construction and demolition waste, Animal manure, Ferro domestic waste, Phosphoric acid gypsum, Glass, Bulky household waste, Waste containing halogenated substances, Household waste non-specified, Waste from cables, Jarosite, Office, shop, and service waste, Plastic waste, Waste paper and cardboard, Oxy-lime sludge, Shipping waste, Shredder waste, Slag and fly ash from incinerating household and communal waste, Waste from painting activities, Blasting grit, Street waste/ market waste/ waste from parks and waterways, Polluted soil, Packaging waste, Fly ash from coal fired power plants, Hospital waste, Sewage sludge.

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