TEXTE
85/2017

National Implementation Plan of the Federal Republic of Germany to the Stockholm Convention

For our Environment

Umwelt Bundesamt

TEXTE 85/2017

National Implementation Plan of the Federal Republic of Germany to the Stockholm Convention

(translation of the German version)

by

Department IV 1.1 International Chemicals Management

Caren Rauert with the aid of numerous colleagues of the German Environment Agency and the Agencies of the Länder

On behalf of the German Environment Agency

Imprint

Publisher:
Umweltbundesamt
Wörlitzer Platz 1
06844 Dessau-Roßlau
Tel: +49 340-2103-0
Fax: +49 340-2103-2285
info@umweltbundesamt.de
Internet: www.umweltbundesamt.de

/umweltbundesamt.de
/umweltbundesamt

Study performed by:
Department IV 1.1 International Chemicals Management
Caren Rauert with the aid of numerous colleagues of the German Environment Agency and the Agencies of the Länder Agency

Study completed in:
July 2017

Edited by:
Department IV 1.1 International Chemicals Management
Caren Rauert

Publication as pdf:
http://www.umweltbundesamt.de/publikationen

ISSN 1862-4804

Dessau-Roßlau, September 2017

Table of Contents

List of Figures

List of Tables

List of Abbreviations Used

AbfKlärV	Klärschlammverordnung (German Sewage Sludge Regulations)
AbfVerbrG	Law implementing Regulation (EC) No. 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste 1) and of the Basel Convention of 22 March 1989 on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 2) (Abfallverbringungsgesetz - Waste Shipment Act)
ABS	Acrylnitrile butadiene styrene
ACEA	Association des Constructeurs Européens d'Automobiles (European Automobile Manufacturers' Association)
AltholzV	Verordnung über Anforderungen an die Verwertung und Beseitigung von Altholz (Altholzverordnung) (German Regulations on the Recovery and Disposal of Waste Wood (Waste Wood Regulations))
AltölV	Altölverordnung (Waste Oil Regulations)
AOX	Adsorbable organic halogens (in organic chemistry, X is generally used as an abbreviation for any halogen)
ARGE	Arbeitsgemeinschaft (work group/project group)
Art.	Article
BAMBI	Bayerisches Muttermilchmonitoring (Bavarian Monitoring of Breast Milk)
BAuA	Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (German Federal Institute for Occupational Safety and Health)
BBodSchG	Gesetz zum Schutz vor schädlichen Bodenveränderungen und zur Sanierung von Altlasten (Bundes-Bodenschutzgesetz) (German Law on Protection Against Harmful Soil Changes and the Remediation of Contaminated Land (Federal Soil Conservation Act))
BBodSchV	Bundes-Bodenschutz- und Altlastenverordnung (Federal Soil Conservation and Contaminated Land Regulations)
BDF	Bodendauerbeobachtungsflächen (Continuous Soil Monitoring Plots)
BfC	Bundesstelle für Chemikalien (Federal Office for Chemicals)
BImSchG	Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge (Bundes-Immissionsschutzgesetz) (German Law on Protection against Harmful Environmental Effects due to Air Pollution, Noise, Vibrations and Similar Processes (Federal Immission Control Act))
BioAbfV	Verordnung über die Verwertung von Bioabfällen auf landwirtschaftlich, forstwirtschaftlich und gärtnerisch genutzten Böden (Bioabfallverordnung) (Regulations on the Recovery of Biowaste on Land Used for Agricultural, Forestry and Gardening (Biowaste Regulations))
BLAC	Bund/Länder-Arbeitsgemeinschaft Chemikaliensicherheit (Joint Working Group of the Federal Government/Federal States on Chemical Safety)
BLMP	Bund/Länder-Messprogramm (Joint Federal Government/Federal States Monitoring Programme)

BMUB	Bundeministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety)
BSH	Bundesamt für Seeschifffahrt und Hydrographie (Federal Office of Maritime Shipping and Hydrography)
BStMUV	Bayerisches Staatsministerium für Umwelt und Verbraucherschutz (Bavarian State Ministry of the Environment and Consumer Protection)
BVL	Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (Federal Office of Consumer Protection and Food Safety)
BAT	Best available technology
ChemBiozidMeldeV	Verordnung über die Meldung von Biozid-Produkten nach dem Chemikaliengesetz (Biozid-Meldeverordnung) (Regulations on the Reporting of Biocide Products in Accordance with the Chemicals Act (Biocide Reporting Regulations))
ChemBiozidZulV	Verordnung über die Zulassung von Biozid-Produkten und sonstige chemikalienrechtliche Verfahren zu Biozid-Produkten und Biozid-Wirkstoffen (Biozid-Zulassungsverordnung) (Regulations on the Approval of Biocide Products and other Chemical Legislation Procedures Regarding Biocide Products and Biocidal Active Substances (Biocide Approval Regulations))
ChemG	Gesetz zum Schutz vor gefährlichen Stoffen (Chemikaliengesetz) (Law on Protection Against Hazardous Substances (Chemicals Act))
ChemSanktionsV	Verordnung zur Sanktionsbewehrung gemeinschafts- oder unionsrechtlicher Verordnungen auf dem Gebiet der Chemikaliensicherheit (Chemikalien-Sanktionsverordnung) (Regulations Providing Sanctions for Infringements of Chemical Safety Regulations under EC and EU Law (Chemical Sanctions Regulations))
ChemStrOWiV	Verordnung zur Durchsetzung gemeinschaftsrechtlicher Verordnungen über Stoffe und Zubereitungen (Chemikalien Straf- und Bußgeldverordnung) (Regulations for the Enforcement off Regulations on Substances and Preparations under EC Law (Chemical Fines and Financial Penalties Regulations)
ChemVerbotsV	Verordnung über Verbote und Beschränkungen des Inverkehrbringens gefährlicher Stoffe, Zubereitungen und Erzeugnisse nach dem Chemikaliengesetz (Chemikalien-Verbotsverordnung) (Regulations on Bans and Restrictions on the Placing on the Market of Substances, Preparations and Articles Hazardous Under the Chemicals Act (Chemical Ban Regulations))
CLP	Classification, Labelling and Packaging (CLP) of Substances and Mixtures, Regulation (EC) 1272/2008 on the Classiffication, Labelling and Packaging of Substances and Mixtures
CLRTAP	Convention on Long-Range Transboundary Air Pollution -
CMR	Cancerogic, Mutagic or Toxic to Reproduction (Reprotoxic)
COMBINE	Cooperative Monitoring in the Baltic Marine Environment
COP	Conference of the Parties
Dann	Designated National Authority
DDT	Dichlorodiphenyltrichloroethane
DepV	Verordnung über Deponien und Langzeitlager (Deponieverordnung) (Landfill and Long-Term Storage Regulations (Landfill Regulations))
Dir	Directive

dl-PCB	dioxin-like PCBs
ECHA	European Chemicals Agency
EC	European Community
EEC	European Economic Community
ElektroG	Gesetz über das Inverkehrbringen, die Rücknahme und die umweltverträgliche Entsorgung von Elektro- und Elektronikgeräten (Elektro- und Elektronikgerätegesetz) (Law on the Placing on the Market, Taking-Back and Environmentally Compatible Disposal of Electrical and Electronic Equipment (Electrical and Electronic Equipment Act))
EMEP	European Monitoring and Evaluation Programme
E-PRTR Reg.	European PRTR Regulations (Regulation (EC) No. 166/2006)
EU	European Union
FGG	Flussgebietsgemeinschaft (River Basin Community)
FuttMV	Futtermittelverordnung (Animal Feed Regulations)
GADSL	Global Automotive Declarable Substance List
GG	Grundgesetz (German Constitution)
GHS	Globally Harmonised System
GefStoffV	Verordnung zum Schutz vor Gefahrstoffen (Gefahrstoffverordnung) (Regulations on Protection Against Hazardous Substances (Hazardous Substances Regulations)
GEMS/Food	Global Environment Monitoring System - Food Contamination Monitoring and Assessment Programme
GrwV	Verordnung zum Schutz des Grundwassers (Grundwasserverordnung) (Regulations on Protection off the Groundwater (Groundwater Regulations))
HBB	Hexabromobiphenyl
HBCDD	Hexabromocyclododecane
HCB	Hexachlorobenzene
HCBD	Hexachlorobutadiene
HCH	Hexachlorocyclohexane
HELCOM	Helsinki Commission
HeptaBDE	Heptabromodiphenyle ther
HexaBDE	Hexabromodiphenyl ether
HIPS	High Impact Polystyrene
ICPER	International Commission for the Protection of the River Elbe
IE	Industrial emissions
IPPC	Integrated Pollution Prevention and Control
ITEq	International Toxicity Equivalents
JAMP	Joint Assessment and Monitoring Programm
JKI	Julius Kühn-Institut

KmV	Verordnung zur Begrenzung von Kontaminanten in Lebensmitteln (Kontaminanten-Verordnung – KmV) (Regulations on the Limitation of Contaminants in Food (Contaminants Regulations))
KrWG	Kreislaufwirtschaftsgesetz (Recycling Management Act)
LABO	Bund/Länder-Arbeitsgemeinschaft Bodenschutz (Joint Working Group of the Federal Government/Federal States on Soil Conservation)
LAGA	Bund/Länder-Arbeitsgemeinschaft Abfall (Joint Working Group of the Federal Government/Federal States on Waste)
LAI	Bund/Länder-Arbeitsgemeinschaft Immissionsschutz (Joint Working Group of the Federal Government/Federal States on Immission Control)
LAWA	Bund/Länder-Arbeitsgemeinschaft Wasser (Joint Working Group of the Federal Government/Federal States on Water)
LFGB	Lebensmittel-, Bedarfsgegenstände- und Futtermittelgesetzbuch (Lebensmittel- und Futtermittelgesetzbuch) (Food, Commodities and Animal Feed Statute Book (Food and Feed Code))
MONARPOP	Monitoring Network in the Alpine Region for Persistent Organic Pollutants
MUDAB	Meeresumwelt Datenbank (Marine Environment Database)
NachwV	Verordnung über die Nachweisführung bei der Entsorgung von Abfällen (Regulations on the Provision of Documentary Evidence of Legally Compliant Waste Disposal (Documentary Evidence Regulations)
NGO	Non-governmental organisation
OCS	Octachlorostyrene
OctaBDE	Octabromodiphenyl ether
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	Polycyclic aromatic hydrocarbons
Para.	Paragraph
PBB	Polybrominated biphenyls
PBDE	Polybrominated diphenyl ethers
PBT	Substances with persistent, bioaccumulative and toxic properties
PCB	Polychlorinated biphenyls
PCB6	6 PCB congeners according to Ballschmiter: No. 28: 2,4,4'-trichlorobiphenyl, No. 52: 2,2',5,5'-tetrachlorobiphenyl, No. 101: 2,2',4,5,5'‑pentachlorobiphenyl, No. 138: 2,2',3,4,4',5'‑hexachlorbiphenyl, No. 153: 2,2',4,4',5,5'‑hexachlorobiphenyl, No. 180: 2,2',3,4,4',5,5'-heptachlorobiphenyl

PCBAbfallV	Verordnung über die Entsorgung polychlorierter Biphenyle, polychlorierter Terphenyle und halogenierter Monomethyldiphenylmethane (Artikel 1 der Verordnung über die Entsorgung polychlorierter Biphenyle, polychlorierter Terphenyle sowie halogenierter Monomethyldiphenylmethane und zur Änderung chemikalienrechtlicher Vorschriften) (PCB/PCT-Abfallverordnung) (Regulations on the Disposal of Polychlorinated Biphenyls, Polychlorinated Terphenyls and Halogenated Monomethyldiphenyl Methanes (Article 1 of the Regulations on the Disposal of Polychlorinated Biphenyls, Polychlorinated Terphenyls and Halogenated Monomethyldiphenyl Methanes and Amending Regulations under Chemicals-Related Legislation) (PCB/PCT Waste Regulations)
PCDD/F	Polychlorinated dibenzodioxins and furans
PCN	Polychlorinated naphthalenes
PCP	Pentachlorophenol
PCT	Polychlorinated terphenyls
PeCB	Pentachlorobenzene
PentaBDE	Pentabromodiphenyl ether
pers. comm.	personal communication/notification
PFC	Polyfluorinated chemicals
PflSchG	Gesetz zum Schutz der Kulturpflanzen (Pflanzenschutzgesetz) (Law on the Protection of Cultivated Plants (Plant Protection Act)
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
PFOSF	Perfluorooctane sulfonyl fluoride
PFT	Perfluorinated tensides (perfluorinated surfactants)
PIC	Prior Informed Consent, Rotterdam Convention
POP	Persistent Organic Pollutant
PRTR	Pollutant Release and Transfer Register -
PU	Polyurethane
RAC	Risk Assessment Committee
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
Reg.	Regulation/s
RHmV	Verordnung über Höchstmengen an Rückständen von Pflanzenschutz- und Schädlingsbekämpfungsmitteln, Düngemitteln und sonstigen Mitteln in oder auf Lebensmitteln und Tabakerzeugnissen (Rückstands-Höchstmengenverordnung) (Regulations on the Maximum Quantities of Residues of Plant Protection and Pest Control, Fertilisers and Other Products in or on Food and Tabacco Products) (Maximum Residue Regulations))
RoHS	Restriction of the Use of Certain Hazardous Substances, Directive 2002/95/EC on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment
SAICM	Strategic Approach to International Chemicals Management

SchadRegProtAG	Gesetz zur Ausführung des Protokolls über Schadstofffreisetzungs- und -verbringungsregister vom 21. Mai 2003 sowie zur Durchführung der Verordnung (EG) Nr. 166/2006 (Law on Execution of the Protocol on Pollutant Release and Transfer Registers of 21 May 2003 and Implementation of Regulation (EC) No. 166/2006)
SCCP	Short-chained chlorinated paraffins
SEAC	Socio Economic Analysis Committee
SH	Schleswig-Holstein
SVHC	Substance of Very High Concern
TA	Technische Anleitung (Technical Instructions)
TEQ	Toxicity Equivalent
TetraBDE	Tetrabromodiphenyl ether
DM	Dry Matter/Dry Mass
TMAP	Trilateral Monitoring and Assessment Programm
TS	Total Solids
UBA	Umweltbundesamt (German Environment Agency)
UDK	Umweltdatenkatalog (Environmental Data Catalogue)
UFOPLAN	Umweltforschungsplan des Bundesumweltministeriums (BMU) (Environmental Research Plan of the Federal Ministry for the Environment (BMU)
UMK	Umweltministerkonferenz (Environmental Ministers' Conference - Conference of the Environmental Ministers of the Federal Government and of the Federal States)
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programme
UPB	Umweltprobenbank (Environmental Specimen Bank of the German Environment Agency)
UPE	Unsaturated polyester
VersatzV	Verordnung über den Versatz von Abfällen unter Tage (Versatzverordnung) (Regulations on the Stowage of Waste Underground (Stowage Regulations))
vPvB	very persistent and very bioaccumulative
WEEE	Waste Electrical and Electronic Equipment
WHG	Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz) (Law on Regulation of Water Resources (Federal Water Management Act)
WHO	World Health Organization
WFD	Water Framework Directive
ZSE	Zentrales System Emissionen (Central System Emissions)

1 Introduction

***P**ersistent **O**rganic **P**ollutants* or **POP**s are chemical substances that remain in the environment long after their release, bioaccumulate in food chains, especially in fatty tissue and in this way, ultimately reach concentrations which have harmful effects on human health and the environment. POPs also have the potential for long-range transport and can spread worldwide via air and sea currents. Thus they not only constitute local or regional risks to the environment and human health, but also impact on regions of the earth far from the source of emissions. Arctic regions and mountain ranges, into which the POPs are carried by air currents and deposit through condensation, appear to be particularly at risk.

By implementing the Stockholm Convention (Secretariat of the Stockholm Convention 2009) on POPs, the Parties undertake to adopt and introduce suitable measures to prevent releases of such substances into the environment, or to at least reduce them as far as is technically possible with reasonable effort.

1.1 The national implementation plan

Drawing up a specific, national implementation plan is one of the obligations of the Convention Parties. Art. 7 Para. 1(a) of the Convention stipulates that each Party shall "develop and endeavour to implement a plan for the implementation of its obligations under this Convention" and "transmit its implementation plant to the Conference of the Parties within two years of the date on which this Convention enters into force for it" (Art. 7 Para. 1(b)). The plan shall be reviewed and updated, as appropriate, "on a periodic basis and in a manner to be specified by a decision of the Conference of the Parties" (Art. 7 Para. 1(c)).

In the years since the original Convention, further substances have been included in the Stockholm Convention at the biannual Conferences of Parties to the Convention:

- In May 2011, the plant protection product technical endosulfan and its related isomers were added to Annex A
- In May 2013, the flame retardant hexabromocyclododecane (HBCDD) was added to Annex A and
- In May 2015, hexachlorobutadien (HCBD) and pentachlorophenol (PCP) and its salts and esters were added to Annex A and polychlorinated naphthalenes (PCN), including di-, tri-, tetra-, penta-, hexa-, hepta- and octa-CNs were added to Annex A and C

The Federal Republic of Germany is not only a Party to the Stockholm Convention, but also to the POP Protocol of the Convention on Long-Range Transboundary Air Pollution (CLRTAP, UNECE 2011a). Further, various European Community regulations concerning POPs apply. All these obligations are described in this implementation plan.

2 Legal framework

2.1 International provisions

The outline principles and policy framework for dealing with chemicals on an international level were defined in the ***S**trategic **A**pproach to **I**nternational **C**hemicals **M**anagement* (SAICM[1]). The objective of this approach is to draw up global regulations for the management of chemicals. The lead organisations involved are the ***U**nited **N**ations **E**nvironment **P**rogramme* (UNEP[2]) and the ***W**orld **H**ealth **O**rganization* (WHO[3]). An initial result of this process is the ***G**lobally **H**armonised **S**ystem* (GHS – UNECE 2011b) for the

1 http://www.saicm.org/
2 http://www.unep.org/
3 http://www.who.int/en/

classification and labelling of chemicals. A further important agreement relating to POPs is the 1998 Protocol on POPs of the CLRTAP.

Other relevant international agreements are the Rotterdam Convention (Rotterdam Convention Secretariat 2008) of 1998 (in force since 2004) on regulated import and export of hazardous chemicals and pesticides, and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal of 1989. The Federal Republic of Germany and the European Union are parties to all these agreements and thus undertake to implement their provisions. This is done, on the one hand, in the form of European regulations with direct effect in the member states of the EU, and on the other hand in the form of European Directives, which require further national implementation.

The Stockholm Convention

The objective of the Stockholm Convention, mindful of the precautionary approach, is to protect human health and the environment from POPs. To this end, varying regulation levels have been specified for the different substances. Substances are assigned to three annexes (see Table 1, p. 19f) of the Stockholm Convention according to the level of regulation they require[4]:

- Annex A
  Substances listed in this annex shall be completely eliminated from the markets of the respective Party. The following measures shall be implemented to help to eliminate the substances: Ban on production and use, ban on importing of the substances as such or in mixtures and as part of products.
- Annex B
  The production and use of substances in annex B are restricted according to the requirements in the annex. No general ban exists, instead a specific arrangement is made for each use. In addition, exemptions may exist for the use of these substances.
- Annex C
  Substances in this annex are not produced intentionally, but their formation in chemical processes cannot be prevented or is difficult to prevent. They are either released into the environment from these processes or are subsequently contained in the products as contamination. This also includes processes in which substances are produced as non-isolated intermediates. For these substances the requirement is to minimise their release as far as possible and, if technically possible, to prevent their release altogether.

In addition, the Convention also specifies how stocks of the substances as such, in mixtures or in articles are to be dealt with. It states that arrangements should be made for the transport and waste treatment of the substances. It also specifies a duty to report for the respective Parties.

Table 1: List of POPs in accordance with the Stockholm Convention

Name	CAS number	C number	Annex to the Stockholm Convention
Aldrin	309-00-2	206-215-8	A
Chlordane	57-74-9	200-349-0	A
Chlordecone	143-50-0	205-601-3	A

4 An overview of the substances and background information on their fields of use is provided on the Internet site of the Stockholm Convention Secretariat.

Name	CAS number	C number	Annex to the Stockholm Convention
Dieldrin	60-57-1	200-484-5	A
Endrin	72-20-8	200-775-7	A
Heptachlor	76-44-8	200-962-3	A
Hexabromobiphenyl (HBB)	36355-01-8	252-994-2	A
Hexabromodiphenyl ether (HexaBDE) and heptabromodiphenyl ether (HeptaBDE); as main components of commercial (C)5-OctaBDE	68631-49-2 446255-22-7	207122-15-4 207122-16-5	A
Hexabromocyclododecane (HBCDD) (1,2,5,6,9,10-hexabromocyclododecane and its main diastereoisomers: alpha-hexabromocyclododecane; beta-hexabromocyclododecane; and gamma-hexabromocyclododecane)	25637-99-4 (3194-55-6, 134237-50-6 134237-51-7 134237-52-8)		A
Hexachlorobenzene (HCB)	118-74-1	204-273-9	A, C
Hexachlorobutadiene	87-68-3		A
α-hexachlorocyclohexane (α-HCH)	319-84-6	206-270-8	A
β-hexachlorocyclohexane (β-HCH)	319-85-7	206-271-3	A
γ-hexachlorocyclohexane (γ-HCH, lindane)	58-89-9	200-401-2	A
Pentachlorobenzene (PeCB)	608-93-5	210-172-0	A, C
Pentachlorophenol (PCP) and its salts and esters	87-86-5 131-52-2 27735-64-4 3772-94-9 1825-21-4		A
Polychlorinated naphthalenes (PCN), including di-, tri-, tetra-, penta-, hexa-, hepta- and octa-CNs			A, C
Technical endosulfan	115-29-7	204-079-4	A

5 Where c stands for *commercial*.

Name	CAS number	C number	Annex to the Stockholm Convention
Tetrabromodiphenyl ether (TetraBDE) and pentabromodiphenyl ether (PentaBDE); main components of commercial c-PentaBDE	40088-47-9 32534-81-9	254-787-2 251-084-2	A
Perfluorooctane sulfonic acid (PFOS), its salts and Perfluorooctane sulfonyl fluoride (PFOSF)	PFOS: 1763-23-1 Sulfonyl fluoride: 307-35-7	PFOS: 217-179-8 Sulfonyl fluoride: 206-200-6	B
Dichlorodiphenyltrichloroethane (DDT)	50-29-3	200-024-3	B
Toxaphene	8001-35-2	232-283-3	A
Mirex	2385-85-5	219-196-6	A
Polychlorinated biphenyls (PCB)	div.	div.	A, C
Polychlorinated dibenzo-p-dioxins (PCDD)	div.	div.	C
Polychlorinated dibenzofurans (PCDF)	div.	div.	C

2.2 European chemical regulations

2.2.1 POPs

As a Party to the Stockholm Convention, the EU has undertaken to implement the requirements of this policy. Implementation takes place within the framework of Regulation (EC) No. 850/2004 (named the POP Regulation in the following) of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants and amending Directive (Dir) 79/117/EEC.

At the fifth ***C**onference **o**f the **P**arties* – COP 5, endosulfan was included as a new POP. The required adjustment to the regulation was made with the following amending regulation:

- Commission Regulation (EU) No. 519/2012 of 19 June 2012 amending Regulation (EC) No. 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annex I

At the sixth Conference of the Parties (COP 6), hexabromocyclododecane (HBCDD) was included as a new POP. The required adjustment to the regulation was made with the following amending regulations:

- Commission Regulation (EU) No. 2016/293 of 01 March 2016 amending Regulation (EC) No. 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annex I
- Commission Regulation (EU) No. 2016/460 of 30 March 2016 amending Regulation (EC) No. 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annexes IV and V

Both the obligations of the Stockholm Convention and of the POPs Protocol[6] of the CLRTAP are implemented in the EU in directly enforceable law through the POP Regulation. The POP Regulation is also more specific about the requirements of the international agreement, for example, by defining specific limits for POP contaminants in new substances, preparations or articles placed on the market.

Article 3 of the POP Regulation regulates a fundamental ban on the production, placing on the market and use of substances listed in Annex I of the Regulation, whether on their own, in preparations or in articles[7]. According to Article 4 Para. 1, the only exemptions are small quantities (*laboratory scale*) of the substances for research purposes and substances occurring as *unintentional trace contaminants*. Annex I contains the substances listed in Annex A and B of the Stockholm Convention. In some cases, more precise conditions are stipulated for the presence of substances in articles and requirements for the recycling of substances or preparations.

Article 13 of the POP Regulation obliges the member states of the EU to issue sanctions applicable to infringements of the ban on the production, use and placing on the market of the substances in Annex I of the regulation. In Germany, these sanctions are implemented in the Chemicals Act (Chemikaliengesetz) and in the Chemical Sanctions Regulations (Chemikalien-Sanktionsverordnung).

For the substances tetra-, penta-, hexa- and heptaBDE, the limit value is 0.001 wt. % (10 mg/kg) as a constituent in substances (e.g. as contamination), in mixtures or in articles or flame protected constituents of articles. A limit of 0.1 wt. % applies if the mixture or the article (or the article constituent) wholly or partly consists of reused materials. A further deviation is allowed if the products fall under the regulatory scope of Directive 2002/95/EC (***R**estriction **o**f the use of certain **h**azardous **s**ubstances* – RoHS[8]). In addition, the POP Regulation allows the continued use of articles that were already on the market before 25 August 2010.

With the inclusion of PFOS in the Stockholm Convention and in the POP Regulation, for the first time a substance was included for which uses currently still exist and in which they cannot be substituted in the short-term. Accordingly, numerous exemptions were provided for the use of this substance and corresponding general conditions were set out in the POP Regulation.

The ban on the trading and use of HBCDD is implemented in the European Union (EU) in Annex I of the POP Regulation (Regulation (EC) No. 850/2004 on persistent organic substances). Since 22 March 2016, products (substances, mixtures and articles) containing more than 100 mg/kg HBCD can no longer be produced or placed on the market in the EU. By way of derogation, residual stocks of insulation materials could be sold and installed until 22 June 2016.

Furthermore, insulation materials made of EPS with HBCDD may be produced in the EU and used in buildings beyond this date, provided the manufacturer has an authorisation under the European Chemicals Regulation REACH. The same applies to insulation materials containing HBCD, which are imported from outside the EU. The exemption for the placing on the market and use of insulation materials made of EPS with HBCD is presently due to end on 21 February 2018 (6 months after the end of the review period of currently issued authorisations). However, sufficient EPS insulation materials without HBCD are already available, so that products containing HBCD should no longer be used (UBA 2016).

---

6 For this reason, the POP Regulation includes other substances such as polycyclic aromatic hydrocarbons (PAH), which are not covered in the Stockholm Convention.

7 The presence of a substance is not considered to be use of a substance. For this reason, chemical legislation defines further limit values for the marketability of articles that, for example, are imported or can contain a substance as contamination.

8 A RoHS-conformant component can contain up to 0.1 wt. % polybrominated biphenyls.

At the 7th Conference of the Parties (COP 7), three other substances were included in the Stockholm Convention: polychlorinated naphthalenes (PCN), pentachlorophenol, its salts and esters (PCP) and hexachlorobutadien (HCBD). PCN and HCBD were already included in the Regulation via the POPs Protocol of the CLRTAP, PCP still has to be included; however, PCP has no authorisation as a biocide in Europe and is therefore not used anymore anyway.

In addition to the existing general chemical legislation sanction system[9] in the Federal Republic of Germany, with the Chemical Sanctions Regulations (ChemSanktionsV), infringements, among other things, of the POP Regulation can be prosecuted as a criminal offence or can be punished as an administrative offence with a fine.

2.2.2 General European chemical legislation

The general framework for chemical substances in the EU is formed by Regulation (EC) No. 1907/2006, named the REACH Regulation and Regulation (EC) No. 1272/2008 on the Classification, Labelling and Packaging of Substances and Mixtures, named the CLP[10] Regulations, as implementation of the GHS at European level.

REACH is an acronym for ***R****egistration,* ***E****valuation,* ***A****uthorisation and Restriction of* ***Ch****emicals*. The registration of substances is a notification procedure. All substances with a production or import quantity of at least one tonne per year must be registered with the European Chemicals Agency (ECHA). The registration involves communicating various data, e.g. physiochemical data, data on effects on humans and the environment. The amount of data to be provided depends on the tonnage band. The quantity of data to be provided is more extensive for high-tonnage substances than for low-tonnage substances. To avoid unnecessary testing on animals, the registrants submit testing proposals for studies, for which no data is available to them. Transition periods up to 01 June 2018 exist for substances that were already on the EU market before September 1981 (existing substances), staggered by quantity bands and appropriate preregistration.

A further procedure of the REACH Regulation is the evaluation of Reregistration dossiers and the evaluation of substances. It is the responsibility of the ECHA to check the registration for completeness and correctness with regard to fulfilment of the formal requirements and any testing proposals submitted by the registrants. The substance evaluation, in which all information on an individual substance is checked with regard to its quality and conclusions are drawn on further risk management, is the task of the member states. The evaluation can end with identification as a ***S****ubstance of* ***V****ery* ***H****igh* ***C****oncern – SVHC*.

The third process of the REACH Regulation included in its name is authorisation: Substances which pose a particular risk to human health or the environment and which have been included in REACH Annex XIV, list of substances subject to authorisation, following a formal procedure, must be authorised before they can be used in the EU. In an application for authorisation, the applicant must describe control of the risk of this specific application with the help of a chemical safety report. If this is not possible for all risks, they have a further opportunity to justify the appropriateness of use of the substance as part of a socioeconomic analysis. Only in cases in which this is successful can an authorisation be granted. Otherwise, use is no longer possible beyond a certain date.

The following substances can be identified as substances of very high concern (SVHC):

---

9 Issue of official orders to remove infringements or to prevent future infringements of EC Regulations under chemical legislation according to § 23 Para. 1 in conjunction with § 21 Para. 2 Sentence 1 of the Chemical Act (Chemikaliengesetz) (ChemG) and the imposing of sanctions according to § 26 Para. 1 No. 10 (punishment with fines) and § 27d ChemG (confiscation of property (articles)) in case of noncompliance with an enforceable official order.

10 Classification, Labelling and Packaging of Substances and Mixtures – CLP.

- **c**arcinogenic, **m**utagenic, toxic to **r**eproduction – CMR substances;
- substances with ***p**ersistent, **b**ioaccumulative, **t**oxic* – PBT properties or with ***v**ery **p**ersistent, **v**ery **b**ioaccumulative* – vPvB); properties
- Substances in other groups, which give reason for similar concern (e.g. hormonally active or sensitising substances).

Substances in Annexes A – C of the Stockholm Convention are not dealt with as part of the REACH authorisation, but are subject to the POP Regulation. Nevertheless, the persistence, bioaccumulation and toxicity properties[11] of the substances are examined as part of the registration under REACH. The criteria for the evaluation of substances are given in REACH Annex XIII[12].

In addition, REACH regulates the procedure for restricting substances and thus repealed Directive 76/769/EEC (Restrictions on Marketing and Use Directive) as of 1 June 2009 (as per Article 139). Existing restrictions were incorporated in Annex XVII of the REACH Regulation (Article 137 Para. 3). Restrictions for the POPs: PFOS, PentaBDE and OctaBDE were incorporated in Annex XVII of REACH. With their inclusion in the Stockholm Convention and subsequent inclusion in the POP Regulation through Regulation (EU) No. 207/2011, the restrictions for PFOS and PentaBDE were deleted from Annex XVII, to avoid duplicate regulations in the EU. OctaBDE and polybrominated biphenyls (PBB) are currently included in both Annex XVII of REACH and in the POP Regulation.

The REACH regulation also describes requirements for communication in the supply chain regarding substances and preparations and substances of very high concern in articles. Information about dangerous properties[13] of substances and preparations and instructions on safe handling of them is issued to users of chemicals with the safety data sheet in accordance with Article 31 of the REACH Regulation. Information about substances and preparations that do not fulfil the dangerous criteria is provided according to Article 32 of the REACH Regulation. REACH does not specify a format for information required under Article 32. The format and content of safety data sheets is defined in Annex II of REACH and was updated by Commission Regulation (EU) Np. 453/2010 of 20 May 2010. This part of REACH thus repeals Directive 91/155/EEC (since 1 June 2007).

The CLP Regulation is closely intertwined with the REACH Regulation. It defines rules for the classification, labelling and packaging of hazardous substances and mixtures. The CLP Regulation replaced Directive 67/548/EEC (Dangerous Substances Directive) as the binding regulation for substances as of 1 December 2010, and Directive 1999/45/EC (Dangerous Preparations Directive) for mixtures as of 1 June 2015.

The European Chemicals Agency (ECHA) was established as part of the introduction of REACH. In addition to carrying out its REACH tasks, it also carries out tasks according to the CLP, Biocide and PIC Regulations. The member states are responsible for enforcing penalties for breaches against these regulations.

11 According to REACH, substances that, among other things, have a persistent, bioaccumulative and toxic or a very persistent and very bioaccumulative behaviour, can be identified as being of very high concern. Long-distance transport behaviour is not examined in REACH and is not a criterion for particular concern (unlike the case with POPs).

12 Last amended by Regulation (EU) No. 252/2011 of 15 March 2011.

13 A substance or preparation is hazardous if one of the criteria of Regulation (EC) 1272/2008 is fulfilled.

2.2.3 European regulations regarding plant protection products[14]

The authorisation of plant production products is uniformly specified throughout the EU in Regulation (EC) No. 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC (Plant Protection Product Regulation). A differentiation is made between the procedure for active substance testing at EU level and the procedure for the authorisation of the formulated plant protection products at member state level.

Active substances in plant protection products are tested at EU level. The European Commission and the member states decide whether an active substance is approved or not Inclusion of the substance in the positive list is one of the conditions for the ability of plant protection products with the respective active substance to acquire authorisation. Active substances, which have properties such as CMR, a harmful effect on the hormone system and PBT properties, cannot be included in the Annex to the regulation (Annex II Section 3). Equally, no substances classified as POP can be included in the annex.

An application for inclusion of an active substance in the annex to the regulation must be accompanied by an extensive dossier with data and tests (Article 7, 8). It requires documents on the physical and chemical properties, on analyses and on the efficacy, toxicology, residue behaviour, environmental behaviour and environmental effects (ecotoxicology). The studies must be performed according to specified testing guidelines by certified test bodies. This dossier is subjected to a *peer review* procedure and the submitted studies are examined critically.

The authorisation of plant protection products must be applied for in each of the member states in which it is to be placed on the market (Article 33). An extensive dossier must also be compiled for the application for authorisation, which is checked and decided upon by the competent authorities of the member states.

None of the substances included in Annexes A – C of the Stockholm Convention is authorised for use in plant protection products.

2.2.4 European biocide regulations

Regulations on dealing with biocides are defined in Regulation (EU) No. 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products.

A harmonised EU procedure is used to decide whether an active biocide substance is added to the list of active substances authorised at EU level. Approval of the active biocide substance is a precondition for the authorisation of biocide products. Thus, a two-stage procedure exists for the active substance assessment (responsibility of the EU) and formulated product authorisation (responsibility of the member states). None of the substances included in Annexes A – C of the Stockholm Convention is notified for active substance testing of biocides. Therefore, authorisation of biocide products that contain POPs is not permissible in Germany.

14 The list merely includes those regulations which, in their respective current version, have a reference to substances covered by the Stockholm Convention.

Similar to the requirements of the EU Plant Protection Products Regulations, substances with properties of very high concern are not approved in principle (exclusion criteria as per Article 5); however, exceptions are possible under particular conditions, but not for active substances that, as POP substances, fall under the EU POP Regulation. The member states can stipulate conditions for use within the scope of the product authorisation. Substances with PBT properties should be replaced as active biocide substances; they are only authorised if the counter-exceptions (conditions) in accordance with Art 5 Para. 2 apply, and then for 5 years only.

2.2.5 Import/Export regulations

Approvals for the import and export of hazardous chemicals are regulated in Regulation (EU) No. 649/2012 of the European Parliament and of the Council of 4. July 2012 concerning the export and import of dangerous chemicals (implementation of the Rotterdam Convention, ***P**rior **I**nformed **C**onsent* – PIC Reg.).

If a hazardous substance listed in Annex I of the regulation is exported to another country that is party to the Rotterdam Convention, the export country must register the substance with the authorities in the destination country. The destination country must then approve the import of the substance to their national territory. The substances in the annexes also include POPs (the various procedures of the regulation are regulated according to Articles 7, 10, 12, 13).

2.3 National legislative and regulatory provisions relating to chemicals

National environmental and chemical legislation is largely determined by EU law: either in the form of European regulations, but also partly through directives, which must then be implemented in national laws. In addition, the definition of responsibilities and regulation of enforcement of the requirements as a sovereign task, are covered within the scope of the national laws and sub-statutory provisions[15].

The central legal enactment element of German substance law is the Chemicals Act (Chemikaliengesetz (ChemG)). It implements or specifies in detail the provisions of the Biocide, REACH, CLP and PIC Regulations. The following regulations, with relevance for the regulation of POPs, are then appended to the Act:

- Hazardous Substances Regulation (Gefahrstoffverordnung (GefStoffV)): regulates the classification, packaging and labelling of hazardous substances as well as their handling and use,
- Chemical Ban Regulation (Chemikalien-Verbotsverordnung (ChemVerbotsV)): regulates the placing on the market of hazardous substances or rather the restriction of placing on the market,
- Biocide Approval Regulation (Biozid-Zulassungsverordnung (ChemBiozidZulV)): describe the approval of biocide products and other procedures under chemical legislation concerning biocide products and active biocide substances,
- Biocide Notification Regulation (Biozid-Meldeverordnung (ChemBiozidMeldeV)): states that all biocide products on the market in Germany must be reported to the approval body.

Provisions concerning the Plant Protection Product Regulation are included in the Law for the Protection of Cultivated Plants (Plant Protection Act))(Pflanzenschutzgesetz – PflSchG)).

15 e.g. as part of administrative regulations.

2.3.1 Responsibilities for legal tasks for chemicals

In the case of biocides and plant protection products, the central elements of the relevant law are enforced directly by higher federal authorities.

The Federal Office for Chemicals (Bundesstelle für Chemikalien - BfC), as Division 5 of the Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin - BAuA) has extensive responsibilities for implementing the REACH, Biocide and CLP Regulations. It works closely with other federal authorities as assessment bodies:

- the German Environment Agency (Umweltbundesamt - UBA) as the environmental assessment body,
- the Federal Institute for Risk Assessment (Bundesinstitut für Risikobewertung - BfR) as the assessment body for health and consumer protection and
- Division 4 within the Federal Institute for Occupational Safety and Health (BAuA) as the assessment body for the health and safety of employees.

Monitoring compliance with REACH, biocide and plant protection laws is the responsibility of the Federal States ("Länder"). Depending on the administrative organisation of the federal state "Land", the competencies can lie within the responsibility of different state (Land) authorities.

2.4 Legislative and regulatory provisions relating to industrial plants

2.4.1 European legislative and regulatory provisions relating to industrial plants

The directive on industrial emissions (IE DIR) Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 regulates integrated prevention and control of pollution occurring as a result of the industrial activities named in Annex I. The IE DIR came into force on 6 January 2011 and was fully implemented in national law.

It also provides regulations for prevention and, where this is not possible, to reduce emissions in air, water and soil and to prevent waste, in order to achieve a high protection level overall for the environment. In accordance with Article 13, BAT reference documents are produced for each type of installation named in Annex I. These reference documents contain conclusions about the best available techniques (BAT reference documents) and emission values associated with these techniques. These BAT conclusions must be bindingly used in national installation permits according to the requirements of the IE Directive. In the national implementation of the IR Directive, allowance is made, exceptional cases, for the setting of less strict emission limitations and deadlines in sub-statutory regulations or in installation permits, if application of the BAT conclusions and associated emission values would be disproportionate due to technical characteristics of the type of installation concerned.

Art. 21 Para. 3 of the IE Directive requires the implementation of BAT conclusions on site, including checking permit conditions and compliance with updated conditions by the respective installation within 4 years.

Water-specific parts of BAT conclusions are currently implemented through the wastewater regulations (Abwasserverordnung) and their annexes. Air-specific parts of BAT conclusions are implemented by means of the TA-Air (TA Luft).

Permits must at lease contain the pollutants in the list in Annex II of the Directive, but also all other polluting substances emitted by the respective installations, if their type and scope are relevant.

The list of polluting substances in Annex II of the IE Directive includes, among other things, the following air pollutants:

- Polychlorodibenzodioxins and furans
- Chlorine and chlorine compounds
- Fluorine and fluorine compounds

Annex II of the IE Directive includes, among other things, the following water pollutants:

- Organohalogen compounds and substances that form organohalogen compounds in the aquatic environment
- Substances and mixtures which have been proven to possess carcinogenic or mutagenic properties or properties which may affect reproduction in or via the aquatic environment
- Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances
- Biocides and plant protection products
- Substances in Annex X of Directive 2000/60/EC (Water Framework Directive – WFD) of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

It also includes substances of the Stockholm Conference.

Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, lays down rules for the prevention of major accidents which might result from certain industrial activities and the limitation of their consequences for human health and the environment. Installations in which particularly dangerous substances or mixtures are present or are likely to be present in quantities from those defined in Annex I of the directive fall under the regulations of this directive. The substances to be taken into account within the scope of the directive include, among other things, polychlorodibenzofurans and polychlorodibenzodioxins.

This directive is implemented in Germany primarily by the 12th Regulations for Implementation of the Federal Imissions Control Act (Control of Major Accident Hazard Regulations - 12th BImSchV)(Störfallverordnung – 12. BImSchV).

Comparable provisions are also included in the Convention on the Transboundary Effects of Industrial Accidents of 17 March 1992 of the United Nations Economic Commission for Europe (UNECE), which also applies in Germany.

2.4.2 National legislative and regulatory provisions relating to industrial plants

Plants (installations) which, by virtue of their nature or operation are particularly able to cause harmful environmental impact or endanger or substantially disadvantage or cause a substantial nuisance to the general public or the neighbourhood, require a permit under the Federal Immissions Control Act (Bundes-Immissionsschutzgesetz - BImSchG). Which plants and installations in detail require a permit has been defined on the basis of Article 4 Para. 1 Sentence 3 in the Regulations (4. BImSchV).

The Federal Government issues legal regulations and administrative regulations on implementation of the law on the basis of authorisations in Articles 47 and 48.

2.4.2.1.1 Technical instructions for air pollution prevention

The Technical Instructions on Air Quality Control of 24 July 2002 (TA Air) (TA Luft) are the first general administrative regulations of the Federal Immissions Control Act (BImSchG). These regulations serve to protect the general public and the neighbourhood from harmful environmental impacts caused by air pollution and precautions against harmful environmental impacts caused by air pollution, in order to achieve a high protection level for the overall environment.

TA Air (TA Luft) contains general and particular requirements for limiting emissions. The general emissions value for the mass concentration of PCDD/F in exhaust or flue gas must not exceed 0.1 ng/m^3 and the mass flow rate 0.25 µg/h, unless exceptions are allowed for specific plants or installations in the special section. The emissions of substances particularly harmful to the environment, such as substances that are carcinogenic, toxic to reproduction or mutagenic, and, for example, polybrominated dibenzodioxins and furans or polyhalogenated biphenyls, must be limited as far as possible, taking into consideration the principle of proportionality (emission reduction requirement No. 5.2.7 TA Luft).

The national statutory regulations with reference to POPs in legislation pertaining to installations include the following:

- First Regulations on Implementation of the Federal Imissions Control Act (BImSchG) (1. BImSchV)

The 1st Immission Control Regulations (1. BImSchV) (amended in 2010) regulates the erection and operation of small and medium-sized combustion plants. They are national regulations that are not based on an EU-wide regulation. Plants for solid fuels in particular can emit relevant quantities of POPs, including PCDD/F. The regulations contain limit values for PCDD/F for the use of so-called agricultural fuels (straw, cereals, other renewable raw materials), compliance with which must be verified on a test rig.

- Thirteenth Regulations on Implementation of the Imissions Control Act (13. BImSchV)

These regulations apply to the erection, nature and operation of combustion plants including gas turbine and gas engine installations and gas turbine and gas engine installations for driving working machines with a total rated thermal input of 50 MW or more, regardless of which fuels or types of fuels are used.

According to these regulations, if solid fuels including biofuels and liquid fuels (except light fuel oil) are used in combustion plants the emission limit value for PCDD/F is 0.1 ng TEQ /m^3 (WHO-TEF 2005). The 13th Immission Control Regulations (13. BImSchV) were amended on 2 May 2013. Existing plants must comply with the regulations' requirements from 1.1.2016.

- Seventeenth Regulations on Implementation of the Imissions Control Act (17. BImSchV)

These regulations regulate the requirements for the erection, nature and operation of incineration and co-incineration plants for the wastes and substances named in Article § 1. Accordingly, for example, an emission limit value for PCDD/F of 0.1 ng TEQ/m^3 (WHO-TEF 2005) applies to incineration plants.

The 17th Immission Control Regulations (17. BImSchV) were amended on 2 May 2013. Existing plants must comply with the regulations' requirements from 1.1.2016.

2.5 Legislative and regulatory provisions relating to water

2.5.1 European legislative and regulatory provisions relating to water

The Water Framework Directive of 2000 (Directive 2000/60/EC) (WFD), last amended by Directive 2014/101/EU establishes the European legal framework for the protection of water bodies. The WFD requires that all waters (surface, ground and coastal waters) reach or safeguard a good status by the end of 2015. Good chemical and ecological status must be achieved or safeguarded for surface waters, and good chemical and quantitative status for groundwater. The member states should achieve this through defined planning and management steps.

Good chemical status for surface waters is determined by environmental standards for 45 priority substances. The environmental standards result from the Priority Substances Directive of 2008 (Directive 2008/105/EC), last amended by Directive 2013/39/EU. The environmental quality standards for "priority substances" are to be complied with by 2021, the new or amended quality standards in Directive 2013/39/EU by 2027. Only release controls until compliance with the environmental quality standards is achieved are provided for "priority substances". The discharges, emissions and losses of "priority hazardous substances" are to be ceased or phased out in accordance with Art. 16 Para. 6 WFD (see below)

The following POPs are included in Annex 1 of the Priority Substances Directive:

- Hexachlorobenzene (HCB)CB,
- Endosulfan,
- Hexachlorobutadiene,
- Pentachlorobenzene (PeCB),
- Pentachlorophenol (PCP)
- Cyclodiene,
- Hexachlorohexane (HCH) (isomer mixture, including lindane),
- Brominated diphenyl ethers (whereby not all brominated diphenyl ethers are POPs)
- DDT
- Perfluorooktansulfanate (PFOS) (new)
- Dioxins (new)
- Hexabromocyclododecane (HBCDD) (new)

The following POP candidates are already priority hazardous substances.

- C10-13 chloroalkanes

According to the Groundwater Directive of 2006 (Directive 2006/118/EC), last amended by Directive 2014/80/EU, good groundwater chemical status is determined firstly by groundwater quality standards, which result from the named directive (Annex II), and secondly by threshold values, which the member states must define for the pollutants listed in the directive (Annex II).

Annex I of the Groundwater Directive names a general groundwater quality standard for active substances in pesticides of 0.1 µg/l. This parameter also covers possible POP contamination of the groundwater. Other threshold values for additional pollutants are based on the initial contamination level in the individual case and must be defined by the member states.

The member states must take suitable measures to maintain or achieve a good status in surface waters and in the groundwater. This commitment goes beyond the requirements of the Stockholm Convention, as it also requires the remediation of waters contaminated with POPs.

The WFD and the Groundwater Directive also contain special regulations for the input of harmful substances into waters.

For example, the WFD commits the Commission to presenting proposals for ceasing or phasing out discharges, emissions and losses of priority hazardous substances. The necessary measures must be taken at EU level; in addition to which, the member states are obliged to implement this requirement of the WFD.

As the above-named POPs are also priority hazardous substances, the phasing-out obligation also applies to them. To date, neither the EU nor the member states have taken any specific measures for implementing the phasing-out obligation.

The phasing-out obligation for the named POPs is in fact, at least in part, implemented by the EU POP Regulation. Here systematic monitoring of the waters is an instrument for measuring the success of any measures and acts as a safety net.

According to Art. 6 of the Groundwater Directive, the input of certain groups of substances is basically prohibited. The substance groups are named in Annex 8 of the WFD. Some substance groups, for example, the organohalogen compounds, include POPs.

2.5.2 National legislative and regulatory provisions relating to water

The WFD is implemented in Germany through the Federal Water Management Act (Wasserhaushaltsgesetz - WHG) and appended regulations, e.g. the Groundwater Regulations (Grundwasserverordnung - GrwV) of 2010 and the Surface Water Regulations (Oberflächengewässerverordnung of 2016 - OGewV). In Germany, the obligation to achieve good chemical status results from the named legislative acts. The GrwV and the OGewV provide the relevant quality standards. The requirements for the above-named POPs are also found here. Because the two regulations are substance-related provisions, the Länder cannot deviate from them.

Use of waters is subject to preventive state control; that is to say, it requires a state permit before its implementation. The introduction or discharge of substances into water constitutes use as defined in Article 9 Para. 1 No. 4 WHG, for which a water permit is required. Uses also include measures that can cause disadvantageous changes to water quality that are permanent or substantial in extent (Article 9 Para. 2 No. 2 WHG). Uses are only permissible provided no harmful water changes are to be expected, which also cannot be prevented or compensated for by auxilliary provisions (Article 12 Part. 1 No. 1 WHG) and requirements under other public law regulations are fulfilled (Article 12 Para. 1 No. 2 WHG). On discharging wastewater, state-of-the-art standards of emission prevention and reduction must be observed as a minimum requirement (Art. 57 Para. 1 No. 1 WHG).

In addition, the granting of a water permit is at the due discretion of the authority. The authorities can thus, for example, set further requirements in an individual case for water ecology reasons.

2.5.2.1.1 Competencies for legislative and regulatory tasks relating to water

The legal requirements regarding water management are defined by the Federal Government in the Water Management Act and its statutory regulations. The Länder can supplement or deviate from these federal requirements through state laws, unless they are substance or plant/installation related requirements. The Länder are solely responsible for enforcement of the requirements relating to water.

2.6 Legislative and regulatory provisions relating to soil conservation

2.6.1 European legislative and regulatory provisions relating to soil conservation

The draft Soil Framework Directive of 2006 was withdrawn by the EU Commission in 2014, after it became clear that the blocking minority of five states, including Germany, would continue.

EU soil conservation policy therefore continues to result from the following legally non-binding documents:

- Thematic Strategy for Soil Protection of 2006
- European Commission Report on Implementation of the Thematic Strategy of 2012
- Soil conservation related statements of the 7th Environment Action Programme

Several provisions with soil conservation relevants can be found in EU secondary legislation, for example the Industrial Emissions Directive of 2010.

2.6.2 National legislative and regulatory provisions relating to soil conservation

In Germany, a law for the protection of the soil and corresponding national regulations exist:

- BBodSchG – Federal Soil Conservation Act (Bundes-Bodenschutzgesetz) (Law on Protection Against Harmful Soil Changes and the Remediation of Contaminated Land of 17 March 1998),
- BBodSchV – Federal Soil Conservation and Contaminated Land Regulations (Bundes-Bodenschutz- und Altlastenverordnung) of 12 July 1999.

The purpose of the BBodSchG and BBodSchV is to safeguard or restore the functions of the soil. Giving due regard to existing and future requirements for use of the soil, hazards to soil and hazards to individuals or the general public caused by soil must be prevented.

The BBodSchG and BBodSchV, above all, regulate the standards and necessary procedural steps for the investigation and remediation of harmful soil changes and contaminated land. In this contest, two types of soil values are relevant, which also include POPs.

- Screening levels
  If screening levels (trigger values) are exceeded, case-by-case testing must be performed, taking into account the soil use, to determine whether a harmful soil change or contaminated land exists. Annex 2 BBodSchV defines screening levels for the soil – human and soil – groundwater migration path for aldrin, DDT, HCB, HCH and PCB6 (total of six indicator congers).
- Action values
  If these exposure or contamination levels are exceeded, taking into account the respective soil use, it can generally be assumed that harmful soil change or land contamination exists and actions are required. Annex 2 BBodSchV defines action values for the soil – human migration path for PCDD/F and for the soil - plant path for PCB6.

In the case of contaminated sites or harmful soil changes, soil conservation law requires that soil in which the designated action and screening levels for substances, which are also POPs, are exceeded be remediated to prevent hazards. In this respect, soil conservation law goes beyond the requirements of the Stockholm Convention. Protection and restriction measures can only be applied if remediation measures are not proportionate.

In addition, the BBodSchG also establishes a commitment to soil related precautions. BBodSchV specifies precautionary values, which are defined as follows.

- Precautionary values
  If these levels are exceeded, taking into account geogenic[16] or extensive human settlement-related contaminant levels, in general it can be assumed that there is a cause for concern with regard to harmful soil change. Precautionary values are defined in 2 BBodSchV for PCB6 and PAHs and dioxins in the soil.

Land owners and the holders of actual control of a plot of land and those who carry out or arrange for the carrying out of works on a plot of land, which can result in a change in the soil quality, are obliged to observe the precautionary values in case of soil related activities.

According to case law, the screening and action values resulting from BBodSchV, must also be taken into account in the implementation of other laws, e.g. mining law.

The Sewage Sludge Regulations (Klärschlammverordnung - AbfKlärV) also have effects on soil conservation. Art. 4 Para. 10 and 11 of these regulations specifies the limit values given in table 2. for the PCDD/F and PCB substance groups and a limit value for total organohalogen compounds (AOX)[17]. If one of these limit values is exceeded, it is prohibited to spread sewage sludge on agricultural land or land used for gardening.

Table 2: Limit values for POP according to the sewage sludge regulations

Parameter	Limit value
PCB, each individual component of 6 PCB6 (calculated: 6 x 0.2 mg/kg x 5)	0.2 mg/kg DM (6 mg/kg DM)
PCDD/F (TEQ)	100 ng/kg DM
Organohalogen compounds as AOX	500 mg/kg DM

2.6.2.1.1 Responsibilities for soil conservation legislative and regulatory tasks

The Federal Government has exercised its legislative poweer regarding soil conservation by enacting the BBodSchG and BBodSchV. Enforcement of the BBodSchG and the BBodSchV lies within the competence of the Länder, which can also issue additional procedural regulations (BMUB 2017). Where sewage sludge is concerned, the competent authorities in the Länder can extend the investigation obligation to other constituents (§ 3 Abs. 5 AbfKlärV).

2.7 Legislative and regulatory provisions relating to waste

2.7.1 International provisions

At internation level, the Basel Convention in particular is relevant, as it constitutes a global control system for transboundary movements of hazardous waste. It provides for a ban of exports of hazardous waste from OECD states to non-OECD states, which has not yet become effective in internation law, as it

16 i.e., natural substance levels in environmental compartments, independent of human activities, e.g. salt level in water bodies or heavy metal levels in soil, as opposed to anthropogenic substance levels, in other words, substance quantities input due to human activities.

17 The parameter AOX for the sum of adsorbable organic halogen compounds also includes POP, but due to the wide range of substances covered has little informative value. Furthermore, by definition, it does not include any fluoride compounds (e.g. PFOS).

has not been ratified by a sufficient number of party states. Howeverm it has already been implemented by the EU and Germany (Sander & Schilling 2010).

To date, seven technical guidelines on environmentally sound disposal of waste containing POPs have been drawn up within the scope of the Basel Convention. In addition, the Secretariat of the Basel Convention and the European Correspondents Guidelines have published training documents (Secretariat of the Basel Convention 2015; EC 2011), including

- *Updated general technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (POPs)*, Secretariat of the Basel Convention 2015
- *Technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with polychlorinated biphenyls polychlorinated terphenyls or polybrominated biphenyls* including hexabromobiphenyl, Secretariat of the Basel Convention 2015,
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride, Secretariat of the Basel Convention 2015,
- Technical guidelines on the environmentally sound management of wastes containing or contaminated with unintentionally produced polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, hexachlorobenzene, polychlorinated biphenyls or pentachlorobenzene, Secretariat of the Basel Convention 2015,
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with hexabromocyclododecane, Secretariat of the Basel Convention 2015,
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with hexabromodiphenyl ether and heptabromodiphenyl ether, or tetrabromodiphenyl ether and pentabromodiphenyl ether, Secretariat of the Basel Convention 2015,
- Technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with the pesticides aldrin, alpha hexachlorocyclohexane, beta hexachlorocyclohexane, chlordane, chlordecone, dieldrin, endrin, heptachlor, hexachlorobenzene, lindane, mirex, pentachlorobenzene, perfluorooctane sulfonic acid, technical endosulfan and its related isomers or toxaphene or with hexachlorobenzene as an industrial chemical, Secretariat of the Basel Convention 2015,
- Destruction and decontamination technologies for PCBs and other POPs wastes (UNEP undated),
- Contact Point Guidelines No. 5 on classification of wood waste under entries B3050 or AC170 (Anlaufstellen 2007).

2.7.2 European legislative and regulatory provisions relating to waste

The following provisions under European Union law, each in their respective current versions, are relevant within the scope of POPs and waste:

- Regulation (EC) No. 850/2004 on persistent organic substances and amending Directive 79/117/EEC,

- Directive 96/59/EC on the on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT),
- Directive 2008/98/EC on waste and repealing certain Directives (Waste Framework Directive),
- Regulation 1357/2014 replacing Annex III to Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives
- Regulation (EC) No. 1013/2006 on shipments of waste (Waste Shipment Regulation),
- Directive 1999/31/EC on the landfill of waste (Landfill Directive),
- Council Decision of 19 December 2002 establishing criteria for the acceptance of waste at landfills (2003/33/EC),
- Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)(new version),
- Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (new version, RoHS Dir),

Regulation 850/2004 states that the upper limit values do not apply to underground storage, see footnote 1 in the table in Annex V, Part 2:

> "These limits apply exclusively to a landfill site for hazardous waste and do not apply to permanent underground storage facilities for hazardous wastes, including salt mines."

Otherwise the given regulation lists upper limits for many POPs.

2.7.3 National waste legislation

According to the Landfill Regulations (Deponieverordnung), in Germany, waste containing POPs, i.e. waste in which the lower limit in Annex IV of Regulation (EC) No. 850/2004 is exceeded, cannot be disposed of above ground, i.e. they can only be disposed of (stored) in underground waste repositories (all created in salt rock) or through mine filling (stowage) in salt rock. The upper limit values therefore do not play a role in the disposal practice for waste containing POPs in Germany.

Since 11 March 2016, through the European Waste Register (Waste Register Regulations - (Abfallverzeichnisverordnung - AVV), the German regulations contain a direct connection to the POP Regulation in the form of a dynamic link (see Waste Register Regulations, subsection 2.2.3.). According to AVV, accordingly, all waste containing POPs that exceed the lower limit in Annex IV of the EU POP Regulation, are deemed to be hazardous and subject to the provision of mandatory documented proof.

German waste law includes requirements for the collection, storage, transport (including transboundary transport), recovery, disposal of waste, provision of documented evidence and waste treatment plants and disposal companies.

The Law on the Promotion of the Recycling Economy and Ensuring Environmentally Sound Management of Waste (Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen) (Recycling Management Act) (Kreislaufwirtschaftsgesetz - KrWG) of 24 February 2012 came into force on 1 June 2012. In contrast to the previous law, it contains a hierarchy of waste treatment measures. For the disposal of waste containing POPs it is significant, in particular that "taking into consideration the principle of precaution and sustainability, those measures that best ensure protection of humans and the environment (should) have priority. Consideration of effects on humans and the environment according to sentence 1 shall be based on the entire life cycle of the waste" (Art. 6).

Explanations on the disposal of waste containing POPs are given in Section 6.3 of this implementation plan.

2.7.3.1.1 Competencies for legislative and regulatory tasks relating to waste

The Länder are responsible for enforcement of waste law, and can individually regulate the tasks and internal state competencies. In several Länder, an obligation to offer or to hand over exists for hazardous waste [18].

Regarding transboundary shipments of waste, according to Art. 14 Para. 1 of the Waste Shipment Act (Abfallverbringungsgesetz - AbfVerbrG), the authorities of the Länder are responsible for measures and obligations related to the shipment of waste from and into federal territory. These Länder authorities are published on an internet site (UBA 2017). According to Art. 14 Para. 4 AbfVerbrG, the German Environment Agency is responsible for transits.

2.8 Provisions in food and feed legislation

2.8.1 European provisions

In the EU, food and feed law is regulated by several regulations. Regulation (EC) No. 178/2002 sets out the fundamental, general food law. It also contains provisions for establishing the EFSA, European Food Safety Agency. This agency works with the national authorities, in Germany with the BVL and the BfR, in the area of risk assessments. The regulation establishes the basis for the protection of human health and consumer interests regarding food. It defines uniform principles and competencies with regard to the creation of a basic scientific foundation, an efficient organisational structure and a procedure for strengthening decision-making in matters of food and feed safety. The regulation applies to all production, processing and distribution stages of food and feed. If it is suspected that food or feed presents a risk to human or animal health, according to Article 10, the general public must be informed of the nature of the risk.

Regulation (EC) No. 396/2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin is very important for implementation of the requirements of the Stockholm Convention, as many POPs are used as pesticides. Annexes II and III of the Regulation define maximum residue levels - MRLs for aldrin, chlordane, chlordecone (kepone), DDT, dieldrin, endosulfan, endrin, HCB, HCH, heptachlor and toxaphene.

Also, Regulation (EEC) 315/93 defines Community procedures for the control of contaminants in food. Contaminant means any substance not intentionally added to food which is present in such food as a result of the production of such food or as a result of environmental contamination. It does not name specific substances; however, Article 2 Paragraph 3 states that the Commission can define maximum tolerances for specific contaminants. It initially did this with Regulation (EC) No. 194/97, which was replaced by the third new version Regulation (EC) No. 1881/2006 on 1 March 2007. This regulation gives maximum levels for PCDD/F and dioxin-like PCB (dl-PCB) for specific foods. On 1 January 2012, Regulation (EU) No. 1259/2011 came into force with new maximum levels.

18 Further information can be found at http://www.info-ags.de/.

Table 3: Since 1 January 2012, action values[19] and maximum levels for dioxins and dioxin-like PCBs (dl-PCB) in selected food groups apply throughout Europe

Food	EU action values (pg WHO-TEQ/g fat) Kopfzeile		EU maximum levels (pg WHO-TEQ/g fat Kopfzeile	
Poultry	**Dioxins**	**dl-PCB**	**Dioxins**	**Dioxins + dl-PCB**
Meat and meat products	1.25	0.75	1.75	3.0
Oils and greases	–	–	1.75	3.0
Chicken eggs and egg products	1.75	1.75	2.5	5.0
Beef and lamb	**Dioxins**	**dl-PCB**	**Dioxins**	**Dioxins + dl-PCB**
Meat and meat products	1.75	1.75	2.5	4.0
Oils and greases	–	–	2.5	4.0
Milk and milk products, including butterfat	1.75	2.0	2.5	5.5
Pork	**Dioxins**	**dl-PCB**	**Dioxins**	**Dioxins + dl-PCB**
Meat and meat products	0.75	0.5	1.0	1.25
Oils and greases	–	–	1.0	1.25
Animal products	**Dioxins**	**dl-PCB**	**Dioxins**	**Dioxins + dl-PCB**
Liver and its processed products of poultry, cattle, sheep and pigs	–	–	4.5	10.0
Mixed animal fat	1.0	0.75	1.5	2.5

Dimensional unit: 1 pg (pikogram) = 0.000 000 000 001 gram

The maximum levels are supplemented by voluntarily applicable action values for the substance group of dioxins and for dioxin-like PCBs in various food. The action values are below the maximum levels and serve as an early warning system. They are intended to help to find high above-average contaminations, i.e. contamination above the so-called background contamination that is unavoidable for food producers, and help to reduce the level of dioxins and PCBs in food. They serve as an aid to finding and restricting or removing local sources of possible contamination before the maximum level is exceeded. Dioxins and dioxin-like PCBs are emitted from different sources. Separate action values were therefore defined for each substance group.

Directive 2002/32/EC defines maximum levels of undesirable substances in animal feed. Maximum levels for aldrin, chlordane, DDT, dieldrin, endosulfan, endrin, HCB, HCH, heptachlor, dl-PCB, PCDD/F and toxaphene on specific animal feedstuffs are anchored here. It also defines action thresholds for PCDD/F and dl-PCB, which if exceeded, triggers investigation by the member states.

19 Commission Recommendation of 23 August 2011 on the reduction of the presence of dioxins, furans and PCBs in feed and food (2011/516/EU; Official Journal of the European Union No. L 218, p. 23-25)

2.8.2 National provisions

In Germany, the Food, Commodities and Animal Feed Statute Book (Lebensmittel-, Bedarfsgegenstände- und Futtermittelgesetzbuch - Food and Feed Code) (Lebensmittel- und Futtermittelgesetzbuch – LFGB) is the overarching act on German food and feed law. It includes all production and processing stages along the food added-value chain and also applies to cosmetics and commodities. According to Art. 9 Para. 1, it is prohibited to place food on the market,

- if plant protection products, fertiliser, soil treatment products, biocide products or their conversion or reaction products are present in or on food and exceed the defined maximum levels,
- if unauthorised plant protection products are in or on food, or products which may not be used in food or its raw materials,
- which do not comply with the requirements of Article 18 Para. 1, including in conjunction with Article 20 Para. 1, of Regulation (EU) 396/2005 on maximum levels of pesticide residues.

The Regulations on the Limitation of Contaminants in Food (Verordnung zur Begrenzung von Kontaminanten in Lebensmitteln) (Contaminant Regulations) (Kontaminantenverordnung – KmV) give maximum levels for PCB on specific food, which must not be exceeded.

According to Art. 17, it is prohibited to produce or handle feed so that food obtained from animals that have been fed as intended and properly

- can impair human health,
- are unsuitable for consumption by humans.

It is also not permitted to produce animals feedstuffs in such a way that they harm animal health or impact the quality of the food produced or endanger the ecosystem due to undesirable substances present in animal excretion products. Animal feedstuff may not be placed on the market or fed to animals if they are likely to impact the quality of the food produced or endanger the ecosystem due to undesirable substances present in animal excretion products.

The European Directive 2002/32/EG on undesirable substances in animal feed has been implemented in national law with the Feed Regulations (Futtermittelverordnung - FuttMV). Accordingly, it is projhibited to place on the market, feed or mix with other feedstuffs with the intention to dilute, feed which exceeds a maximum level given in Directive 2002/32/EC (§ 8 FuttMV).

2.8.2.1.1 Competencies for food and feed legislative and regulatory tasks

Food and feed law is the responsibility of the Federal Ministry of Food and Agriculture (BMEL). The authorities in the Länder are responsible for the monitoring measures required under the LFGB. The Länder can issue further regulations for implementation of the monitoring.

The food and feed companies themselves are obliged to notify the competent authorities of existing test results for levels of dioxins/furans, dl-PCB and non-dl PCB in or on food and feed. These authorities then forward all the results they have to the BVL.

The precise range of notification obligations and how and to what extent this notification must specifically take place in practice has been regulated since 1 May 2012 by the "Regulation on Duties to Notify and Pass On Information on Substances Undesiable for Health" ("Verordnung zu Mitteilungs- und Übermittlungspflichten zu gesundheitlich nicht erwünschten Stoffen" (BGBl. 2012 I S. 58)).

Since 4 August 2011, as part of an amendment to the Food and Feed Statute Book in Germany, a general duty to report has applied to private laboratories, if they have reason to assume that an unsafe food or feedstuff is on hand. If this is the case, private laboratories are obliged to report their analysis results and the client who requested the analyses without delay to the competent authorities.

2.9 Implementation of environment-related requirements by official bodies

The Conference of the Ministers of the Environment (Umweltministerkonferenz - UMK) coordinates superordinate environmental law issues between the Federal Government and the Länder in Germany (UMK 2011). The ministers and senators of the environment of the Federal Government and Länder are represented on the committee with voting rights. In the UMK the Länder agree their approach, take a position vis-a-vis the Federal Government and together with the Federal Government, seek mutually agreed solutions to substantive issues. The resolutions of the UMK have no direct legal effect. The UMK currently has eight Federal / Länder working committees set up within its area of competence, which cover the different environmental topics. The following are of relevant in the context of the statutory principles and POPs described above:

- Joint Working Group of the Federal Government/ Länder on Chemical Safety (Bund/Länder-Arbeitsgemeinschaft Chemikaliensicherheit (BLAC)),
- Joint Working Group of the Federal Government/ Länder on Soil Conservation (Bund/Länder-Arbeitsgemeinschaft Bodenschutz (LABO)),
- Joint Working Group of the Federal Government/ Länder on Immission Control (Bund/Länder-Arbeitsgemeinschaft Immissionsschutz (LAI)),
- Joint Working Group of the Federal Government/ Länder on Water (Bund/Länder-Arbeitsgemeinschaft Wasser (LAWA)),
- Joint Working Group of the Federal Government/ Länder on Waste (Bund/Länder-Arbeitsgemeinschaft Abfall (LAGA)),
- Joint Working Group of the Federal Government/ Länder on DIOXINS (Bund/Länder-Arbeitsgruppe DIOXINE) (reactivation planned).

Reference is made here to the exemplary work of the LAGA, which has drawn up the following POP-relevant publications and has made decisions.

- LAGA Circular Resolution No. 2010/04: The LAGA recommends to the Länder that by way of transition the value of 1000 mg/kg, be used as the sum parameters as a lower limit for the four PBDEs (tetra, penta, hexa and hepta-BDE) in Annex IV of Regulation (EC) No. 850/2004.
- Resolution regarding TOP 5.4 of the 95th LAGA meeting: The LAGA recommends to the Länder that by way of transition a value of 10 mg/kg (recycling) and a value of 50 mg/kg (above-ground landfill) be used as a lower limit for PFOS (perfluorooctansulphonate and its derivates), in Annex IV of Regulation (EC) No. 850/2004 ,
- Report to the “Amtschefkonferenz” (conference of Secretaries of State of the Federal Government and Länder): Persistent organic pollutants in waste legislation enforcement (Persistente organische Schadstoffe im abfallrechtlichen Vollzug) (LAGA 2010).

3 Measures to reduce or eliminate releases from intentional production and use (Article 3)

3.1 Substances in Annex A of the Stockholm Convention

Compounds of several substances in Annex A of the Stockholm Convention have mainly been used as protection against insects, fungi and arachnids (especially mites). They were therefore constituents of plant protection product formulations, biocides for the protection of materials (e.g. wood), hygiene products or veterinary medicinal products (control of mites, ticks, lice, etc.). In Germany or rather at European level, their use was subject to special statutory provisions.

3.1.1 Plant protection products

In Directive 79/117/EEC, the member states were obliged to ban the placing on the market and use of plant protection products that contain specific active substances. Aldrin, chlordane, dieldrin, endrin, heptachlor, HCB, toxaphene, HCH and DDT were affected by this ban. Furthermore, active substances in plant protection products had to be tested in accordance with Directive 91/414/EEC (Plant Protection Directive) and included in a positive list. None of the POPs were included in the positive list. The Prohibition Directive 79/117/EEC was amended by the coming into force of the POP Regulation, in that the ban on chloride compounds was deleted and the ban of the POP Regulation was applied. With the addition of new POPs and the exclusion of substances with POP properties for use as an active substance within the framework of the Plant Protection Product Regulation, a general ban exists on the use of all POPs in plant protection. Directive 79/117/EEC was repealed by the Plant Protection Product Regulation (EC) No. 1107/2009.

With the exception of mirex and endosulfan, use of the named active substances had already been banned in the Federal Republic of Germany for many years, through the Regulations on the Use of Plant Protection Products of 10 November 1992 (Plant Protection Use Regulations) (Pflanzenschutz-Anwendungsverordnung). However, plant protection products containing mirex had never been authorised in Germany. The last authorisation for a plant protection product containing endosulfan in Germany ended in 1994. An application for inclusion of endosulfan in Annex I of the Plant Protection Directive failed in 2005, following which, authorisations for plant protection products containing endosulfan were withdrawn throughout Europe (Decision 2005/864/EC). Endosulfan was exported from Germany up to the end of 2009 (BVL 2009).

The substance PeCB was never used as a plant protection product itself, but was used as an intermediate product for the production of another plant protection product, pentachloronitrobenzene (quintozene). The last authorisations for plant protection products containing this active substance in Germany ended in 1987. Since 1988, a general ban on the use of quintozene in plant protection products has existed in Germany (Annex 1 of the Plant Protection Use Regulations) (Pflanzenschutz-Anwendungsverordnung). No production or use of PeCB is known of since 1988. As a result of the EU active substance examination for plant protection products, quintozene was not included in Annex I of Directive 91/414/EEC (Commission Decision 2000/816/EC).

3.1.2 Biocide products

According to the Biocide Reporting Regulations (Biozid-Meldeverordnung) (ChemBiozidMeldeV) none of the substances covered by the Stockholm Convention have been registered as an active substance in Germany. There is thus no basis for continued legal use. It can therefore be assumed that there are no biocide products containing these active substances on the market.

This statement also applies to the newer POPs, α- and β-HCH. Both compounds can be found as contamination in another POP, lindane. Lindane has merely been notified as an active substance for product group 3, biocide products for veterinary medicine. Lindane was still authorised for use in products against head lice (Jacutin gel) until the end of 2007 (UBA 2007a). Due to the identification of lindane as a POP and its associated inclusion in the POP Regulation, a complete ban exists on the use of lindane, without exception. Another substance that is one of the new POPs and was used as an insecticide, chlordecone, was still listed as an active substance in a product for control of pharaoh ants until 2001, but was banned in 2002 at the instigation of the UBA with reference to implementation of the POP Protocol (BMU 2004b).

3.1.3 Polychlorinated biphenyls (PCB)

Until 1982, PCBs were produced in West Germany on an industrial scale. They were used as insulation fluids in transformers and capacitors, as plasticisers in plastics (joint sealing compounds, ceiling cladding, cable sheathing and similar uses), as a flame retardant in wall paints, lacquers, adhesives and in hydraulic oils.

Since 1978, use of PCBs was phased out gradually until the last transformers containing PCBs had to be taken out of service in 2010. At that time, these were the only still permissible exemption from a complete PCB ban and had to be disposed of following their use, whereby irreversible destruction or disposal of the PCB is specified from a PCB level of 50 mg/kg (Article 7 POP Regulation in conjunction with Annex IV). According to Art. 54 Para. 2 GefStoffV, in transitional regulations, such products in operation on 29 July 1989 and in which components containing PCB are installed that contain less than 100 ml liquid containing PCB are exempted until they are taken out of service.

3.1.4 Hexabromobiphenyl (HBB)

HBB was used as a flame retardant in the 1970s. Production of highly brominated compounds ended in Germany in 1985 (UNEP 2006). Europe-wide, use of HBB in textiles has been restricted since 1983 by Directive 83/264/EEC (as part of the higher level PBB substance group) and was implemented in Germany as part of the Chemical Ban Regulations (Chemikalien-Verbotsverordnung - ChemVerbotsV). Also within the provision of a regulation on PBB, since 2006, the RoHS Directive has banned the placing on the market of products containing more than 0.1 percent of the homogeneous material (Article 4 in conjunction with Annex). PBBs were already no longer used in electrical equipment before this date (UBA 2007b). Other uses are not known. It can therefore be assumed that these facts together with the legal provisions lead to HBB not playing a role in Germany.

3.1.5 Polybrominated diphenylethers (PBDE)

The PBDE family contains more than 200 compounds. In the context of this report, use of the abbreviation PBDE refers to the four congener groups, which are regulated in the Stockholm Convention (UNEP 2009a; UNEP 2009b). These four substances are:

- TetraBDE[20]
- PentaBDE[21]
- HexaBDE[22]

20 According to SC 4/18 it primarily means BDE-47, CAS No: 40088-47-9, but also includes other cogeners.

21 According to SC 4/18 it primarily means BDE-99, CAS No: 32534-81-9, but also includes other cogeners.

22 According to SC 4/18 it primarily means BDE-153, CAS No: 68631-49-2, BDE-154, CAS No: 207122-15-4, but also includes other cogeners.

- HeptaBDE[23]

In the past, PBDEs were used in different commercial mixtures. The two mixtures mainly used were C-PentaBDE, with main constituents tetra- and pentaBDE and the two other POPs, hexa- and heptaBDE in smaller proportions. The other mixture was C‑OctaBDE, whose main constituents are hexaBDE and heptaBDE and that contains smaller quantities of pentaBDE. The typical composition of C-PentaBDE is shown in Tab. 4.

Table 4: Composition of C-PentaBDE (UBA 2011a)

Name	CAS number	Congener designation**	Typical concentration in the mixture (wt. %)*	Mean concentration (wt. %)
TriBDE	49690-94-0	BDE17 BDE28	0–1	0.5
TetraBDE	40088-47-9	BDE47 BDE66	24-38	32.3
PentaBDE	32534-81-9	BDE99 BDE85 BDE100	50-62	58.4
HexaBDE	36483-60-0	BDE138 BDE153 BDE154	4-12	8.3
HeptaBDE	68928-80-3	BDE183	Traces (<0.5)**	0.5

Data basis: *POPRC (2005), **Bergmann (2007), greyed-out rows contain information on substances covered by the Stockholm Convention

The composition of C-OctaBDE varies greatly and has changed over the years. Tab. 5 gives an overview of this.

Table 5: Composition of C-OctaBDE mixture over time (UBA 2011a)

	up to 1994 (wt. %)	Sample from three suppliers, 1997 (wt. %)	Voluntary Self-undertaking of industry OECD, 2000 (wt. %)	Selected manufacturers 2000 - 2001 (wt. %)	Mean concentration (wt. %)
PentaBDE	10.5–12.0*	n/s	1.4-12	< 0.5	4.7%
HexaBDE		5.5	n/s	< 12	7.4 %
HeptaBDE	43.7 – 44.5	42.3	43 – 58	< 45	44.5 %
OctaBDE	31.3 – 35.3	36.1	26 – 35	< 33	31.6 %
NonaBDE	9.5 – 11.3	13.9	8 – 14	< 10	10.7 %
DecaBDE	0 – 0.7	2.1	0 – 3	< 0.7	1.1 %

23 According to SC 4/18 it primarily means BDE-175, CAS No: 446255-22-7, BDE-183, CAS No: 207122-16-5, but also includes other cogeners.

Data basis: POPRC (2008), greyed-out rows contain information on substances covered by the Stockholm Convention, (n/s not specified)

The States that are Party to the Stockholm Convention are obliged to prevent production and use of PBDEs. Until 2030, the recycling of waste (end-of-life) products containing PBDE and use and disposal of products made of recycled materials are exempted from this, under the condition that the recycling and disposal are environmentally sound and that no PBDEs are recovered separately. The objective must therefore not be to recover the POPs, but to recover and re-use materials containing POPs. Regulation 757/2010 amended the POP Regulation and defined a limit of 0.1 wt. %, based on the material of an article containing the recyclate (Annex I Part A). According to Article 7 of the POP Regulation, waste must be treated so that the POP it contains is destroyed or irreversibly transformed. The limit (concentration) above which the destruction requirement applies is defined in Annex IV of the POP Regulation. The lower POP limit for the total content of PBDEs is 1000 ppm (1000 mg/kg).

Before a harmonised EU-wide limit value was adopted, Germany had already recommended a national limit for enforcement by the Länder of 1000 ppm (1000 mg/kg) for the total content of PBDEs (including non-POP PBDEs) for a transitional phase (LAGA 2010). Germany thus already fulfilled the requirements of the Stockholm Convention and the POP Regulation in relation to the regulation of waste streams containing POP until final elimination POPs.

A Party of the Stockholm Convention is obliged to prevent the export of articles containing PBDE, if the level of substances exceeds the authorised limit for the placing on the market of an article within the territory of the Party. In Europe, this is regulated in the POP Regulation by a complete transport ban on the substances as such, in mixtures and in articles. Only contaminations are allowed; for articles made of new materials the limit is 10 ppm (10 mg/kg). For articles that contain recyclates the limit is 0.1 wt. % (1000 mg/kg). The limits are defined in Annex I of the POP Regulation and apply to each individual substance in the group.

3.2 Substances in Annex B of the Stockholm Convention

3.2.1 Dichlorodiphenyltrichloroethane (DDT)

The production, placing on the market and use of DDT have been banned in Germany since 1972 through the so-called DDT Act (DDT-Gesetz). Applications for exemptions could have been submitted to the BVL for research and analysis purposes (ChemVerbotsV, Annex to § 1, Paragraph 1). In 1994, the provisions of the DDT Act were included in the Hazardous Substances Regulations (Gefahrstoffverordnung - GefStoffV) and the Chemical Ban Regulations (ChemVerbotsV) (§ 1 Para. 1 in conj. with Para. 1 of the Annex to the ChemVerbotsV), they were then deleted again from the GefStoffV as part of the revision at the end of 2010. The obligation to obtain a permit for research and analysis purposes has become obsolete with the EU POP regulation and was cancelled with the new ChemVerbotsV of 20 January 2017.

3.2.2 Perfluorooctane sulfonate PFOS

PFOS is a member of the perfluorinated and polyfluorinated chemicals (PFC) group of substances. Due to the surface-active properties of PFOS and related compounds, they are also called perfluorinated tensides (PFT) or perfluorinated surfactants. PFTs had been used in different technical processes and surface coating products and in speciality chemicals since the 1950s.

Due to its problematic environmental behaviour, in 2000, the US American company 3M – until then the worldwide largest PFOS producer – decided to voluntarily phase-out production and use of PFOS by the end of 2002 (3M 2000). This corporate decision caused a substantial drop in the use of PFOS in the EU (RPA 2004). Since 2006, PFOS has been subject to a ban with specific exemptions in the EU. In

2009, PFOS was also included in the Stockholm Convention and included in the POP Protocol. Table 6 gives an overview of the chemical substances included in Annex B of the Stockholm Convention.

Table 6: PFOS compounds as given in Annex B of the Stockholm Convention

PFOS compound	CAS No.
Perfluorooctane sulfonate	1763-23-1
Perfluorooctane sulfonyl fluoride	307-35-7
Potassium salt	2795-39-3
Diethanolamine salt	70225-14-8
Ammonium salt	29081-56-9
Lithium salt	29457-72-5
Tetraethylammonium salt	56773-42-3
Didecyldimethylammonium salt	251099-16-8

The States that are Party to the Convention are obliged to restrict production and use. A range of accepted uses and specific exemptions are listed in the Annex to the Stockholm Convention. Accepted uses are uses that continue to be allowed. Specific exemptions must be registered by the Parties to the Convention if they are to be used. As the EU, alongside Germany, is also a Party to the Stockholm Convention, it has already fulfilled this obligation for all EU member states. Therefore, all specific exemptions in Germany are permissible in Germany without separate registration, provided they have also been included in the POP Regulation. Thus, the following exemptions from the ban on use exist for PFOS:

Accepted applications:

- Photographic coatings,
- Anti-reflection coatings for photolithographic processes and photographic coatings used in the production of semiconductors,
- Etchants for high-frequency semiconductors,
- Hydraulic fluid in aviation,
- Use as a wetting agent in hard-chrome plating (chromium VI) in closed circulation systems),

In addition, the following specific exceptions apply:

- Photomasks in semiconductors and liquid crystal display industry,
- Use as wetting agent for monitored electroplating systems[24]

The following accepted uses and specific exemptions, which were included in Annex B of the Stockholm Convention, were not included in the European POP Regulation and are thus banned in the EU:

- Certain medical equipment (ethylene-tetrafluoroethylene coploymer films, in-vitro diagnostic equipment and colour filters for charge-coupled device),
- Insect bait for the control of leaf-cutting ants.
- Electronic parts of several colour printers and colour photocopiers,
- Insecticides for the control of red fire ants and termites,
- Chemical-based oil production measures,

24 Since 26 August 2015, no longer allowed as use in the EU, as the exemption in the POP Regulation has expired.

- Carpets,
- Leather,
- Textiles and upholstery,
- Paper and packaging,
- Coatings and coating additives,
- Rubber and plastics.

The accepted uses and specific exemptions were reviewed in 2015, and will be reviewed every four years thereafter, to decide whether they are continued.

PFOS continues to be produced due to the exemptions for specific uses of PFOS. The production quantities must be reported to the Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin - BAuA), and currently amount to 9 t/a, part of which is exported.

Since June 2008, PFOS, its salts, halogenides, amides and other derivates, including polymers, have been banned as a substance, in mixtures and articles by Directive 2006/122/EC (PFOS Restriction Directive[25]), whereby specific exemptions already existed, similar to the exemptions of the subsequent POP Regulation. In June 2009, this ban as well as the exemption provisions, were included in REACH, Annex XVII (Regulation (EC) No. 552/2009).

With the change to the European POP Regulation[26] the exemptions provided for PFOS in Annex XVII of the REACH Regulations were included and, with a few changes, were included in Annex I of the POP Regulation. The restrictions of Annex XVII of REACH were deleted.

Annex IV of the POP Regulation defines a lower POP limit for the level of PFOS in waste of 50 mg/kg.[27]

Before an EU-wide harmonised limit was adopted, Germany had already recommended a national limit for enforcement (as a limit for Annex IV POP Regulation) by the Länder of 50 mg/kg for the level of PFOS in waste for a transition period (LAGA 2011).

4 Measures for the Register of Specific Exemptions (Article 4)

Article 4 of the Stockholm Convention requires that the Parties register the exemptions issued for a limited period for the production or a specific use of substances in Annexes A and B.

The Federal Republic of Germany itself has not applied for any specific exemptions for the production or use of a substance in Annexes A and B in the current valid form under the provisions of Article 4 of the Stockholm Convention. For member states of the European Union, this obligation is covered on their behalf by the EU, as a Party to the Stockholm Convention.

5 Measures to Reduce or Eliminate Releases of Substances in Annex C (Article 5)

Article 5 of the Convention specifies the minimum measures to be taken to reduce or eliminate releases from unintentional production with the goal of "*their continuing minimisation and, where feasible, ultimate elimination*".

25 And its national implementation ("Eleventh Regulations Amending Regulations under Chemicals-Related Legislation")
26 The change was implemented by Regulations (EC) No. 756/2010 and No. 757/2010.
27 The change was implemented by Regulation (EC) No. 1342/2014.

The relevant substances resulting from unintentional production are named in Annex C of the Stockholm Convention. This annex currently lists the following substance groups: PCDD/F, HCB, PCB and PeCB.

5.1 Article 5 a Development of a national action plan

Article 5 a of the Stockholm Convention commits the Parties to identify the emission sources of the above-named contaminants and to quantify the total quantities released annually and to report on these. On the basis of the emission inventories prepared for this reporting, national action plans are drawn up, in which the measures to prevent or reduce these substances are documented.

In addition to the Stockholm Convention, the POPs Protocol of the CLRTAP and the POP Regulation also require that emission inventions be drawn up for unintentionally formed POPs as part of the emission reporting. The Federal Republic of Germany must report these emissions within the scope of the named agreements.

Data on the emissions for unintentionally released POPs are collected by the UBA and provided for the reporting in the Central System Emissions (ZSE). The ZSE is a central database, which enables a large number of national and international reporting obligations regarding atmospheric emissions to be fulfilled (e.g. for UNFCCC 1992, UNECE, EU, etc.). The data in the ZSE are checked and updated regularly. A report from 2010, had the objective of improving the data situation for the ZSE, however few emission data exist for the POPs. Extensive investigations had to be carried out in the possible sources to improve the data situation. Yet the report showed that, in comparison to 1990, there had been no increasing POP emissions in Germany (Rentz et al. 2010). Despite the checking and updating, the POP inventories hold many uncertainties and are in part incomplete.

National trend tables for the German reporting on atmospheric emissions for POPs since 1990 can be found on the UBA internet site (UBA 2016e).

5.2 Article 5b-e: Promotion and requiring use of measures and best available techniques for release reduction and source elimination

Measures

Industrial plants, which due to their nature or operation, can cause particularly harmful environmental effects are subject to mandatory approval under the Federal Immission Control Act (Bundes-Immissionsschutzgesetz - BImSchG). Material requirements are specified by the sub-statutory rules in relevant implementing regulations of the Federal Immission Control Act (BImSch Regulations) and the Technical Instructions on Air Quality Control (TA Air) (TA-Luft).

Wastewater discharges are regulated by the Water Management Act (Wasserhaushaltsgesetz - WHG). Official permits and consents to use water bodies are issued under this act. The sub-statutory rules consist of the Wastewater Regulations and their annexes, with which requirements for the discharge of wastewater are regulated.

Reference documents on the best available techniques (BAT) with associated emission values are drawn up according to the Industrial Emissions Directive (IE Directive, Directive 2010/75/EU). Water-specific BAT conclusions are currently implemented through the wastewater regulations (Abwasserverordnung) and their annexes. Air-specific BAT conclusions are implemented by means of the TA Air, if emission values are associated with it.

Annex C of the Stockholm Convention lists a range of source categories, which have a high potential for the formation release from unintentional production due to the technology used.

From the above-named rules and standards, measures result for these source categories, with which the Stockholm Convention objectives of minimising or eliminating releases from unintentional production can be achieved. The following articles are indirectly or directly concerned:

- Use of practical release reduction and source elimination measures (Article 5b),
- Use of substitute materials (Article 5c of the Stockholm Convention),
- Use of best available techniques (Article 5d of the Stockholm Convention in conjunction with Annex C, Part V)

Promotion measures taken (Article 5 e of the Stockholm Convention)

The measures to promote use of the best available technique for existing and new sources according to the source category of Annex C of the Stockholm Convention are regulatory in Germany.

All sources in Annex C Part III of the Stockholm Convention are covered by the regulations addressed in Chapter 2.6.

A particularly relevant type of plant for PCDD and PCDF emissions are small and medium-sized combustion plants. They do not require approval according to Art. 4 of the BImSchG. Provisions for this type of plant are given in the Regulations for small and medium-sized combustion plants, 1.BImSchV for implementation of the BImSchG. These regulations are Germany-specific and are not used to implement an EU Directive. They do not contain any limit values for substances in Annex C, however they do define the requirements for the quality of the fuels, the binding advising of the operators about permissible fuels and proper handling of the plant and monitoring the emissions. These requirements are aimed at achieving a general reduction in pollutant emissions including reducing emissions of PCDD, PCDF and other POPs.

Control and compliance with the requirements is carried out by the chimneysweep as part of the regulatory compliance of small combustion plants.

6 Measures to Reduce or Eliminate Releases from Stockpiles and Wastes (Article 6)

Article 6 Paragraph 1 requires that each Party

> *"... ensures that stockpiles consisting of or containing chemicals listed either in Annex A or Annex B and wastes, including products and articles upon becoming wastes, consisting of, containing or contaminated with a chemical listed in Annex A, B or C, are managed in a manner protective of human health and the environment ...."*

This obligation should be implemented, in particular, by

- Identifying stockpiles of POPs,
- Identifying products and articles that contain POPs,
- Environmentally sound collection, storage, transport and finally disposal.

A central requirement is the destruction or irreversible transformation of POP content of waste (Art. 6 Para.1 lit. d ii).

6.1 POP stockpiles

Article 5 of the POP Regulation requires that the Member States report to the Commission stockpiles consisting of or containing (> 50 kg) of POPS by 19 July 2005 (twelve months after the Regulation came into force). No such stockpiles were reported to the competent authorities of the Länder, so that is assumed that PCB stockpiles do not (no longer) exist in Germany. However, investigations have shown that especially transformers containing PCB are not drained as specified before they were

stored underground, but instead were disposed of with the liquid containing PCB. In addition, export statistics of the Environmental Statistics Act show, in the years 2005 – 2010, a total of 23,499 tonnes of transformers containing PCB were exported. In addition, from 2005 – 2009, materials containing PCB with a total mass of 3450 tonnes were imported for permanent storage (UBA 2017a). From 2011 to 2015, in total 7042 tonnes of transformers and capacitors containing PCB were exported (waste code number: 160209). Transborder statistics (UBA 2017a - Statistics concerning transfrontier shipment of waste))

6.2 POPs in used (end-of-life) products and articles

6.2.1 PBDE in used (end-of-life) products and articles

In the past, PBDEs were used as a flame retardant in various products. These applications are now banned throughout Europe. However, they were also used in long-life articles, some of which are still in use, so that human and environment exposure to PBDE can still exist. In addition, there is a risk that if they are disposed of improperly, e.g. uncontrolled incineration, the production of dioxins and furans can be promoted due to the bromine contained in them.

An overview of the known uses of C-PentaBDE is given in Table 7.

Table 7: Overview of the most important former areas of use and products of C-PentaBDE

Historical use		Applications	Finished products (e.g.)	Current status
As flame retardant in polyurethane foam (PUR)	Most common use of C-PentaBDE in the EU (95%): PentaBDE concentrations: 2-18%	Seat cushions, head supports, dashboards, etc. mattresses, Packaging, upholstery	Automobiles, furniture upholstery, transport, sound installations, packagings, cushioning packaging material, imitation wood	All uses banned for the EU market, Articles solely made of new materials with contaminations up to 10 mg/kg tetra-, penta-, hexa- or heptaBDE are marketable. Articles in which recyclates are used, up to a content of 1000 mg/kg tetra-, penta-, hexa- or heptaBDE are marketable Articles within the scope of RoHS basically marketable up to a PBDE content (total) of 1000 mg/kg.
In polyvinylchloride (PVC)	Low use in the EU (5%): precise concentrations not available	n/s	Floorings, window profiles, pipes, cable insulation and sheathing	
In epoxy resin		Insulation material, fibre composite plastics, construction adhesive, anti-corrosion protection	Printed circuit boards, boat and modelmaking, interior walls of ships, electronic parts	
In unsaturated polyesters (UPE)		Insulating material	Housings, paints/lacquers, handles for saucepans, etc.	
Rubber		Insulating material	Conveyor belts, foam tubes, insulation parts	

Historical use		Applications	Finished products (e.g.)	Current status
Paints/lacquers		Coatings	Marine and industrial paints for the protection of containers	
Textiles		Coating and impregnation	Carpets, car seats, furniture, protective clothing	
Hydraulic oils		Drilling oils, hydraulic liquids	Offshore drilling, coal mining	

(UBA 2012)

An overview of known C-OctaBDE uses is given in Table 8.

Table 8: Overview of the most important areas of use and products of C-OctaBDE

Historical use	Application	Products (e.g.)	Current status
Acrylnitrile butadiene styrene (ABS)	Electrical and electronic equipment	Computer and television housings and all types of electrical and electronic equipment	Production, placing on the market and use per se are banned, however: articles with contaminations up to 10 mg/kg tetra-, penta-, hexa- or heptaBDE are marketable, Articles, in which recyclates are used, up to a content of 1000 mg/kg tetra-, penta-, hexa- or heptaBDE are marketable Articles within the scope of RoHS basically marketable up to a PBDE content (total) of 1000 mg/kg
High Impact Polystyrene (HIPS)	Plastic housings	Computers and televisions and all types of electrical and electronic equipment (mobile phones)	
	Toy materials	Plastic toys	
	Cold resistant layer	Refrigerators	
Polybutyleneterephtalate	Housing material	Electronic equipment	
	Vehicle industry	Plug-in connectors	
	Household	Shower head or iron	
Polyamide polymers	Textiles	Furniture	
	Construction materials	Pipes and fittings, plastic films	

(UBA 2012)

The articles in which commercial PBDEs were used in relevant quantities and which are still partly found on the market due to their long life are automobiles, electrical equipment and (upholstered) furniture.

Bromated flame retardant was used in various areas of the automotive industry. Treated polyurethane (PU) foams were used in seat cushions, head supports, dashboards, inside door panels, ceilings, steering wheels and loudspeaker systems. PU foams were mainly treated with C-pentaBDE, which was also used in other plastics and textiles (BiPRO 2011).

Automotive industry material and substance databases were introduced in Germany from 1998 and in the EU from 2000 (***I**nternational **M**aterial **D**ata **S**ystem*, IMDS,[28] and the banned substance list ***G**lobal **A**utomotive **D**eclarable **S**ubstance **L**ist*, GADSL[29]). As a result, it is possible to trace back from when these substances were no longer used in the European automotive industry. On the basis of the data and other information from the automotive industry, no uses of the POP-PBDEs are known of from 2000 (ACEA 2010).

The materials containing PBDE from disposed of end-of-life vehicles are not recycled in Germany. They are mostly removed (incineration) or the materials containing PBDE are used to produce energy. The only known material recovery paths are the use of certain fractions for landfill body construction and for mine filling (Lower Saxony 2007, p. 20f).

In 2010, the waste stream from end-of-life vehicles contained an estimated 3.4 tonnes C-pentaBDE and 2.6 tonnes C-octaBDE (UBA 2012).

With a view to the quantities still to arise in the future, consideration of the average age of existing vehicles in Germany (see Table 10) in conjunction with the average use periods until they are finally scrapped (see Table 9) can provide information.

Table 9: Proportion of existing vehicles with first registration since 2000

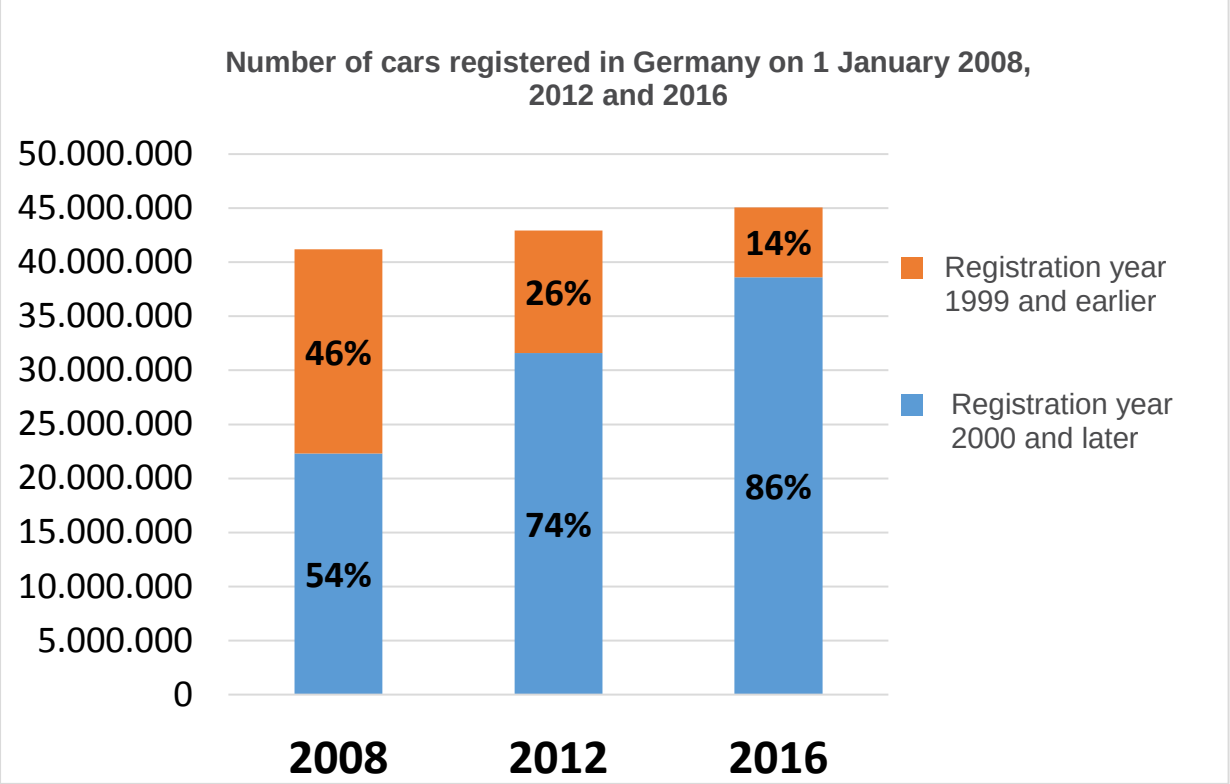
	2008	2012	2016
Car registrations in 2000 and later	22,321,712	31,613,638	38,619,326
Proportion of registration in 2000 and later	54%	74%	86%
Car registrations in 1999 and earlier	18,861,759	11,313,961	6,451,825
Proportion of registration in 1999 and earlier	46%	26%	14%
Total car registrations	41,183,594	42,927,647	45,071,209

(Kraftfahrt-Bundesamt (Federal Motor Transport Authority) (2016))

28 "International Material Data System": Archive, exchange and management system for vehicle construction. On the basis of this system, a material data sheet is created in which, for the component concerned, all materials used and pro rata substance components are named and all data necessary for subsequent recycling of the vehicle part are recorded (IMDS 2016).

29 "Global Automotive Declarable Substance List": The list of declarable substances used in vehicles worldwide based on the IMDS. GADSL is an instrument for the communication of banned substances in the materials and at the same time is used as the basis for checking for the release of the material data sheet for the respective component by the automotive manufacturer concerned, http://www.gadsl.org (GADSL 2011).

Figure 1: Existing cars in Germany, 2008, 2012 and 2016,



(Kraftfahrt-Bundesamt (Federal Motor Transport Authority) (2016))

Table 10: Average number of vehicles in Germany 2008, 2012 and 2016,

Year (1 January of each year)	Motorcycles	Cars -	Buses and coaches	Trucks -	Tractors -	For comparison: Motor vehicles in total	Trailers
2008[30]	12.8	8.0	8.7	7.5	27.3	9.1	14.6
2012	14.7	8.5	8.8	7.6	28.7	9.8	16.0
2016	16.6	9.2	8.9	7.8	29.5	10.5	17.3

(Kraftfahrt-Bundesamt (Federal Motor Transport Authority) (2016))

It can be seen that on 1 January 2016, there were still 6.5 million cars in Germany that were first registered before 2000 - these could potentially contain POP-BDE. These accounted for a 14 % share of the total car stocks of 45.1 million cars. Four years ago, (2012), the proportion of cars that could potentially contain POP-BDE was still 26 %, in 2008 it was 46 % (18.9 million cars). This shows that the potential for vehicles containing POP-BDE is reduced sharply.

Within the scope of the Ufoplan project "Updating the methods used for monitoring proportions for end-of-life vehicles" (Fortschreibung der Methodik zum Quotenmonitoring für Altfahrzeuge), FKZ 3715 33 305 0, during the shredder tests performed on end-of-life vehicles, samples were taken from

30 From 1 January 2008, only registered vehicles without temporary shutdowns/taking out of service are included.

the shredder heavy fraction < 2 mm and the shredder light fraction and, among other things, their PBDE levels were examined.

Publication of the final report on the project, which terminates at the end of 2016, is planned for 2017.

C-OctaBDE was used in electrical and electronic equipment, mainly as a flame retardant in plastic housings made of ABS, to a small extent in housing plastics made of HIPS, polybutylene terephthalate and polyamide polymers (BiPRO 2011). Due to its restriction, C-OctaBDE is only to be expected in waste equipment. The RoHS limit applicable to new articles placed on the market is 0.1 wt. % of the flame-protected material.

In Germany, waste electrical equipment (WEE) is subjected to separate collection (Art. 10 Para. 1) and proper treatment (Art. 20 ElektrG) in accordance with the law on the placing on the market, taking back and environmentally sound disposal of electrical and electronic equipment (Gesetz über das Inverkehrbringen, die Rücknahme und die umweltverträgliche Entsorgung von Elektro- und Elektronikgeräten) (ElektroG) . Equipment from private households are taken back by the recoverable material depots of the public waste management companies (Art. 13 ElektroG) and by the retail trade (Art. 17 ElektroG), waste equipment from commercial sources is generally taken back by the manufacturers and dealers or are disposed of by the final owners (Art. 19 ElektroG).

The plastics from WEE are separated out, either manually (only a very few, large parts) or mechanically. With the mechanical separation, at the end of the automatic sorting process of the WEE components a so-called non-metallic residual fraction is produced (NMRF). This generally contains plastics, but also other substances such as wood, rubber, pieces of printed circuits and copper wool. This fraction is partly further treated with the objective of separating non-brominated plastics (generally ABS and PS) from brominated plastics and to recover the materials. Non-treated NMRF and the separated-out constituents of the NMRF containing bromine are usually thermally recovered (waste to energy). The separating out of brominated plastic parts does not differentiate between different fire retardants; plastic parts with permitted brominated fire retardants are therefore also separated out and recovered thermally.

Random sample tests on WEE plastics and plastic fractions repeated show positive analysis results with regard to various PBDE:

- Approx. 100 ppm pentaBDE was detected in tests on equipment categories 1 – 4 in consumer electronics (without CRT and flat screens), (Wäger 2010). Other tests on small electrical equipment in Switzerland showed an average pentaBDE level of 34 ppm (Morf 2005).
- OctaBDE was not found in tests on large household appliances. In category 2 equipment, especially in small equipment with the exception of vacuum cleaners, octaBDE was detected with between 100 and 1,000 ppm. In IT and consumer electronics (without CRT and flat screens) the average octaBDE concentration was approx. 1,000 ppm. In the tests, plastics from CRT televisions had an octaBDE concentration of 900 ppm, CRT monitors 2,500 ppm. On the other hand, no octaBDE was detected in flat screens. (Wäger 2010)
- In the tests on shredded CRT television and monitor housings, octaBDE was found in five of seven samples. The concentration was between 3,000 and 14,000 ppm, i.e. significantly higher than in the tests by Wäger. The testing of shredded plastic parts from mixed waste electrical and electronic equipment showed octaBDE values of over 1,000 ppm in five of eight samples, maximum 4,500 ppm. Two samples had octaBDE concentrations just below 1,000 ppm and it could not be detected in one sample. (Schlummer 2007)

- The tests described clearly show that pentaBDE is used in electrical and electronic equipment to a smaller extent than the two commercial forms octa- and decaBDE. DecaBDE had the highest concentration.
- According to RoHS, the PBDE concentration that must not be exceeded if used in new electrical and electronic equipment is 1,000 ppm. It is made up of the concentrations of penta-, octa- and decaBDE. If the individual concentrations of the tests are added together, it can be seen that the concentration of PBDE lies above the RoHS limit in almost all the fractions tested in the quoted studies. Until 30.06.2008, an exemption existed for the use of decaBDE in electrical and electronic equipment. It can therefore be assumed that PBDE is still to be found in waste electrical and electronic equipment and accordingly, this plastic is not permissible for recycling.
- In CRT television and monitor housings the individual concentrations of octa- and decaBDE in the tests by Wäger and Schlummer are also higher than 1,000 ppm. In the tests on small electrical equipment by Morf the RoHS limit is reached on addition of the concentrations of octa- and decaBDE. In the tests on small electrical equipment by Wäger the cumulative PBDE concentration is also above 1,000 ppm. The same applies to IT electronics.
- In the tests on plastics from mixed waste electrical equipment by Schlummer (2007), the added PBDE concentration is below the RoHS limit in only one of eight samples. The maximum PBDE concentration, which was detected by Schlummer in plastics from mixed waste electrical equipment, was 7,500 ppm.
- According to the tests by Wäger on plastics from vacuum cleaners, flat screens and printers, even if the concentrations of the different PBDEs are added together, the RoHS limit is not reached.

Tests on small electrical equipment in Switzerland showed a lower octaBDE level with an average 530 ppm (Morf 2005).

Table 11: Results of the chemical analysis for flame retardant of the NMRF (bold printed values are above the RoHS limit)

Analysis	Sample A	Sample B	Sample C	Sample D
Antimony[a] [ppm]	162	475	551	174
Bromine tot.[b] [% by mass]*	0.4	0.26	0.48	0.11
Chlorine tot.[b] [% by mass]*	1.8	0.95	0.68	1.3
TBBPA[c] [ppm]	2,100	1,700	1,000	1,600
DecaBDE[c] [ppm]	< 50	220	1,200	4,100
NBDE[c] [ppm]	< 50	< 50	< 50	83
OctaBDE[c] [ppm]	< 20	< 20	< 20	< 20
PBDE 28[c] [ppm]	< 1	< 1	< 1	< 1
TeBDE[c] [ppm]	< 10	< 10	< 10	< 10
PBDE 47[c] [ppm]	< 1	< 1	< 1	< 1
PeBDE[c] [ppm]	< 10	< 10	< 10	< 10
PBDE 99[c] [ppm]	< 1	< 1	< 1	< 1
PBDE 100[c] [ppm]	< 1	< 1	< 1	< 1

Analysis	Sample A	Sample B	Sample C	Sample D
HxBDE[c] [ppm]	< 10	< 10	< 10	< 10
HpBDE[c] [ppm]	< 15	< 15	< 15	< 15
DecaBB[c] [ppm]	< 50	< 50	< 50	< 50
HBCD[c] [ppm]	< 50	< 50	< 50	< 50

a EN ISO 16171
b EN 15408 / EN ISO 10304-1
c EN ISO 22032
* 1 % by mass = 10,000 ppm

Table 12: Results of the chemical analysis for flame retardant in large plastic parts

Analysis	ABS from vacuum cleaners[31]	PS from the rear panels of LCD televisions[32]	ABS from the rear panels of LCD televisions[33]
Antimony[a] [ppm]	4.8	391	1,080
Bromine tot.[b] [ppm]	110	16,400	4,520
Chlorine tot. [b] [ppm]	1,170	652	581
TBBPA[c] [ppm]	57	< 20	10,000
HBCD[c] [ppm]	< 50	110	< 50
DecaBDE[c] [ppm]	< 50	< 50	< 50
NBDE[c] [ppm]	< 50	< 50	< 50
OctaBDE[c] [ppm]	< 20	< 20	< 20
PBDE 28[c] [ppm]	< 1	< 1	< 1
TeBDE[c] [ppm]	< 10	< 10	< 10
PBDE 47[c] [ppm]	< 1	< 1	< 1
PeBDE[c] [ppm]	< 10	< 10	< 10
PBDE 99[c] [ppm]	< 1	< 1	< 1
PBDE 100[c] [ppm]	< 1	< 1	< 1
HxBDE[c] [ppm]	< 10	< 10	< 10
HpBDE[c] [ppm]	< 15	< 15	< 15
DecaBB[c] [ppm]	< 50	< 50	< 50

a EN ISO 16171
b EN 15408 / EN ISO 10304-1
c EN ISO 22032

Summarising, the literature search and chemical analyses showed:

31 Composite sample from six parts
32 Composite sample from two parts
33 Composite sample of six parts

- PentaBDE, polybrominated BB and HBCD were only detected in very few samples and the detected concentrations are far below the limits set by the RoHS Directive.
- DecaBDE, on the other hand, is detected in a significantly higher number of the analysed samples, including by the current UBA report[7], within the range of the RoHS limit of 1,000 ppm or even significantly above it (up to 1,600 ppm (Wäger, 2010) and 4,100 ppm[7]). An average concentration in small electrical equipment is given as 510 ppm (Wäger, 2010). In CRT housing plastics the decaBDE concentration can be above 20,000 ppm (up to 21,500 ppm (Schlummer, 2007).

Calculations for 2008 show an average C-OctaBDE level in the plastic fractions of the WEE streams relative to the total plastic fraction of 0.12 percent. Based on the 14000 tonne quantity of waste produced, two calculation methods give a potential level of C-octaBDE of around 1.7 to 35.6 tonnes C-octaBDE in the waste stream from waste electrical and electronic equipment in Germany (UBA 2012).

Article 7 (2) of the POP Regulation requires that waste that contains above 1000 mg/kg PBDE must be treated so that the PBDEs are destroyed or irreversibly transformed.

In Germany, brominated and thus PBDE-containing plastics are usually treated in thermal recovery and removal / disposal methods. The PBDE is destroyed in these processes. Placing waste containing POPs on above-ground landfill sites is not permitted under the Landfill Regulations (Deponieverordnung) (DepV) (see Chapter 6.3.3 - Disposal of waste containing POP on landfill sites). However, historically, articles from the electrical sector were also used in landfill construction and accordingly are currently present there (UBA 2012).

Recycling methods in which material use of plastic fractions possibly containing PBDE (e.g. printed circuit boards, housing plastics) takes place are not known of, according to information received from the recycler industry (UBA 2012).

According to a current study (BiPRO 2011) a large proportion of the C -pentaBDE used to produce PU foams for use in the upholstered furniture and mattress industry. It can be assumed that a large part of this was used in Great Britain (JRC 2001), as the fire safety requirements are higher there (BiBRO 2011).

According to the soft polyurethane foam industry association (Verband der Polyurethan-Weichschaum-Industrie e.V. - VWI), since 1995, no substances in the PBDE substance group have been used to produce soft PU foam, provided the mattresses, upholstered furniture and vehicle seats/interiors were produced in Germany. It can therefore be assumed that PBDE will not arise in future recovery or disposal of the products (VWI 2011).

As the waste stream from upholstered furniture and mattresses is only disposed of thermally, it can be assumed that no more C-pentaBDE is contained in the resulting material stream.

6.2.2 Use of PFOS

Diverse uses of PFOS are mentioned in the literature. It is frequently difficult to determine whether PFOS itself is really used or a closely related compound, which under certain circumstances may only contain contaminations of PFOS, which was used in the production of the other substance. In most cases, PFOS is used as a process chemical and does not remain in the articles in relevant quantities.

According to the current exemption arrangements of the POP Regulation, PFOS is or was used for the following uses

- Surface finishing
- Photo industry

- Firefighting

According to calculations of a study carried out on behalf of the German Environment Agency, the quantity of PFOS consumed for surface technology is estimated to be approx. 3600 kg per year (UBA 2012). Since 28 August 2015, use of PFOS has only been allowed for hard chrome-plating, so that polyfluorinated compounds were substituted in decorative chrome-plating, plastic electroplating and also hard chrome-plating. However, even after long periods of time, small quantities of PFOS are still found in the wastewater of plants that used PFOS so that installed treatment technologies must continue to be operated.

Possible emissions into the environment occur mostly via the water path. On the one hand from the process itself, or indirectly through the disposal of baths, where PFOS is still used and is not only still bleeding out after the changeover to another wetting agent, and its subsequent treatment as waste Wastewater treatment measures (in the process or in waste) were able to increasingly contribute to targeted reduction of PFOS, although there is still no state-of-the-art for separation of PFOS from wastewater as defined in the wastewater regulations (AbwV), so that PFOS is regularly measured in wastewater treatment plants in Germany. However, it is possible to reduce plant-specific PFOS emissions, e.g. by means of specific ion exchangers

Another area of use for PFOS was the photo industry. According to I&P Europe, no photo material containing PFOS is currently produced in Germany by member companies of I&P Europe (as of 2011). At present, PFOS is only still used in the production of photo negatives. However, originally it was also used to produce photo plates and paper. PFOS-free chemicals are now used here (I&P Europe 2011).

In 2010, the main proportion of PFOS in the photo industry (approx. 80 percent) was used for X-ray films (I&P Europe 2011). Through voluntary efforts of the photo industry, the use of substances containing PFOS has reduced substantially over the past ten years and at present (as of 2011) no photo material containing PFOS is produced in Germany (I&P Europe 2011).

Regarding photo waste, a differentiation can be made between private waste and commercial waste. Photo materials disposed of in household waste (waste code number 20 03 01) is thus part of municipal waste, which is disposed of thermally. In commercial use, photo materials are recycled, above all due to the high silver content and the plastic fractions. Therefore, especially in the medical sector, larger quantities of material containing PFOS are probably still to be found. Especially as, according to Art. 18, 27, 28 and 36 of the X-Ray Regulations (Röntgenverordnung) and announcement regarding the X-ray record card, X-rays of persons over 18 years of age must be stored for 10 years after the date of the last examination.

The precise proportion of PFOS in the environment that comes from photo materials cannot be recorded (e.g. through residual levels in wastewater). However, in general, for Germany it can be concluded that under the relevant waste management rules, the photo industry is not a significant source of PFOS emissions in the environment.

Foam extinguishants containing PFOS were used in firefighting, to extinguish flammable liquids and melting solids. Foam extinguishants containing PFOS, which were placed on the market before 27 December 2006, had to be used up by 27 June 2011. According to Article 7 of the POP Regulation, after 27 June 2011 they must be treated as waste and disposed of quickly. The remaining stockpile were incinerated, whereby PFOS was thermally decomposed and no emissions were produced (BiPRO 2011).

6.2.3 DDT in waste products and articles

DDT contaminations are to be expected especially in timber structures and in the territory of the former GDR, were agents containing DDT[34] were widely used in interiors until 1989 (LAGuS 2015).

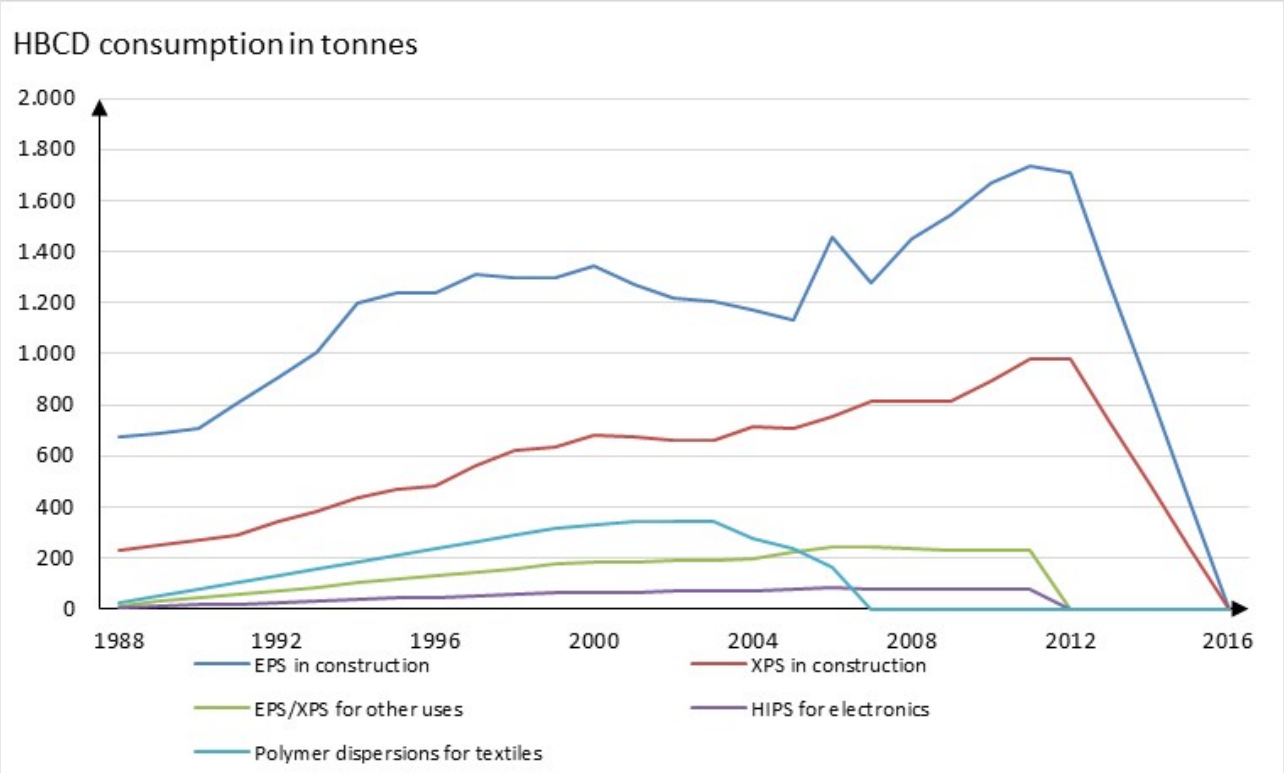
The Waste Timber Regulations (Altholzverordnung) do not define a separate limit for DDT. Wood that has been identified as treated is burned in co-incineration or in waste incineration plants and as an input material in biomass power plants. The dioxin and furan emissions produced during combustion must lie within the limit of 0.1 ng/m^3 as defined in the 17. BImSchV. The same limit is currently defined in the still valid Directive 2000/76/EC (Annex II) and the IE Directive (Annex VI, Part 3) that came into force from 2013.

6.2.4 HBCD in waste products and articles

Due to its technical properties, HBCD was mainly used as a flame retardant for plastics. HBCD was primarily used as an additive flame retardant in rigid EPS (expanded polystyrene) and XPS (extruded polystyrene) foam boards in the construction sector. Another area of use included use as a polymer dispersion for textiles, especially for upholstered furniture, upholstered seats in transport, curtains and wall coverings, mattress ticking, household textiles and car textiles (UBA 2015). HBCD was also used in housing plastics made of "high-impact polystyrene" (HIPS) for electrical and electronic equipment, e.g. audio and video equipment, distribution boxes for electrical cables in the construction sector and refrigerator claddings (quantity used 1 to 7%) (UBA 2015). In Germany, HBCD was especially used as an additive flame retardant in polystyrene in the construction sector. From 2013, HBCD was also substituted in this application and by August 2015, had almost completely been replaced by an alternative flame retardant. In Germany, according to current information, HBCD is currently not used in the packaging sector or in the textile sector. There are also no specific indications that HBCD HIPS is still used in the electrical sector. Figure 2 shows the higher relevance in terms of quantity of HBCD in EPS and XPS applications compared to other applications.

34 technical DDT with approx. 70 % pp´DDT, 20 % o,p-DDT, and p,p-DDE, p,p´-DDD and o,p´-DDD.

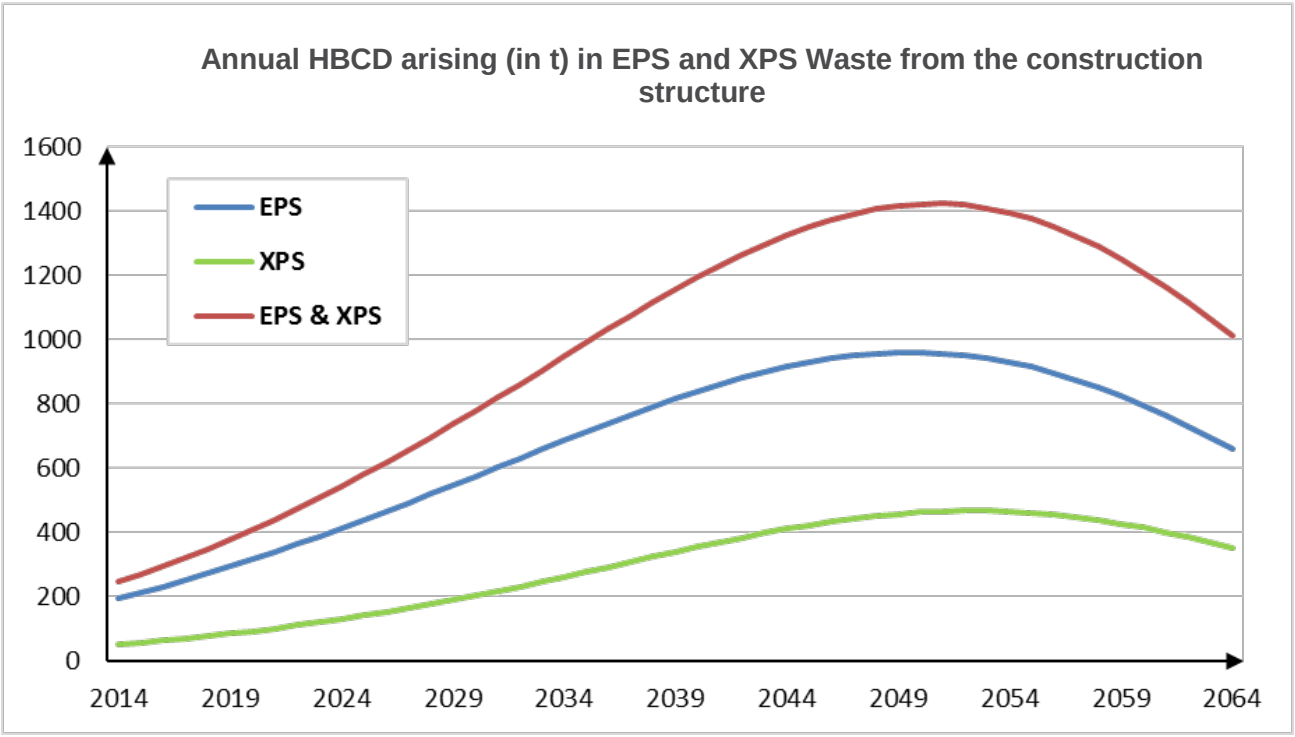
Figure 2: Estimate of HBCD consumption in the relevant applications in Germany from 1988 to 2016 (in tonnes)



Source: UBA 2015

Due to the comparatively large quantities used (over 60,000 t in total up to 2015) and very long product life (50 +/- 25 years) it is estimated that the majority of the products are still in circulation and will get into the waste streams in future (see Figure 3) (UBA 2015).

Figure 3: Estimate of the future annual occurrence of HBCD in EPS and XPS waste from the construction sector from 2014 to 2064 (in tonnes)



Source: UBA 2015

In the textile sector, most of the quantities of HBCD have already arisen as waste and only comparatively small quantities will get into the future waste stream.

Polystyrene packaging plastics contaminated with HBCD can play a role, especially with regards to imports from the electrical and electronic sector, and can lead to the contamination of "clean" polystyrene packaging through recycling processes.

Table 13 contains an estimate of the current relevance of the different areas in which HBCD can occur.

Table 13: Relevance of possible occurrences of HBCD

Possibly relevant occurrence	Estimation of the relevance
Rigid expanded polystyrene foam (EPS) in the construction sector	Until 2015 highly relevant in products and, due to the long life, relevant in future for many decades in waste (approx. 160 t HBCD/a in 2012; approx. 960 t HBCD/a around 2050)
Rigid extruded polystyrene foam (XPS) in the construction sector	Until 2015 highly relevant in products and, due to the long life, relevant in future for many decades in waste (approx. 41 t HBCD/a in 2012; approx. 460 t HBCD/a around 2050)
Use of EPS and XPS outside of the construction sector	Currently no longer relevant in products; Also, no longer relevant in wastes due to the limited life of the products (use mainly in the packaging sector) (approx. 0.4 t HBCD/a in 2012) with continued reducing relevance.

Possibly relevant occurrence	Estimation of the relevance
High Impact Polystyrene (HIPS)	Currently no longer relevant in products; previously used in the electrical sector; secondary relevance in waste in comparison to EPS/XPS (approx. 70 t/a in 2012 with continued reducing relevance). Imports could play a certain role for waste
Polymer dispersions for textiles	Since 2007, no longer relevant in products; until then used in institutional sector (meeting places) and the automotive sector; due to the quantity used in Germany and the life, secondary relevance in waste (approx. 290 t/a in 2012 with continued reducing relevance)
Sewage sludge	Not relevant (currently approx. 0.1 t/a)
Combustion residues Waste incineration	Not relevant (currently approx. 0.01 t/a)

Source: UBA 2015

Waste treatment

Art. 7 Para. 2 of the POP Regulation requires that waste is disposed of in such a way "as to ensure that the persistent organic pollutant content is destroyed or irreversibly transformed". This destruction requirement is satisfied in the disposal of waste containing HBCD by means of thermal treatment.

EPS and XPS insulation panels can be suitably treated with other waste in waste incineration plants equipped to state-of-the-art standards if it accounts for up to 2% of the total waste. The HBCD is completely destroyed (destruction rate by incineration in waste incineration plants > 99.99%) and the bromine it contains is collected as salt in the flue gas cleaning. (UBA 2015)

In future, insulation materials containing HBCD will only be able to be recycled for materials if the HBCD content is below the relevant limit applicable since 22 March 2016 of 100 mg/kg, given in Annex I of the POP Regulation for new materials and articles to be placed on the market. The same applies to packagings, housing plastics or textiles that contain HBCD (UBA 2016).

HCBD-free offcuts of expanded polystyrene (EPS) from new build or renovation activities, e.g. installing external thermal insulation composite systems (ETICS), on the other hand, can continue to be recycled to reuse the materials. After they have been crushed and extruded, the offcuts collected in loose or pressed form can be used to produce polystyrene regranulate.

To date, construction EPS from the dismantling of buildings must to thermally recovered, as typical construction adhesions make mechanical recycling impossible. Trials are underway with methods for depleting pollutants in EPS polystyrene plastics with the aim of selectively dissolving and extracting contaminations and HBCD from the material (e.g. the CreaSolv® process). A quick test exists for differentiating between HBCD-free and HBCD-containing on the basis of X-ray fluorescence analysis.

6.3 Waste containing POP

Paragraphs 2 and 4b of Article 7 of the POP Regulation formulate requirements for the disposal or recovery of

- waste that is known to consist of POPs,
- wastes that contain POPs or are contaminated by them and

- wastes that exceed the lower concentration limits in Annex IV of the POP Regulation.

In addition, the regulations of the KrWG and a range of special legislative waste regulations apply, which are described in the following. Since September 2016, waste containing POPs in Germany has been classified as hazardous waste in accordance with the Waste Register Regulations (Abfallverzeichnisverordnung). Above all, the new classification affects polystyrene insulation materials, which have a flame retardant finish containing HBCD (see Chap. 6.2.4 – HBCD in waste products and articles). In December 2016, HBCD was exempted from this regulation for the duration of one year. This decision was taken by the Bundesrat (the upper house of the German parliament) on 16 December 2016, was confirmed by a decision of the cabinet on 21 December 2016 and immediately entered into force. For a longterm solution, the Ministry of the Environment will consult with the Länder to consider the legal issues concerning chemicals, immission protection and waste regulations.

6.3.1 Waste containing PCDD/PCDF

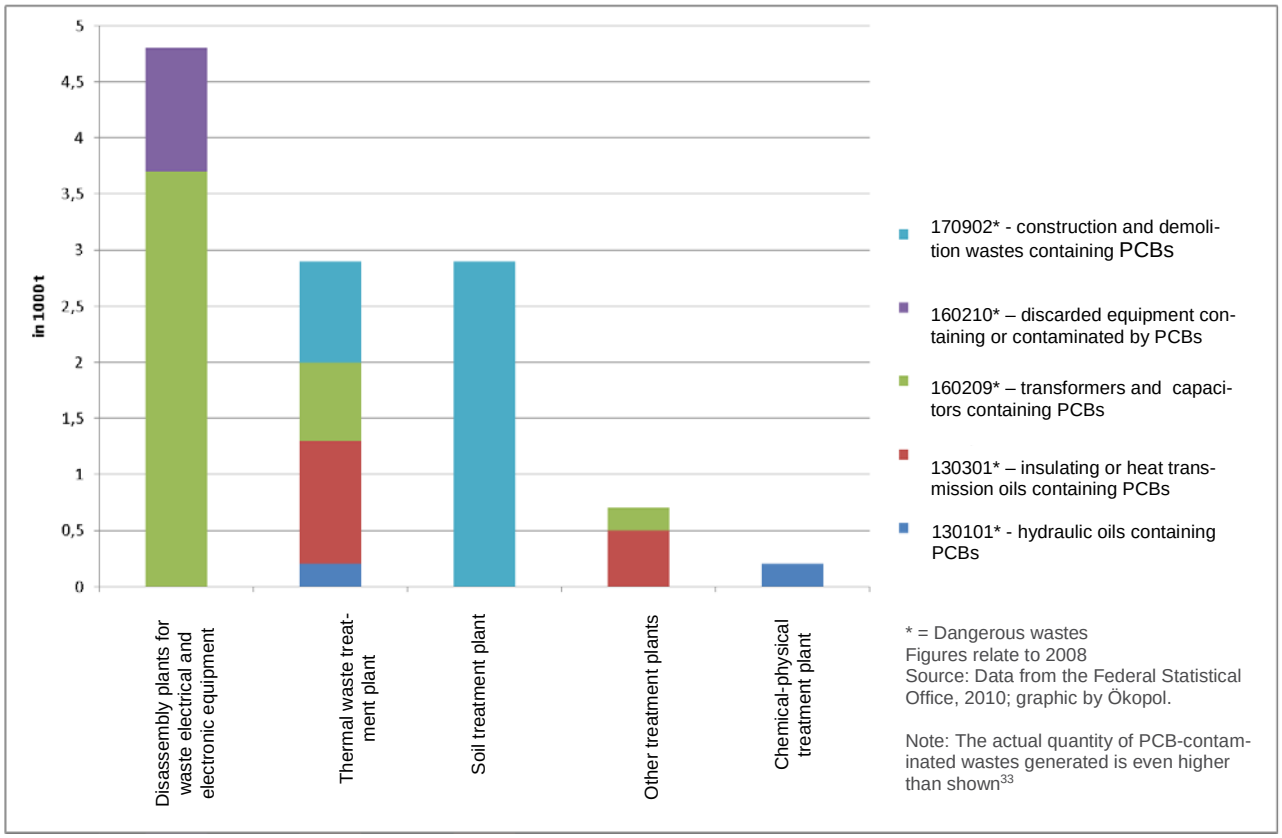
According to Article 7 of the POP Regulation, waste containing PCDD/F must be disposed of or recovered at the latest from a concentration limit of 15 µg/kg so that PCDD/F are destroyed or irreversibly transformed (Art. 7, Para. 2 in conjunction with Annex IV). In general, this waste is disposed of in high-temperature incineration. Waste containing PCDD/F, which are the result of thermal processes, e.g. fly ashes, are stored permanently underground in an underground storage facility or as mine filler in salt rock formations, in accordance with Annex V of the POP Regulation.

6.3.2 Waste containing PCB

In addition to the requirements of the POP, specific legislative waste regulations apply to waste containing PCB, e.g. the PCB/PCT waste regulations (PCBAbfallV), in which, in Art. 2 Para. 3 it states that, insofar as it is technically possible and economically reasonable, fractions containing PCB are to be removed before construction waste is sorted and disposed of separately.

Due to its use, PCB is not disposed of separately but as part of equipment and materials, so that the quantity of PCB waste to be disposed of is substantially higher than the quantity of PCB used (UBA 2017b). The Federal Statistics Office (Statistische Bundesamt) showed the following input quantities of inland waste containing PCB, which was fed into German disposal facilities in 2008 (see Figure 4).

Figure 4: Inland input quantities of waste containing PCB in German disposal facilities.



(Data: Destatis/Cahsun, pers. comm. 2011)[35]

Since 1998, waste statistics show what types and quantities of waste are imported and exported (UBA 2017a).

In the following, specific information is provided on different waste streams containing PCB:

Waste wood containing PCB

In the past, thermal and sound insulation boards in particular were treated with agents containing PCB. According to Annex II of the Waste Wood Regulations (Altholzverordnung - AltholzV), waste wood can only be used for the production of wood-based panels made of chippings and wood shavings, if the concentrations of PCB < 5 mg/kg. Taking the AltholzV into consideration, it can be used to produce synthesis gas or to produce activated charcoal / industrial coal if the levels are below 50 mg/kg. If the PCB levels are above 50 mg/kg, according to Art. 1 Para. 2 of the PCBAbfallV and Art. 2 Number 4 b and Number 5 of the AltholzV, the waste wood is “waste PCB wood” and must be disposed of according to the PCBAbfallV.

Waste oil containing PCB

35 The quantity is even higher, as for reasons of confidentiality, the Federal Statistics Office is not able to give quantities in all cases, and part of the hazardous waste is also used in landfill construction, in underground and above-ground mining and in plants for the preparation and recovery of construction and demolition waste, and because a range of other wastes under different code numbers an also contain PCB, without this being explicitly noted in the plain text of the waste code numbers (DESTATIS/Stute, pers comm. 2011).

Art. 2 of the German Waste Oil Regulations (Altölverordnung - AltölV) states that the treatment (i.e. renewed placing on the market) of waste oil must be given priority over energy recovery or disposal. However, according to Art. 3, waste oil can only be treated if their PCB content is less than a level of 20 mg PCB/kg, or if the products resulting from the treatment process have a PCB content less than the relevant limit. According to Article 4 Para. 1 of the POP Regulation, retreated waste oils may only contain PCBs, if they occur as unintentional trace contaminants. Otherwise, according to Article 7 of the POP Regulation, from a PCB level of 50 mg/kg, PCB waste must be disposed of irreversibly. Thus, stricter requirements exist for the treatment (recycling, no PCB enrichment in the recovered substance cycle) of waste oil than is specified in the EU.

Remaining uses of PCB in large closed equipment

In 1994, more than 300,000 tonnes of equipment and liquids containing PCB still had to be disposed of. Of these, in 2004 more than 99 percent had already been disposed of (BMU 2004c). By 2010, only two transformers containing PCB were still operated under an exemption permit. In the survey for the European Commission, other transformers containing PCB were recorded, which has escaped the earlier controls. These are around 30 transformers containing PCB with a total weight of 35.9 tonnes. Appropriate disposal plans have been drawn up for this equipment. Transformers containing PCB were stored in underground storage facilities from 1983; the transformers were partly drained before being placed underground. From 2004 to 2010, around 14,000 tonnes of the stored equipment were dismantled (MKULNV & MAIS 2011), drained, decontaminated and the metals were recovered.

Remaining uses of PCB in closed small equipment/applications

Small capacitors were stored in underground storage facilities until 2004. Since 2005, small capacitors containing PCB have been disposed of in high-temperature incineration plants (UBA/Friedrich pers. comm. 2011). The quantity of PCB in still active applications such as sealing compounds or fluorescent lamp capacitors cannot be estimated. Information on proper disposal for the owners of electrical equipment and components containing PCB is partly issued by the Länder, e.g. in the Free and Hanseatic City of Hamburg (Freie und Hansestadt Hamburg 2002).

Remaining uses of PCB in "open" systems

Due to their wide range of uses, PCBs are still contained in various articles. According to Art. 1 Para. 2 of the PCBAbfallV, mixtures or articles as defined by the Chemicals Act (ChemG, which contain more than 50 mg/kg PCB, must be disposed of. Material recovery, i.e. the production of new articles, is only allowed according to Article 4 Para. 2 of the POP Regulation, if PCB is only present in the products as unintentional trace contaminants. Several Länder authorities have drawn up guidelines on the remediation of buildings contaminated with PCB, e.g. NRW (2003), Bavaria (1994) and Baden-Württemberg (2001).

All remaining PCB-containing waste was disposed of until the end of 2010. Nonetheless, until 2016, PCB from unknown sources has surfaced. This concerns PCB from electric and electronic equipment with parts containing PCB, PCB-containing wastes from construction and demolition projects, sealants and PCB-containing parts from scrap cars. These sources for PCB-containing wastes cannot be excluded for the future.

6.3.3 Disposal of waste containing POPs on landfill sites

The provisions of Article 7 Paragraph 4 of the POP Regulation, which unlike the POP destruction requirement of Article 2, allow the storage of waste containing POPs on landfill sites, were fully implemented in German law with the Landfill Regulations (Deponieverordnung - DepV). Accordingly, waste

named in Annex V of the POP Regulation, which exceed the concentration limits of the substances listed in Annex IV of the same Regulation, may not be stored on above-ground landfill sites (§ 7 Paragraph 1 Number 7 DepV). The same applies to waste with other persistent or bioaccumulative toxic substances, which cause concern regarding impairment of the welfare of the general public if stored on landfill sights.

The concentration limits in Annex IV of the POP Regulation represent the limits of landfill class III in practical terms.

Specific and significantly lower limits for BTEX, PCB, TPH and PAH were defined with the landfill guidelines for inert substance landfills (landfill class 0) and were included in the DepV (Annex 3 Number 2 Table 2 DepV). Even stricter limits apply if waste is used on landfill sites to improve the geological barrier or for the recultivation layer.

The Länder individually apply intermediate limits for classes I and II (landfill sites for non-hazardous waste). On the basis of a report issued by the Joint Working Group of the Federal Government/ Länder on Waste (Länderarbeitsgemeinschaft Abfall - LAGA) of 21.06.2011, the Conference of the Ministers of the Environment (Umweltministerkonferenz) recommends the use of the proposed harmonised limits.

According to Article 7 Paragraph 4 letter b) POP Regulation, the authorities can also approve an alternative procedure named in Annex V if the Annex IV limits are exceeded, if the waste owner proves that decontamination of the waste and destruction of the POPs under environmental aspects is not the preferred option. Of the alternatives named in Annex V of the POP Regulation, only permanent storage in underground facilities in salt rock is permitted in Germany with the DepV. The verification approved by the competent authority must be submitted to the operator of the underground landfill in good time before the first delivery of the waste.

With the first Amending Regulations of the Landfill Regulations (Deponieverordnung) the reference to the POP Regulation was made flexible ("in the respective valid version"), so that the DepV always considers the current version even if changes are made to the annexes of the POP Regulation.

6.3.4 Recovery of waste containing POPs in mine filling

In the Stowage Regulations (Versatzverordnung (VersatzV)), limits for specific parameters for the stowage of waste underground are defined according to Art. 4. These limits are named in Annex 2. PCB is the only POP in these regulations. According to Art. 4 Para. 2, exceeding of the limit values is only permissible in the following exceptional cases:

- *"if the basic geogenic levels of the rock are complied with (not relevant for POPs),*
- *in case of stowage of "combustion residues from coal burning" in coal-bearing rocks and in the surrounding rock and*
- *for stowage in salt rock if long-term safety verification has been provided"* (LAGA 2010).

6.3.5 Biowaste

The Biowaste Regulations (Bioabfallverordnung - BioAbfV) and the Fertiliser Regulations (Düngemittelverordnung - DüMV), regulate the soil-related recovery of composts and digested residues (digestate) from biowaste. Biowaste from households, commerce and production suitable for the production of composts and digestates are summarised in both regulations in a concluding list. This includes plant and animal waste materials such as waste from food processing, food waste, garden and park waste, etc. Limit values are only defined in the Biowaste Regulations for heavy metals, which are monitored regularly. The Fertiliser Regulations (Düngemittelverordnung) defines additional limits for dioxins and PFTs

(sum of PFOA and PFOS), compliance with which must be guaranteed by the producer/distributor. Limits do not exist for other organic pollutants.

> "*But the BioAbfV contains the obligation for waste handlers, to have tests for other pollutants performed on the unmixed input materials or the treated biowaste, if indications of increased levels exist, especially according to the type, quality or origin of the input materials (Art. 4 Para. 8). The obligation to test for additional pollutants also includes POPs in case of corresponding indications*" (LAGA 2010).

The new version of the Biowaste Regulations (Bioabfallverordnung) came into force on 1 May 2012. The current version of the Fertiliser Regulations was published on 5.12.2012 (DüMV 2012). The current versions of both regulations can be found at www.gesetze-im-internet.de.

6.3.6 Sewage sludge

The parameters and limits in sewage sludge given in Chapter 2.6.2 can be extended to include other constituents by the competent authority (Art. 3 Para. 5 AbfKlärV). This includes POP pollutants. Several Länder have made use of the obligation to test for additional pollutants for the pollutant group of perfluorinated tensides (PFT) and have defined indicative values for the tests (see Table 14).

These pollutants are found due to their wide use in numerous industrial and consumer products, e.g. in cleaning agents and cosmetic products. As a result, they can also be detected in sewage sludge from municipal wastewater treatment plants, which in turn can be spread on agricultural land (LAGA 2010).

Table 14: Länder-specific indicative values

Land	Indicative values for PFT in sewage sludge for agricultural use (µg/kg DM)	Remark
Brandenburg	100	Total PFOS + PFOA
Berlin	100	
Baden-Württemberg	100	Sum of nine PFTs including PFOS
Bavaria	100	Sum of 11 PFTs including PFOS, 25% tolerance
Hesse	100 (recommended)	Total PFOS + PFOA
Lower-Saxony	200 (recommended: 100)	Total PFOS + PFOA
North Rhine-Westphalia	100	Total PFOS + PFOA
Rhineland-Palatinate	100	Sum of 10 PFTs including PFOS
Schleswig-Holstein (SH)	200 (Recommended: 100[36])	Total PFOS + PFOA
Saxony	100	Total PFOS + PFOA
Saxony-Anhalt	100[37]	Sum of PFOS + PFOA, 25% tolerance
Thuringia	200 (recommended: 100)	Total PFOS + PFOA

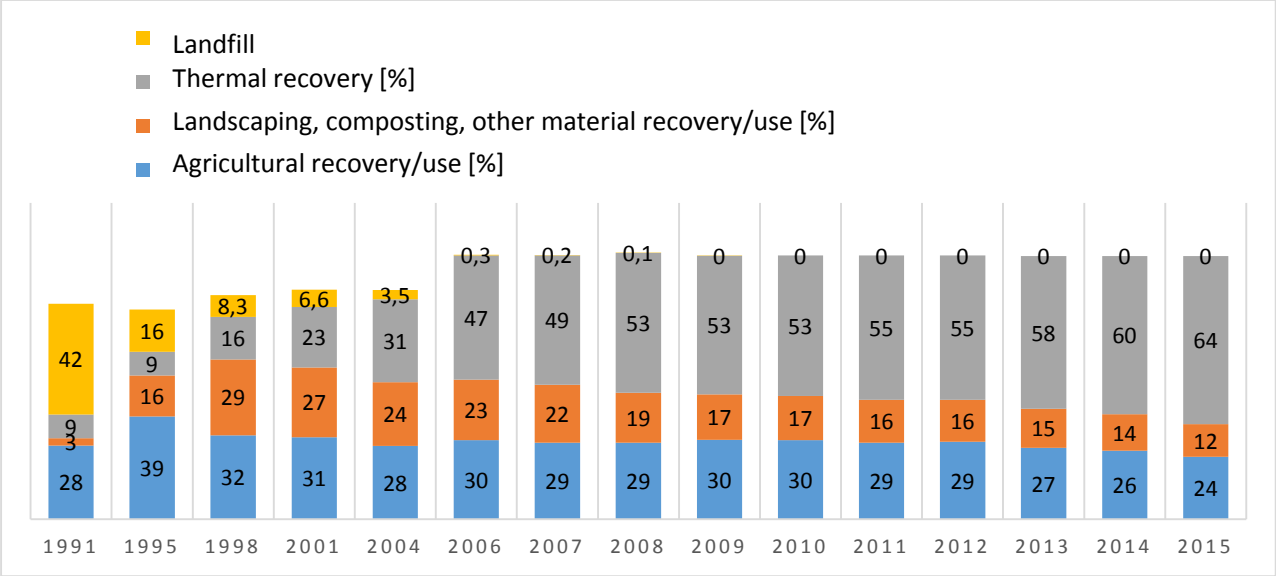
(LAGA 2010)

36 The PFT levels determined to date in SH in sewage sludge used agriculturally were all below the recommended value of 100 µg/kg DM).

37 In addition to use on land used for agriculture and gardening, also applies to recultivation measures and measures for the erection of structures (e.g. landscaping construction).

According to BMU (2008), the level of individual organic tested for in municipal sewage sludge has decreased or stagnated in recent years. At the same time, the proportion of sewage sludge used in agriculture, agricultural building and compositing is falling slightly. In 2004, the proportion was still 52 percent, by 2015 it had reduced to 36 percent (see Figure 5).

Figure 5: Disposal routes of sewage sludge over time, dated 2015.



(after Wiechmann et al. 2013 and DESTATIS)

To prevent possible accumulation of pollutants in soil in the long-term, efforts are made to continue to increase the requirements for sewage sludge that can be used agriculturally. According to the Recycling Management Act (Kreislaufwirtschaftsgesetz), substance requirements for the use of sewage sludge on agricultural land can only be regulated in waste law, if proper and safe use of sewage sludge is not already ensured through provisions in fertiliser law (Art. 11, Paragraph 2, Sentence 3, KrWG). The Fertiliser Regulations (Düngemittelverordnung) already contain an identification value for PFT in fertilisers of 0.05mg/kg dry matter as the sum of PFOA and PFOS and a limit for the placing on the market of fertilisers, soil auxiliaries, culture media and plant growth stimulants of 0.1 mg PFT per kg dry matter.

At the same time, the proportion of sewage sludge disposed of thermally or in co-incineration, increased from 31 % in 2004 to 64 % in 2015. The significant increase in thermal treatment of sewage sludge is due to the requirements of the Waste Dumping Regulations (Abfallablagerungsverordnung), under which the storage of untreated sewage sludge on landfill sites has been prohibited since 2005. The combustion of sewage sludge in suitable mono and co-incineration plants is the main sewage sludge disposal route in future (UBA 2017c). The aim is to give preference to combustion in mono incineration plants, as this is the only way for the recoverable materials in the sewage sludge ashes produced (especially phosphorous) to be re-used to save resources (BMUB 2016, page 72f). Alternatively, the phosphorus can be recovered before the thermal treatment. Co-incineration should continue to be possible for low-phosphorus sewage sludge.

6.3.7 Contaminated land/harmful soil contamination

At present, more than 271,000 sites in Germany are recorded as potentially contaminated (BMUB 2016). Details of the current number of recorded sites are given in the respective Länder in the corresponding contaminated land registers or by the German Environment Agency (LABO 2016 and UBA 2016b). These

usually provide information about all uses of the land to date, their technological orientation and contaminations typical for the industries concerned. During production of lindane (γ-HCH), large quantities of α- and β-HCH were created as "by-products", which used to be stored above ground, including in Germany. With the inclusion of the compounds as POPs, these landfill sites are to be viewed as being POP contaminated sites (UBA/Friedrich pers. comm. 2011). Vijgen (2006) assumes that 390,000 to 450,000 tonnes of HCH residues exist in Germany.

7 Measures for Public Information, Developing Awareness, Education (Article 10)

Providing information, developing awareness and educating about POP-relevant topics is currently carried out by the German Environment Agency and the Länder.

The German Environment Agency informs the public in print media, press releases and via the internet (UBA 2016c, UBA 2016d, POP-Dioxin Information Portal 2016) about current cases (UBA 2010) and areas of use of POPs and problems that result due to their use.

7.1 Pollutant release and transfer register (Thrude formerly PRTR)

PRTR stands for ***P**ollutant **R**elease and **T**ransfer **R**egister*.

The PRTR Germany provides online information, e.g. about pollutants released in a region by large industrial companies. It thus makes a contribution to increased transparency of environmental information and is intended to motivate companies to increase their environmental performance (Thrude 2016).

On the basis of the European PRTR Regulation (Regulation (EC) No. 166/2006, E-PRTR Regulation, Article 5) and the German PRTR Act (Law Implementing the Protocol on Pollutant Release and Transfer Registers (Gesetz zur Ausführung des Protokolls über Schadstofffreisetzungs- und -verbringungsregister – SchadRegProtAG, Art. 3), industrial companies in Germany report to the UBA (Art. 5) in electronic form about

- the release of pollutants into the air, water and soil,
- the transfer of quantities of waste,
- the transfer of pollutants with wastewater, which is discharged into external wastewater treatment plants,

if specific emission threshold values or waste quantities are exceeded.

In addition, PRTR Germany contains information on emissions from diffuse sources, for example, from traffic and agriculture.

Reporting for the PRTR takes place yearly. The first report year was 2007. The data must be reported to the EU and added to the national register 15 months after the end of the respective report year (i.e. by 31st March of the following year).

According to Annex II of the E-PRTR Regulation, 91 pollutants are relevant for releases into the air, water and soil and for transfers of pollutants in wastewater. A facility that carries out a PRTR activity is obliged to report if they come from a specific industry (e.g. the chemical industry or mineral oil industry) or carries out specific activities above a capacity threshold in other industries (see PRTR Regulation Annex I).

In the PRTR, a differentiation is made between hazardous and non-hazardous waste. According to Art. 5 Para. 1 E-PRTR Reg. these must be reported to the PRTR, if

- hazardous waste in quantities larger than 2 tonnes per year,
- non-hazardous waste in quantities larger than 2,000 tonnes per year

are taken outside of the company's site.

A differentiation must be made between waste for recovery and disposal.

Where hazardous waste is shipped abroad, in addition to the provisions named in Regulation (EC) No. 1013/2006, the operator is obliged to give the name and address of the recovery or disposal company and the actual recovery or disposal location.

The PRTR contains information on all POPs of the Stockholm Convention with the exception of PFOS. The complete substance list of the PRTR is specified in Annex II of the PRTR Regulation.

The data are also input into the European database (ePRTR 2016). In addition, individual authorities provide information about POP data specific to the individual Länder, e.g. LANUV NRW (2017).

7.2 Dioxin database of the Federal Government and Länder

With a resolution of the 37th UMK in 1991, the Joint Working Group of the Federal Government / Länder on DIOXINS was given the task of initiating the setting up a central DIOXINS database. In a startup phase from 1993 to 1997, the UBA developed a concept for cross-media database management system for persistent organic substances. In cooperation with the federal authorities and the Länder (DIOXINS Working Group), since 1997 the data for the different environmental compartments has been developed continuously. The BVL is in charge overall technically for the food and feed sector, the health sector is supported technically by the BfR.

The database serves as a central instrument for the documentation and evaluation of results from investigation programmes on dioxin contamination of the environment, of food and feed and humans. In addition, data on waste, recoverable materials and residual materials, sewage sludge and other technical products are included and evaluated. In addition to the programs and investigations that are the responsibility of the federal authorities and the Länder, data from research projects and special projects and from food contaminations that have become known of are also increasingly being input into the database system (Dioxin Datenbank 2016).

An XML interface updated in 2016 enables food data from the database of the BVL to be transferred into the dioxin database of the Federal Government and the Länder. Additionally, implemented software helps to maintain catalogues on the basis of the BVL Catalogue Portal (ADV-Kataloge). This enables improved and prompter updating of the dioxin database and thus up-to-date and prompt information.

The data in the dioxin database of the Federal Government and the Länder is expanded continuously to include congener-specific measurement results from the technosphere. As part of a recently completed evaluation (Quass et al., 2016), more than 800 congener-specific data records for PCDD/F and for PCB sources from the technosphere were added to the data of the dioxin database of the Federal Government and the Länder.

In particular, dioxins and PCB pollution sources from the technosphere were identified and typical congener patterns of various pollutant types were created. Congener profile comparisons were assessed scientifically using statistical methods, in order to better qualify and quantify transfer via different paths in the environment and ultimately in the food chain.

These data are prepared scientifically, and can then be made available in a useful form for further scientific evaluations. The dioxin database of the Federal Government and the Länder must be extended to include other POPs. These include mixed halogenated PCDD/F and PCB and brominated flame retardant,

including their substitute substances. PCBs and thus their substitute substances in particular play an important role in flame retardants/fire resisting agents.

In addition to dioxins and PCBs, data on other environmental pollutants is recorded (including other POPs). These are:

- Chlorobenzenes
- Chlorophenols
- Polychlorinated biphenyls
- Organochloro pesticides
- Polybrominated diphenyl ethers
- Perfluorooctane compounds
- Musk compounds
- Nitro musk compounds
- Polycyclic musk compounds
- Polyhalogenated dibenzodioxins/furans
- Polybrominated flame retardant
- Polychlorinated naphthalines (PCN)

The task of the technical application developed for the dioxin database is not only to include and uniformly structure the monitoring data collected in Germany from investigation programmes, to display trend statements with relation to time and space on the contamination situation in various compartments, but also to provide data and information on contamination events, e.g. in food. These evaluations and assessments can ultimately be used for implementation of environmental policy measures (adjusting statutory provisions), to determine a need for further data and to fulfil national and international obligations to document the status of the environment. Three reports on the status of the environment with POPs were published by the German Environment Agency in 2002 and 2007. In the following years evaluations and assessments of the data available within the scope of environmental data took place and are taking place (see following chapter). These online offers on the status of the environment in Germany are updated yearly.

7.3 Environmental data

On the internet site "Data on the Environment 2015 - Environmental Trends in Germany", interested parties can find data on the cause of environmental pollution, changes in the environmental status, effects on humans and the environment and environmental policy objectives, strategies and measures. Up-to-date tables and graphic diagrams, background information on data sources, their legal basis and environmental policy quality and action targets are available on these topics. In addition, links to further literature and internet sites of other German and international institutions are given for more in-depth information and are also updated annually and not event driven.

Comprehensive information is also provided here on the POPs, e.g. on emissions, immission, soil contamination, etc. The articles are created in cooperation with other federal authorities, especially the BMUB and the Federal Statistics Office (UBA 2015a).

7.4 Small combustion plants

Small combustion plants are a relevant source of POPs. Reduction in emissions is primarily possible by preventing the use of impermissible fuels (e.g. treated wood, other waste). The UBA and many Länder provide information on correct handling of small solid fuel combustion plants, which is intended to enlighten operators and assist chimney sweeps with their advisory work under 1. BImschV (see Chap. 2.4.2)

8 Research, Development and Monitoring Measures (Article 11)

Article 11 of the Stockholm Convention requires the States that are Party to the Convention, within their capabilities, to encourage and/or undertake suitable research, development and monitoring at national and international level pertaining to

- POPs,
- if relevant their alternatives and
- candidate persistent organic substances.

In addition to the sources and releases into the environment (Para. 1 lit. a), this also involves the presence, levels and trends in humans and the environment (Para. 1 lit. b) and the effects on human health (Para. 1 lit. d).

8.1 Research

Research at different levels in Germany is described in the following. This includes activities of the Federal Government that have been or are undertaken, for example, as part of the UFOPLAN[38] and research projects of the Länder. Where the objective of a project is to examine a specific issue or situation rather than to undertake continuous testing and measurement, it is considered to be distinct from monitoring.

8.1.1 Activities of the Federal Government

Identification of substances with POP properties

To develop the criteria and identify chemicals with POP properties, the existing methods for forward-looking appraisal of the long-distance transport potential of semi-volatile organic compounds are developed further. This concerns instruments for identifying substances with properties stated in Annex D of the Stockholm Convention and evaluating them for their POP properties.

To this end, funds from the BMU's research budget were used to drive forward further development of the POP criteria, with focus here on the PBT substances and the identification of new candidate POPs

38 The Federal Ministry of the Environment needs sound, scientifically substantiated information as the basis and help in its decision-making and thus implementation of its environmental policy objectives. The departmental research of the BMU makes a significant contribution to this. This is geared to the priorities and objectives of the environmental policy. The medium-term research requirements of the BMU necessary for this is described in a research framework. The research projects resulting from the research framework are set out annually in the environmental research plan (UFOPLAN) of the BMU.

(BMU 2011e, BMU 2010). Furthermore, new detection methods for POPS in the environment were to be tested in research projects (BMU 2010).

In addition, research projects were drawn up, whose purpose was to establish the presence of POPs in the environment and in articles, in order to determine Germany's status quo with regard (in particular) to the new POPs.

To determine the occurrence of five new POP substances (HBCD, HCBD, PCP, PCN and SCCP), proposed for inclusion in the Stockholm Convention, in waste and recycling materials, between 2012-2015 a research project was conducted in which limit values were also derived for the destruction of the POP levels in waste. On the basis of this data, proposals were derived for the limit values in Annex IV of the POP Regulation and for specific disposal routes, which on the one hand ensure the greatest possible removal of pollutants and on the other hand enable environmentally sound recycling processes (UBA 2015).

In the environmental research plan (UFOPLAN) of the BMUB, the research topic dioxins and PCBs is a focal point within the environmental policy area of "substance risks". The objective is to reduce the risks of chemical substances and preparations by detecting and controlling them. National and international scientific establishments and research institutes conduct these investigations to determine the whereabouts of these chemicals in the food chain and in the environment.

In cooperation with the BMUB, the German Environment Agency started a research project on path-based elucidation of causes, in particular, to examine food contamination paths. The global DIOXIN project: Elucidation of the causes of dioxin pollution sources and sinks (Ursachenaufklärung für Quellen und Senken der Dioxinbelastung) (FKZ: 3712 65407) was divided into subproject 1 "Analysis and trend estimation of the pollution of the environment and contamination of food with selected POPs and extension of the data in the dioxin database of the Federal Government and the Länder with the objective of path-base elucidation of causes" (Analyse und Trendabschätzung der Belastung der Umwelt und von Lebensmitteln mit ausgewählten POPs und Erweiterung des Datenbestandes der Dioxin-Datenbank des Bundes und der Länder mit dem Ziel pfadbezogener Ursachenaufklärung) (FKZ 3712 65 407 1, Weber et al., 2015) and subproject 2 "Assignment and quantification of dioxin inputs into the air path by examining emission-side and immission-side congener patterns" (Zuordnung und Quantifizierung der Dioxineinträge auf dem Luftpfad mittels Betrachtung der emissionsseitigen und immissionsseitigen Kongenerenmuster) (FKZ 371265 407 2, Quass et al. 2016). This project describes the overall problem of environmental pollution due to polychlorinated dioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) in a structured way, in particular, with regard to the environment - food path.

Attention is focussed on analysis of the priority problem areas of air, soil, biota and pollutants from/in the technosphere. Resulting need for action is determined and already confirmed aspects of the situation of PCDD/F and PCB impacts on the environment and food are named. Investigation results for PCDD/F, PCB and other chloro organic compounds, acquired through scientific monitoring and regulatory compliance monitoring programmes of the Federal Government, Länder and scientific establishments, and through event-related projects are summarised. Sources and sinks of PCDD/F and PCB and possible input paths in the environment are identified. The focus is on input paths in the food chain and contamination of livestock.

Another focal area is the analysis and assessment of the contamination of buildings with PCB. In the 1960s and 1970s, substances containing PCB, such as joint sealing compounds, paints and coatings were used in the construction of buildings and houses. Due to the persistence of PCB, these buildings potentially still pose a risk to the environment, humans and animals.

The research report on the second subproject (FKZ 3712 65 407 02, Quass et al., 2016) also includes estimates of the potential inventories of PCB and PCDD/F, the ranges of atmospheric immissions and the retention time and remobilisation potential.

PCB substitutes also require documentation. For example, use of chloroparaffins and tetrachlorobenzene increased after the PCB ban. This key aspect is taken into account by a current research project of the German Environment Agency. To this end, a further research project was initiated: “Evaluation of monitoring data on POPs, POP candidates and substitute substances to elucidate the causes, paths and trends of environmental pollution" (Evaluierung von Monitoringdaten zu POPs, POP-Kandidaten und Ersatzstoffen zur Aufklärung von Ursachen, Pfaden und Trends der Umweltbelastung) (FKZ 3715 65 423 0)

The intention of the project is to process existing monitoring data of the Federal Government, Länder and scientific institutions on POPs, their substitutes and the POP candidates acquired from programmes and event-based projects. It is based on the available results on the POP data pool from the research project FKZ: 205 61 435 “Evaluation of POP exposure data” (Evaluierung von Expositionsdaten zu POPs) (completed 5/ 2007) and the results of the R&D projects FKZ371265 407/01, Weber et al., 2015 and FKZ 3712 65 407 2, Quass et al., 2016. A particular focus of the data work is POP substitutes.

A team of international experts headed by the German Environment Agency, has been researching the impact of persistent organic pollutants (POPs) on remote alpine regions since 2005 and developed new methods specifically for this purpose. The results enable regions of origin, seasonal differences and long-term trends to be analysed for the first time ever. In the international MONARPOP research project (Monitoring Network in the Alpine Region for Persistent Organic Pollutants), the occurrence of POPs in the Alps is examined in an international collaboration. The focus is primarily on dioxins, furans and polychlorinated biphenyls (PCB). The measurement results from 2005-2013 verify that POPs are transported in the air over long distances and the Alps act as a barrier. The cold conditions of high Alpine areas increase persistence and local accumulation (see also Chapter 13.2.2).

8.1.2 Activities of the Länder

An overview of the research and monitoring projects in the individual Länder is given in tables 15 and 16 in the Appendix. Table 17 names information portals for the public. The activities of the Länder listed there and the research project data and reports can be called up in the information portal of the dioxin database (see Chapter 7.2).

8.2 Monitoring activities of the Federal Government

This section describes the monitoring activities, which alongside other substances, also include the monitoring of POPs. On the one hand, monitoring programmes of the Federal Government are named, which are used to assess impact on the environment – including humans – (8.2.1 - 8.2.4), and on the other hand, monitoring programmes of the Federal Government, which are used to assess environmental pollution in the narrower sense and in the context of specific legal provisions.

The German Environment Agency operates a nation-wide air monitoring network to investigate long-range transboundary air pollution within the framework of international monitoring programmes (the EMEP (European Monitoring and Evaluation Programme)) and to take measurements in rural background locations in accordance with the EU Air Quality Directive. Within the scope of the EMEP, as the national coordination body, the German Environment Agency reports on the annual emissions of selected POPs, which occur unintentionally in various sectors and get into the environment. Within the EMEP programme, the German Environment Agency measures, among other things, indicator PCB, at 5

stations and makes this data available to the programme (see Chapter 8.2.5). The UBA also writes the Informative Inventory Report (IIR) and is responsible for quality control and quality assurance at all relevant process steps. At the same time, the national coordination body is the single point of contact (SPC) for all the institutions involved.

8.2.1 German environmental study on health (formerly called the Environmental Survey)

Since 1985, the German Environment Agency has repeatedly undertaken studies on large cross-sections of the population to investigate the potentially harmful substances and environmental impacts with which people in Germany come into contact. Currently, with the German Environmental Study of the Health of Children and Young People (Deutschen Umweltstudie zur Gesundheit von Kindern und Jugendlichen), nationwide data is being collected on the physical contamination of children and young people and their possible exposure in their homes. Children and young people aged 3 to 17 years old from 167 investigation locations in Germany are taking part in the study; they were selected so that they are representative for the population of the named age group in Germany.

Within the framework of the Human Biomonitoring (HBM), blood and urine samples of the participating children and young people are examined. The drinking water, house dust and indoor air, among other things, are examined for contaminants in order to characterise the living environment.

In particular, analyses are performed of

- endocrine disruptors (substances that can harm health by influencing the hormone system) such as flame retardants, parabens, phthalates and bisphenol A,
- Substitutes for phthalates in plastics and other plasticisers,
- Substances that can harm the nervous system, such as polychlorinated biphenyls (PCB), mercury and pesticides from the group of chlorinated cyclic hydrocarbons,
- Air pollutants such as fine dust, ultrafine particles, benzothiazoles, naphthalin, toluene, formaldehyde and other volatile organic compounds,
- potentially carcinogenic and cancer-promoting substances such as lead, arsenic, polycyclic aromatic hydrocarbons (PAH), volatile organic compounds such as benzene, formaldehyde,
- substances with low degradability or long residence times in the body, such as polyfluorinated compounds, cadmium, lead.

Standardised interviews are also held with the participants and their parents, to determine significant factors, which influence the extent of the individual contamination, e.g. home environment, home fixtures and fittings, eating habits, product uses and environmentally relevant behaviour.

The current data is used to derive reference values, which describe the extent of the contamination of children and young people in Germany with environmental pollutants at the time of the investigation (so-called background contamination). These reference values can be used as an evaluation standard, when it comes to determining whether comparatively increased contamination of test subjects exists or not. If applicable, the cause of the increased contamination should then be clarified. The reference values are pure statistically defined values, which are given no health significance per se. The so-called HBM values must be used for a health appraisal of measured values.

8.2.2 Dioxin database of the Federal Government and Länder

The dioxin database of the Federal Government and the Länder is a good example of cooperation between the Federal Government and the Länder. It is a comprehensive, cross-media instrument, in which

data collected in Germany from the environment, and food and human data, including the metadata necessary for their assessment, are documented.

The database currently contains exposure data from around 489 compartment-specific monitoring programs with more than 34,000 congener-specific individual samples for the environmental compartments soil, water, air, biota (plant, animal), for waste, recoverables, residual materials, preparations and articles, for house and attic dust, for feed and food and for human samples (tissue, bodily fluids). It also contains extensive information on sampling, analysis and location description.

The Federal Government and state authorities are jointly responsible for maintaining the data records. The exchange of data is based on the administrative agreement between the Federal Government and the Länder on environmental data exchange, in the version of March 1996, with Annex II.3. "Exchange of data on polyhalogenated dibenzodioxins and dibenzofurans and other chloro organic substances" (Austausch von Daten zu polyhalogenierten Dibenzodioxinen und Dibenzofuranen sowie weitere chlororganische Stoffe).

Since 2003, it has been possible to access this data and information via a web portal. This application simplifies data exchange between the participants, quality assurance by the data suppliers and access to the aggregated data (e.g. trend evaluation) as well as the underlying individual data. Access can be controlled through a rights and roles concept. More than 250 professional users currently have online access to the database system. They can use it to generate queries and perform evaluations. Users of the database can transmit metadata of measurement results or monitoring programmes via an online data entry form. A WebService interface also allows quality-assured data to be downloaded.

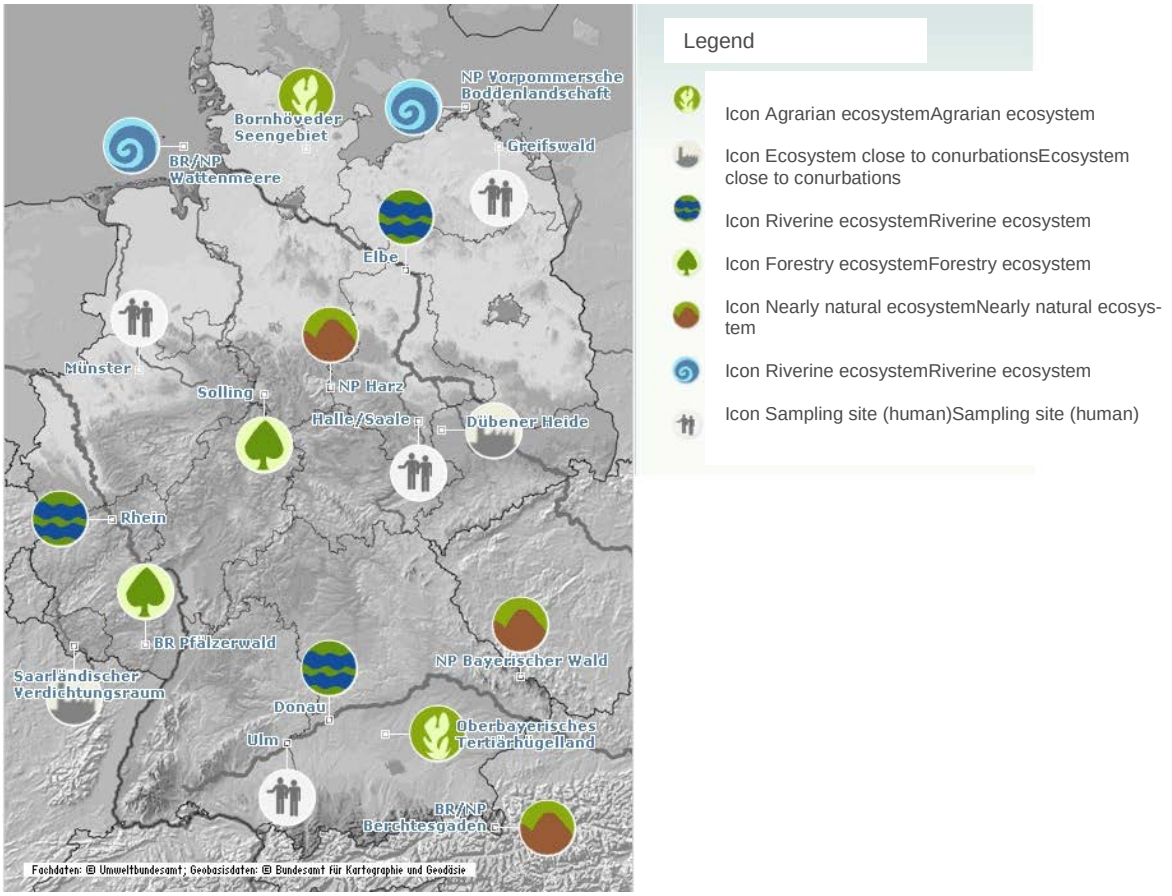
Furthermore, regular meetings are held or rather were held with representatives of federal and Länder authorities, laboratories and representatives of organic farmer associations.

8.2.3 Environmental specimen bank

Since the beginning of the 1980s, the German Environment Agency has coordinated the Environmental Specimen Bank (Umweltprobenbank 2016a) of the Federal Government on behalf of the Federal Ministry of the Environment. With the collection and long-term storage of defined environmental and human samples, the environmental specimen bank pursues the goal of tracking the behaviour and whereabouts of substances that are particularly persistent and accumulative in the environment, and recording the contamination of humans with these substances.

The environmental specimens include samples from terrestrial, limnic and marine habitats. In addition, various human samples are collected (blood plasma, whole-blood, 24-hour urine collection). The samples are taken periodically from the same ecosystems/populations, so that long-term trends can be described. Abb. 4, p. **Fehler! Textmarke nicht definiert.** gives an overview of the individual sampling areas/populations.

Figure 6: Sampling areas of the environmental specimen bank



Source: Environmental specimen bank (Umweltprobenbank, 2016b)

A range of substances/substance groups covered by the Stockholm Convention are regularly analysed in the monitoring programme of the environmental specimen bank. For many of these substances, 20-30-year time series exist in samples of various species and compartments. For example, for seagull eggs, various North Sea island results exist for dioxins/furans/dl-PCB, aldrin, dieldrin, heptachlor, octachlorostyrene (OCS), pentachlorophenol (PCP), HCB, PCB, DDT, PeCB, HCH, PFOS and other PFAS, PBDE, HBCDD), Trends for PBDE, HBCDD, HCB, PFAS (10) and dioxins/furans, DL-PCBs exist for fish from the Baltic Sea and North Sea and inland waters. Some of these compounds are also examined in terrestrial samples, for example, in deer liver. The data is available to download and/or in report form on the website of the environmental specimen bank (Umweltprobenbank). In addition to studies to check the effectiveness of substance restrictions, the environmental specimen bank also examines the trends and levels of substitute substances, which are marketed instead of the regulated substances. Current examples are short and long-chain PFAS and Dechlorane Plus and other flame retardants.

8.2.4 "Fourth WHO-coordinated survey of human milk for persistent organic pollutants"

The UBA (FG IV 2.2) coordinates the German contribution to the *"Fourth WHO-coordinated survey of human milk for persistent organic pollutants"* (WHO 2007). Based on concentration measurements of PCDD/F, PCB in human milk samples of earlier studies in 1987 to 2003, in another campaign, data was acquired for chronological trend statements on these substances (UBA 2008).

Unlike in earlier years, the investigation programme, which is conducted on behalf of the ***G**lobal **E**nvironment **M**onitoring **S**ystem* - Food Contamination Monitoring and Assessment Programme

(GEMS/Food) of the WHO, was not limited to PCDD/F and PCB, but was extended to include all substances in the annexes to the Stockholm Convention. Optionally, PBDEs should also be measured. The report on this project was made available to the WHO in 2007 (WHO 2007).

8.2.5 Environmental monitoring activities in the context of European legislation

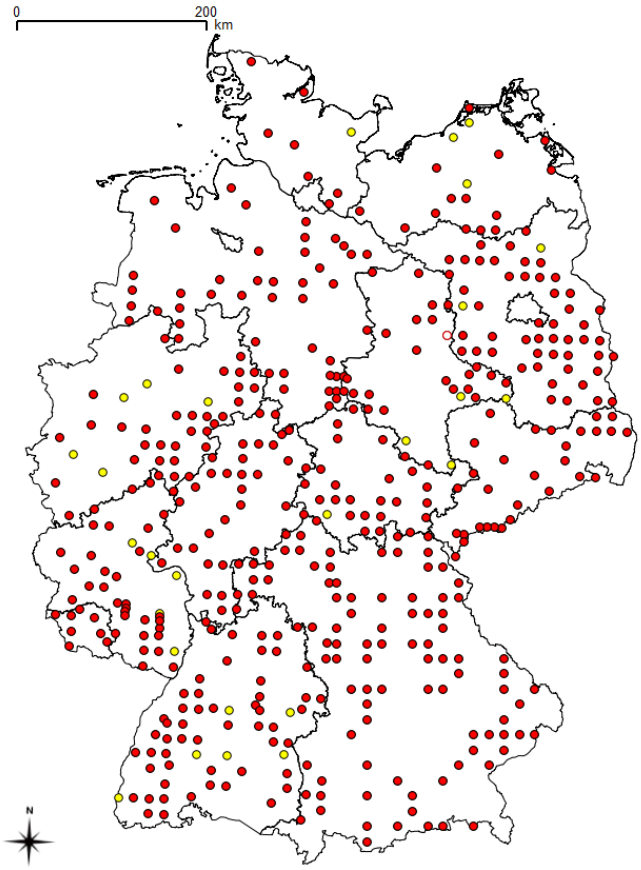
No specific monitoring programmes solely for the POPs of the POP regulation exist in Germany. The substances measures within the framework of environmental monitoring activities generally follow the requirements of European regulations and directives (e.g. priority substances of the WFD) or other international monitoring programmes (HELCOM, OSPAR). The respective substances measured in the programmes also include individual substances included in the annexes to the Stockholm Convention and/or the POP Protocol of the CLRTAP.

Forest soil status survey – background contamination with persistent organic substances

On planning the second forest soil status survey the Joint Working Group of the Federal Government /Länder "BZE II" considered it necessary to collect data on persistent organic substances (organic compounds) and included them in the draft paper of the BZE II (BZE 2007). The objective of the Joint Working Group of the Federal Government / Länder "BZE II" was, in view of the hazardousness and general spread of the POPs, to improve the database on their propagation and contamination of the forest ecosystems. The survey was carried out with work shared between the forestry and environmental side. Determination of typical levels of organic pollutants in forest soil is an independent project of the environmental side. The soil samples required for this were taken by the Länder as part of the BZE II. The background levels for Germany of the following substances representative for a site were determined: DDT and metabolites, HCB, HCH, PCB6, aldrin/dieldrin and PAH16.

The sampling concept of the BZE II was used for the survey, whereby the points of the ICP Forest and the EU BioSoil Programme (16 km x 16 km grid, approx. 450 points) were chosen from the grid of approx. 2,000 BZE sampling points (8 km x 8 km grid) (BMELV, 2016). This ensures comparability of the results at European level. In addition, the grid density was increased locally in some areas. This increased the size of the sample to around 475 points in total. The examined sampling horizons are the forest floor and the depth levels 0 – 5 cm and 5 – 10 cm of the topsoil.

Figure 7: Sampling points of the BZE II – additional organic compounds programme



Red: ICP Forest or EU BioSoil Programme (16kmx16km network; approx. 450 points); Green: Additional compaction points (26 points)

MONARPOP

The international **Mo**nitoring **N**etwork in the **A**lpine **R**egion for **P**ersistent **O**rganic **P**ollutants (MONARPOP) surveyed POPs in the Alps from July 2003 to December 2007. Due to the higher precipitations and lower temperatures, deposition of POPs is increased in this region. Before the project was started, the significance of contamination had hardly been surveyed. MONARPOP examined the POPs and other organic pollutants, in particular, with regard to their:

- long-distance transport into remote alpine regions,
- primary source areas
- extent of contamination in the Alps, including regional differences,
- change with altitude,
- inventories stored in forest forests of the Alps,
- possible biological effects of the measured contaminations.

Also, the intention was to provide decision-makers with information and thus establish an instrument for monitoring the success of the Stockholm Convention (Monarpop 2017). Almost all the POPs analysed were also found in the environmental samples. Particularly astounding is, that both mirex, which was never used in Central Europe, and DDT, which was banned in the 1970s, were found in samples that indicate current contamination. For example, they were found in the air, deposits or in needle samples (Monarpop 2009).

EMEP

The United Nations Economic Commission for Europe has a ***E**uropean **M**onitoring and **E**valuation **P**rogramme* - EMEP 2016. EMEP provides information about emissions, concentrations, depositions and long-range transboundary transport of air pollutants and draws up emission scenarios. EMEP uses the emission data provided by the states and meteorological data to model transport and transformation of air pollutants in the atmosphere and concentrations and depositions of air pollutants. EMEP also determines the transboundary transport of the pollutants as pollutant import and export balances. Within the framework of EMEP, the UBA makes the German contribution to a Europe-wide air monitoring network, which provides measured data of the long-distance transport of air pollutants. POPs were already included in the monitoring programme in the 1990s. The measurements for the German share of the project are taken by the UBA at five stations of the air monitoring network (coastal, lowland and low mountain range stations) (UBA 2017d). The POPs determined in the UBA air monitoring network include PAHs, organochloro pesticides (e.g. g-HCH) and PCBs.

Water monitoring

In implementation of the WFD, according to the OGewV 2016 (Annex 6 and 8), investigations are conducted for so-called priority substances, other pollutants and river basin-specific pollutants. These include many POPs. The investigations are carried out in the water and/or suspended solids phase and/or biota. Some monitoring programmes are also supplemented by effect monitoring with biomarkers.

Furthermore, specific substances are also investigated within the scope of the coordinated monitoring programmes of the international river basin commissions for the River Danube, Elbe, Oder and Rhine. The choice of substances is defined by commissions made up representatives of the riparian states and the results are published. The monitoring programmes are adjusted continuously and are increasingly orientated to the substances of the WFD. For example, a report drawn up on behalf of Hamburg's environment and energy authority, documents substance properties, production and use and legal provisions for polychlorinated biphenyls within the River Elbe catchment area. It also takes a detailed look at their spatial distribution and development over time and names significant pollutant source regions and types (ELSA 2016).

A report on behalf of the State Office for the Environment, Nature Conservation and Geology of Mecklenburg West-Pomerania (Landesamt für Umwelt, Naturschutz und Geologie Mecklenburg–Vorpommern) presents the results of pollutant monitoring conducted in 2015 on fish from selected flowing, still and coastal waters of Mecklenburg-West Pomerania. In addition, for the period of the monitoring investigations conducted to date (2013 – 2015), the measurement results of the EU-regulated priority pollutants with the corresponding Biota EQS (Lung 2016).

The Joint Federal Government/ Länder Monitoring Programme for the Marine Environment of the North Sea and Baltic Sea (BLMP) works with other domestic and international establishments and programmes, e.g. the river monitoring programmes

- RBC Elbe (FGG Elbe 2017),
- RBC Weser (FGG Weser 2017)
- and the **T**rilateral Wadden Sea **M**onitoring and **A**ssessment **P**rogramme (TMAP) based in Tönning and Wilhelmshaven (Nationalpark Wattenmeer 2011).

.

In the "Investigations into the accumulation of various persistent contaminants in terrestrial wild animals" ("Untersuchungen zur Akkumulation verschiedener persistenter Schadstoffe)in terrestrischen

Wildtieren") the Bavarian State Environmental Agency (bayrische Landesamt für Umwelt) (LfU 2016) conducted a research project on the contamination of Bavarian wild animals with various polybrominated flame retardants, polychlorinated biphenylene (PCB), polyfluorinated tensides (PFT), polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/F), various endocrine disrupters and heavy metals. The final report is now available and presents the results. Samples were taken from the liver and in part from the flesh of various wild animals in five forest areas of Bavaria with different levels of contamination. Increased levels of the PCB and PCDD/F substance groups were found in the liver samples of all species examined. By contrast, most of the samples analysed for endocrine disrupters had levels below the respective quantification or detection limit. Comparatively low levels of low fluorinated flame retardant were also found in the liver samples.

8.3 Monitoring activities of the Länder

The authorities of the Länder of Germany also carry out investigation programmes to monitor environmental status within the scope of their enforcement activities. The results of the investigation programmes are needed and used as the basis for the design and organisation of regional measures.

To fulfil the obligations under the Water Framework Directive (WFD), the Länder conduct investigation programmes into the contamination of surface water with micropollutants, which also include POPs. Here the concentrations in the water phase and partly in the biota are recorded. In several Länder the investigation programme extends beyond the obligations of the WFD. This concerns the range of substances examined and the conducting of sediment and suspended solid investigations. In addition, in recent years, the occurrence of PFOS (BW, RP, TH) and the POP candidates PFOA (RP, BW) in the groundwater has been determined in several Länder.

The continuous soil monitoring programme, within which POPs are also investigated, was continued in almost all Länder. Background values were determined, especially for POPs, although the selection of substances investigated varied between the Länder.

Furthermore, individual Länder operate specific monitoring programmes for environmental pollution due to POPs. For example, Baden-Württemberg set up a long-term programme for the investigation of peregrine falcon eggs within the framework of cross-media environmental monitoring. As things stand, all POPs listed up to 2013 have been included to date. Peregrine falcon eggs have proven to be a good bioindicator for the POP monitoring required under the Stockholm Convention. The state intends to continue the programme in the future.

8.4 Regulatory compliance monitoring

Regulatory compliance monitoring, in distinction to scientific or data monitoring, involves monitoring the implementation of statutory provisions. It can also overlap with the data / scientific monitoring. The scientific and regulatory compliance monitoring activities of the Länder are listed in the Appendix in Table 17.

8.4.1 Activities of the Federal Government and the Länder

Since 1997, the competent departments of the Federal Government and the States of Bremen, Hamburg, Mecklenburg-West Pomerania, Lower Saxony and Schleswig-Holstein have worked together to monitor the marine environment of the North Sea and Baltic Sea within the framework of the Joint Federal Government/ Länder Monitoring Programme for the Marine Environment of the North and Baltic Seas (BLMP).

To support implementation of the EU Marine Strategy Framework Directive (MSFD) (2008/56/EC), with effect from 30 March 2012, the BLMP was replaced by the Marine Protection Administrative Agreement of the Länder and the Federal Government and the Federal Government/ Länder Committee for

the North and Baltic Seas (Verwaltungsabkommen Meeresschutz der Ländern und des Bundes and the Bund/Länder-Ausschuss für Nord- und Ostsee) (BLANO) (VerwAbk Meeresschutz, 2012). Cooperation to date in monitoring the marine environment is continued, taking into account the existing distribution of competency between the Federal Government and the coastal Länder of Germany and the additional requirements of the MSFD. "BLMP", as the abbreviation for the "Federal Government/ Länder Monitoring Programme", continues to be used for the joint monitoring and assessment of the marine environment of the North and Baltic seas by the Federal Government and the coastal states within the framework of the Marine Protection Administrative Agreement.

The objective of the cooperation is to achieve efficient and complete fulfilment of the national, European and international obligations. The Federal Government and coastal states cooperate for the purpose of marine protection, in particular,

- "in the implementation and execution of the EU Marine Strategy Framework Directive;
- for joint monitoring and assessment of the marine environment of the North and Baltic Seas;
- within the framework of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention);
- within the framework of the Convention on the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention);
- in the coordination of marine protection with the Trilateral Cooperation on the Protection of the Wadden Sea ;
- in the incorporation of relevant EU Directives insofar as useful and necessary for the implementation of the MSFD (including the Fauna Flora Habitat Directive (92/43/EEC) and the Birds Directive) and
- in deriving marine protection requirements in conjunction with the objectives of the EU Water Framework Directive (WFD)." (VerwAbk Meeresschutz, 2012)

The Federal Government and Länder work together, "*to coordinate and improve fulfilment of national, European and international obligations, to create synergies, to ensure the quality of the data, to agree and harmonise the monitoring programmes for investigation of the status of the North and Baltic Seas, to document the investigation reports, to assess the condition of the national coastal and marine waters together and to inform each other about all findings significant for the environmental status of the North and Baltic Seas. The Federal Government is responsible for maintaining the data and information and making it available for the fulfilment of national, European and international obligations. The signatories [of the Administrative Agreement] ensure effective and timely provision of required quality assured data, information and documents for fulfilment of the agreed purposes." "The signatories shall coordinate, consult and agree the individual tasks to ensure that coherent marine strategies are developed jointly by the Federal Government and Länder."* (VerwAbk Meeresschutz, 2012). The Federal Government / Länder partners mutually grant each other all exemptions and reductions allowed under their regulations for the costs incurred under the administrative agreement.

The Federal Government represents German interests in the above-named international conventions and in the external relationship with neighbouring states, undertakes the consultation, agreement and coordination in the marine regions. The Federal Government ensures the coordination of the monitoring

programmes, the compilation, presentation and reporting of the results to the international commissions.

The data from the various monitoring programmes are collected, among other things, in the Marine Environment Database (Meeresumwelt Datenbank - MUDAB). The MUDAB is operated by the Federal Institute of Hydrology (Bundesanstalt für Gewässerkunde - BfG) on behalf of the German Environment Agency.

Within the framework of the extensive monitoring programmes of the BMLP and successor cooperations, organic trace substances in water, sediment and biota of the North and Baltic Seas are also investigated. An overview of the individual legal sources, (incl. WFD) in which substances are listed, which are measured, is given in the BLMP Monitoring Manual, Pollutants Information Summaries (BLMP Monitoring-Handbuch, Kennblatt Schadstoffe, MHB, 2015). The Monitoring Manual is being revised to meet the monitoring programme requirements of the Marine Strategy Framework Directive. In addition to monitoring the marine environment, this also requires collecting data for pressure and measures-related indicators.

9 References

3M (2000): Weppner, William A. Phase-out Plan for PFOS-Based Products. 3M. St. Paul, MN. July 7, 2000

ABFALLVERBRINGUNGSGESETZ, Gesetz zur Ausführung der Verordnung (EG) Nr. 1013/2006 des Europäischen Parlaments und des Rates vom 14. Juni 2006 über die Verbringung von Abfällen und des Basler Übereinkommens vom 22. März 1989 über die Kontrolle der grenzüberschreitenden Verbringung gefährlicher Abfälle und ihrer Ent-sorgung (Abfallverbringungsgesetz – AbfVerbrG) vom 19. Juli 2007 (BGBl. I S. 1462), das zuletzt durch Artikel 626 Absatz 1 der Verordnung vom 31. August 2015 (BGBl. I S. 1474) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/abfverbrg_2007/gesamt.pdf

ABFALLVERZEICHNISVERORDNUNG, Abfallverzeichnis-Verordnung vom 10. Dezember 2001 (BGBl. I S. 3379), die zuletzt durch Artikel 1 der Verordnung vom 4. März 2016 (BGBl. I S. 382) geändert worden ist, https://www.gesetze-im-internet.de/bundesrecht/avv/gesamt.pdf

ABWASSERVERORDNUNG - AbwV (wastewater regulations), Verordnung über Anforderungen an das Einleiten von Abwasser in Gewässer (Abwasserverordnung – AbwV) Ausfertigungsdatum: 31.03.1997, in der Fassung der Bekanntmachung vom 17. Juni 2004 (BGBl. I S. 1108, 2625), die zuletzt durch Artikel 20 des Gesetzes vom 31. Juli 2009 (BGBl. I S. 2585) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/abwv/gesamt.pdf

ACEA (2010): Persönliche Mitteilung der ACEA - European Automobile Manufacturers Association, 2010

ALTHOLZVERORDNUNG, Verordnung über Anforderungen an die Verwertung und Beseitigung von Altholz (Altholzverordnung – AltholzV) vom 15. August 2002 (BGBl. I S. 3302), die durch Artikel 6 der Verordnung vom 2. Dezember 2016 (BGBl. I S. 2770) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/altholzv/gesamt.pdf

ALTÖLVERORDNUNG (AltölV), Ausfertigungsdatum: 27.10.1987, in der Fassung der Bekanntmachung vom 16. April 2002 (BGBl. I S. 1368), die durch Artikel 2 der Verordnung vom 20. Oktober 2006 (BGBl. I S. 2298) geändert wor-den ist, http://www.gesetze-im-internet.de/bundesrecht/alt_lv/gesamt.pdf

Anlaufstellen (2007) - Anlaufstellen Basler Übereinkommen: Anlaufstellen-Leitlinien Nr. 5 zur Einstufung von Holzabfällen in den Einträgen B3050 oder AC170, http://www.bmub.bund.de/fileadmin/Daten_BMU/Download_PDF/Abfallwirtschaft/anlaufstellen_leitlinien_5.pdf

ARGE BLMP Nord- und Ostsee (2010a): Arbeitsgemeinschaft Bund/Länder-Messprogramm (ARGE BLMP) für die Meeresumwelt von Nord- und Ostsee, Internetauftritt, (Stand 08.06.2010), http://www.blmp-online.de/Seiten/Infos.html

Baden Württemberg (2001): Richtlinie für die Bewertung und Sanierung PCB-belasteter Baustoffe und Bauteile in Gebäuden (PCB-Richtlinie) – Fassung September 1994, http://www.gaa.baden-wuerttemberg.de/servlet/is/16493/6_1.pdf

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989) http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx

BAuA (2011): Internetauftritt, (Stand 15.05.2009) http://www.baua.de/de/Chemikaliengesetz-Biozidverfahren/Export-Importverordnung/Besondere-Verfahren.html

Bayerisches Immissionsschutzgesetz (BayImSchG): Bayerisches Immissionsschutzgesetz (BayImSchG) in der in der Bayerischen Rechtssammlung (BayRS 2129-1-1-U) veröffentlichten bereinigten Fassung, das zuletzt durch Gesetz vom 2. August 2016 (GVBl. S. 248) geändert worden ist, http://www.gesetze-bayern.de/(X(1)S(qsbmtqpkliyemrboy0jkzvmj))/Content/Document/BayImSchG?AspxAutoDetectCookieSupport=1

Bayerisches Landesamt für Umwelt (LfU 2016)"Untersuchungen zur Akkumulation verschiedener persistenter Schadstoffe in terrestrischen Wildtieren",http://www.bestellen.bayern.de/application/applstarter?APPL=STMUG&DIR=stmug&ACTIONxSETVAL(artdtl.htm,APGxNODENR:283761,AARTxNR:lfu_all_00136,USERxBODYURL:artdtl.htm,KATALOG:StMUG,AKATxNAME:StMUG,ALLE:x)=X

Bayern (1994): Richtlinie für die Bewertung und Sanierung PCB-belasteter Baustoffe und Bauteile in Gebäuden (PCB-Richtlinie), http://www.bgbau-medien.de/html/bau/pcb_rl.pdf

Bergmann, Meike (2007): Bestimmung polybromierter Diphenylether in Kunststoffen und Untersuchungen zum Emissionsverhalten. BAM-Dissertationsreihe, Band 20. Bremerhaven https://opus4.kobv.de/opus4-bam/frontdoor/index/index/docId/138 http://nbn-resolving.org/urn:nbn:de:kobv:b43-1382

BIOABFALLVERORDNUNG, Verordnung über die Verwertung von Bioabfällen auf landwirtschaftlich, forstwirtschaftlich und gärtnerisch genutzten Böden (Bioabfallverordnung – BioAbfV) Bioabfallverordnung in der Fassung der Bekanntmachung vom 4. April 2013 (BGBl. I S. 658), die zuletzt durch Artikel 5 der Verordnung vom 5. Dezember 2013 (BGBl. I S. 4043) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/bioabfv/gesamt.pdf

BIOZID-MELDEVERORDNUNG (Biocide Notification Regulation), Verordnung über die Meldung von Biozid-Produkten nach dem Chemikaliengesetz (Biozid-Meldeverordnung – ChemBiozidMeldeV) vom 14. Juni 2011 (BGBl. I S. 1085), http://www.gesetze-im-internet.de/bundesrecht/chembiozidmeldev_2011/gesamt.pdf

BIOZIDVERORDNUNG (2012) Verordnung (EU) Nr. 528/2012 des europäischen Parlaments und des Rates vom 22. Mai 2012 über die Bereitstellung auf dem Markt und die Verwendung von Biozidprodukten http://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:02012R0528-20140425&qid=1491213939278&from=EN

BIOZID-ZULASSUNGSVERORDNUNG (Biocide Approval Regulation), Verordnung über die Zulassung von Biozid-Produkten und sonstige chemika-lienrechtliche Verfahren zu Biozid-Produkten und Biozid-Wirkstoffen (Biozid-Zulassungsverordnung – ChemBi-ozid-ZulV) vom 4. Juli 2002 (BGBl. I S. 2514), die durch Artikel 15 des Gesetzes vom 22. August 2006 (BGBl. I S. 1970) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/chembiozidzulv/gesamt.pdf

BiPRO (2011): Study on waste related issues of newly listed POPs and candidate POPs, Consortium ESWI Expert Team to Support Waste Implementation European Commission, Service request under the framework contract No ENV.G.4/FRA/2007/0066, 25 March 2011(Update 13 April 2011), http://ec.europa.eu/environment/waste/studies/pdf/POP_Waste_2011.pdf

BLMP Monitoring-Handbuch 2015, Kennblatt Schadstoffe, MHB, http://mhb.meeresschutz.info/de/kennblaetter/neue-kennblaetter/details/pid/28.html?file=files/Kennblaetter%20PDF/de/Gast/kennblaetter_9f967ca7807b707bfd5f9137f769af9e.pdf

BMELV, 2016: http://www.bmel.de/DE/Wald-Fischerei/Waelder/_texte/Bodenzustandserhebung.html

BMLFUW (2004): CHEM - News XIII "aktuelle stoffpolitische Schwerpunkte der Abteilung für stoffbezogenen Umweltschutz - Chemiepolitik. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Österreich

BMU (2004b): Bericht der Bundesregierung zur Umsetzung des Protokolls zu dem Übereinkommen von 1979 über weiträumige grenzüberschreitende Luftverunreinigung betreffend persistente organische Schadstoffe, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) in Zusammenarbeit mit dem Umweltbundesamt (UBA),

BMU (2004c): Pressemitteilung des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit vom 16.06.2004: PCB-Ausstieg in Deutschland fast abgeschlossen, http://www.bmub.bund.de/pressemitteilung/pcb-ausstieg-in-deutschland-fast-abgeschlossen/

BMUB (2016): German Resource Efficiency Programme II, Programme for the sustainable use and conservation of natural resources, Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). http://www.bmub.bund.de/en/service/publications/downloads/details/artikel/german-resource-efficiency-programme-ii/

BMUB (2017): Download gesetzlicher Regelungen zum Bodenschutz: http://www.bmub.bund.de/themen/wasser-abfall-boden/bodenschutz-und-altlasten/downloads/ (getestet 23.01.2017)

Breidenbach, H. (2011): Persönliche Mitteilung von Dipl. Ing. Herbert Breidenbach, ZVO, 2011.

BUNDES-BODENSCHUTZGESETZ, Gesetz zum Schutz vor schädlichen Bodenveränderungen und zur Sanierung von Altlasten (Bundes-Bodenschutzgesetz – BBodSchG)vom 17. März 1998 (BGBl. I S. 502), das zuletzt durch Artikel 3 des Gesetzes vom 9. Dezember 2004 (BGBl. I S. 3214) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/bbodschg/gesamt.pdf

BUNDES-BODENSCHUTZ- UND ALTLASTENVERORDNUNG (BBodSchV) vom 12. Juli 1999 (BGBl. I S. 1554), die zuletzt durch Artikel 16 des Gesetzes vom 31. Juli 2009 (BGBl. I S. 2585) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/bbodschv/gesamt.pdf

BUNDES-IMMISSIONSSCHUTZGESETZ (Federal Immissions Control Act), Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge (Bundes-Immissionsschutzgesetz – BImSchG), Ausfertigungsdatum: 15.03.1974, in der Fassung der Bekanntmachung vom 26. September 2002 (BGBl. I S. 3830), das zuletzt durch Artikel 1 des Gesetzes vom 20. Juli 2011 (BGBl. I S. 1474) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/bimschg/gesamt.pdf

BVL (2009): Absatz an Pflanzenschutzmitteln in der Bundesrepublik Deutschland – Ergebnisse der Meldung gemäß §19 Pflanzenschutzgesetz für das Jahr 2009, Juni 2010: http://www.bvl.bund.de/SharedDocs/Downloads/04_Pflanzenschutzmittel/meld_par_19_2009.pdf;jsessionid=B51DFF6D05E498FBAB811179C0DA8887.1_cid103?__blob=publicationFile&v=2

BZE (2007): Bund-Länder-Arbeitsgruppe „BZE II“, Zielsetzung und Konzeption der zweiten Bodenzustandserhebung im Wald (BZE II-Konzeptpapier), http://bfh-web.fh-eberswalde.de/bze/upload/BZEII_Konzept/0701_BZE-Konzeptpapier_v2korr.pdf

CHEM (2006): Overview of Existing Information on PFOS Production, Use, Emissions and Pathways to the Environment and Cost/Benefits with alternatives/substitutes. 2006-01-25.

CHEMIKALIENGESETZ (Chemicals Act), Gesetz zum Schutz vor gefährlichen Stoffen (Chemikaliengesetz – ChemG), Ausfertigungsdatum 16.09.1980, in der Fassung der Bekanntmachung vom 2. Juli 2008 (BGBl. I S. 1146), das zuletzt durch Artikel 6 des Gesetzes vom 6. Februar 2012 (BGBl. I S. 148) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/chemg/gesamt.pdf

CHEMIKALIEN-SANKTIONSVERORDNUNG (Chemical Sanctions Regulations), Verordnung zur Sanktionsbewehrung gemeinschafts- oder unionsrechtlicher Verordnungen auf dem Gebiet der Chemikaliensicherheit (Chemikalien-Sanktionsverordnung - ChemSanktionsV) http://www.gesetze-im-internet.de/bundesrecht/chemsanktionsv/gesamt.pdf

CHEMIKALIEN-VERBOTSVERORDNUNG (Chemical Ban Regulation) Verordnung über Verbote und Beschränkungen des Inverkehrbringens und die Abgabe bestimmter Stoffe, Gemische und Erzeugnisse nach dem Chemikaliengesetz (Chemikalien-Verbotsverordnung – ChemVerbotsV), Ausfertigungsdatum 20.01.2017, (BGBl. I S. 794), die zuletzt durch Artikel 2 der Verordnung vom 20. November 2017 (BGBl. I S. 94) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/chemverbotsv/gesamt.pdf

COMMISSION DECISION of 27 December 2000 concerning the non-inclusion of quintozene in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant-protection products containing this active substance (notified under document number C(2000) 4136) (2000/816/EC) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32000D0816&rid=1

COMMISSION DECISION of 2 December 2005 concerning the non-inclusion of endosulfan in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing this active substance (notified under document number C(2005) 4611) (2005/864/EC) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32005D0864&rid=1

COMMISSION DIRECTIVE 91/155/EEC of 5 March 1991 defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 10 of Directive 88/379/EEC http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01991L0155-20070601&qid=1496332385393&from=ENCOUNCIL DECISION of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003D0033&rid=2

COMMISSION DIRECTIVE 2014/80/EU of 20 June 2014 amending Annex II to Directive 2006/118/EC of the European Parliament and of the Council on the protection of groundwater against pollution and deterioration http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0080&rid=1

COMMISSION DIRECTIVE 2014/101/EU of 30 October 2014 amending Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0101&rid=6

COMMISSION REGULATION (EC) No 194/97 of 31 January 1997 setting maximum levels for certain contaminants in foodstuffs http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01997R0194-20020405&qid=1498488072557&from=EN

COMMISSION REGULATION (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006R1881-20160401&qid=1498488188702&from=EN

COMMISSION REGULATION (EC) No 552/2009 of 22 June 2009 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards Annex XVII http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009R0552&rid=1

COMMISSION REGULATION (EU) No 453/2010 of 20 May 2010 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0453&rid=1

COMMISSION REGULATION (EU) No 756/2010 of 24 August 2010 amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annexes IV and V http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0756&rid=1

COMMISSION REGULATION (EU) No 757/2010 of 24 August 2010 amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annexes I and III http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0757&rid=1

COMMISSION REGULATION (EU) No 207/2011 of 2 March 2011 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards Annex XVII (Diphenylether, pentabromo derivative and PFOS) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R0207&rid=1

COMMISSION REGULATION (EU) No 252/2011 of 15 March 2011 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards Annex I http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R0252&rid=1

COMMISSION REGULATION (EU) No 1259/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for dioxins, dioxin-like PCBs and non dioxin-like PCBs in foodstuffs http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R1259&rid=1

COMMISSION REGULATION (EU) No 519/2012 of 19 June 2012 amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annex I http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0519&rid=1

COMMISSION REGULATION (EU) No 1342/2014 of 17 December 2014 amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annexes IV and V http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1342&rid=1

COMMISSION REGULATION (EU) No 1357/2014 of 18 December 2014 replacing Annex III to Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1357&rid=1

COMMISSION REGULATION (EU) 2016/293 of 1 March 2016 amending Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants as regards Annex I http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0293&rid=1

COMMISSION REGULATION (EU) 2016/460 of 30 March 2016 amending Annexes IV and V to Regulation (EC) No 850/2004 of the European Parliament and of the Council on persistent organic pollutants http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0460&rid=1

Control of Major Accident Hazard Regulations - 12th BImSchV (STÖRFALLVERORDNUNG, 12. Verordnung zur Durchführung des Bundesimmissionsschutzgesetzes, Störfallverordnung – 12. BImSchV) https://www.gesetze-im-internet.de/bundesrecht/bimschv_12_2000/gesamt.pdf

COUNCIL DIRECTIVE 67/548/EEC of 27 Tune 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31967L0548&rid=3

COUNCIL DIRECTIVE of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01976L0769-20090601&qid=1496329465570&from=EN

COUNCIL DIRECTIVE of 21 December 1978 prohibiting the placing on the market and use of plant protection products containing certain active substances http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31979L0117&rid=1

COUNCIL DIRECTIVE 83/264/EEC of 16 May 1983 amending for the fourth time Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31983L0264&rid=1 DDT-Gesetz (1972):Gesetz über den Verkehr mit DDT (DDT-Gesetz) vom 7. August 1972 https://www.bgbl.de/xaver/bgbl/text.xav?SID=&start=%2F%2F*[%40node_id%3D%27208351%27]&skin=&tf=xaver.component.Text_0&hlf=xaver.component.Hitlist_0#bgbl172082.pdf

COUNCIL DIRECTIVE of 15 July 1991 concerning the placing of plant protection products on the market http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01991L0414-20110801&qid=1496333461102&from=EN

COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01992L0043-20130701&qid=1499070213289&from=EN

COUNCIL DIRECTIVE 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01996L0059-20090807&qid=1498470797223&from=EN DEPONIEVERORDNUNG, Verordnung über Deponien und Langzeitlager (Deponieverordnung – DepV) vom 27. April 2009 (BGBl. I S. 900), die zuletzt durch Artikel 2 der Verordnung vom 4. März 2016 (BGBl. I S. 382) geändert worden ist die zuletzt durch Artikel 1der Verordnung vom 17. Oktober 2011 (BGBl. I S. 2066) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/depv_2009/gesamt.pdf

COUNCIL DIRECTIVE 1999/31/EC of 26 April 1999 on the landfill of waste http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01999L0031-20111213&qid=1498471128062&from=EN

COUNCIL REGULATION (EEC) No 315/93 of 8 February 1993 laying down Community procedures for contaminants in food http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01993R0315-20090807&qid=1498487914609&from=EN

DESTATIS/Cahsun (2011): Information von Nadine Cahsun, Statistisches Bundesamt, Email vom 11.08.2011 bzgl der Sonderauswertung Input/Output gefährliche Abfälle nach EAV-Schlüssel und Anlagenart basierend auf der jährlichen Erhebung des Statistischen Bundesamtes, Fachserie 19 Reihe 1, Umwelt Abfallentsorgung 2008, Er-schienen am 13. Juli 2010, Tabelle 19.1 ergänzt am 15. September 2010, Artikelnummer 2190100087004, Wiesbaden 2010.

DESTATIS/Stute pers. Komm. (2011): Information von Christiane Stute, Statistisches Bundesamt, Email vom 04.03.2011.

Dioxin Datenbank (2016): Übersicht zu Mess- und Beobachtungsprogrammen des Bundes, der Länder und anderer Einrichtungen, http://www.dioxindb.de/

DIRECTIVE 1999/45/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01999L0045-20150601&qid=1496332751903&from=EN

DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing a framework for Community action in the field of water policy http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32000L0060&from=EN

DIRECTIVE 2000/76/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 December 2000 on the incineration of waste http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32000L0076&rid=1

DIRECTIVE 2002/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 7 May 2002 on undesirable substances in animal feed http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02002L0032-20150227&qid=1498488502964&from=EN

DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02002L0095-20130103&qid=1496327978923&from=EN

DIRECTIVE 2006/118/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 December 2006 on the protection of groundwater against pollution and deterioration, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006L0118-20140711&qid=1498458929416&from=EN

DIRECTIVE 2006/122/ECOF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 December 2006 amending for the 30th time Council Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (perfluorooctane sulfonates) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006L0122&rid=1

DIRECTIVE 2008/105/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0105&rid=1

DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&rid=1

DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008L0098-20150731&qid=1498471010562&from=EN

DIRECTIVE 2008/105/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0105&rid=1

DIRECTIVE 2010/75/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02010L0075-20110106&qid=1496383704256&from=EN

DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02011L0065-20160715&qid=1498471605319&from=EN

DIRECTIVE 2012/18/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0018&rid=1

DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0019&rid=1

DIRECTIVE 2013/39/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013L0039&rid=1

Düngemittelverordnung: Verordnung über das Inverkehrbringen von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln (Düngemittelverordnung - DüMV) vom 5. Dezember 2012 (BGBl. I S. 2482), die durch Artikel 1 der Verordnung vom 27. Mai 2015 (BGBl. I S. 886) geändert worden ist" http://www.gesetze-im-internet.de/bundesrecht/d_mv_2012/gesamt.pdf

EC (2011): European Commission – Environment: Waste Shipments: Correspondents' Guidelines and other guidance documents, http://ec.europa.eu/environment/waste/shipments/guidance.htm

ELEKTRO- UND ELEKTRONIKGERÄTEGESETZ, Gesetz über das Inverkehrbringen, die Rücknahme und die umweltverträgliche Entsorgung von Elektro- und Elektronikgeräten (Elektro- und Elektronikgerätegesetz – ElektroG) vom 20. Oktober 2015 (BGBl. I S. 1739), das zuletzt durch Artikel 3 der Verordnung vom 20. Oktober 2015 (BGBl. I S. 1739) geändert worden ist, https://www.gesetze-im-internet.de/elektrog_2015/

ELSA (2016): PCB in der Elbe – Eigenschaften, Vorkommen und Trends sowie Ursachen und Folgen der erhöhten Freisetzung im Jahr 2015. Behörde für Umwelt und Energie, Projekt Schadstoffsanierung Elbsedimente, Hamburg, S. 78 http://elsa-elbe.de/assets/download/fachstudien/ELSA_PCB_Bericht_2016.pdf

EMEP (2001): EMEP Manual for Sampling and Analysis (Version November 2001), http://www.nilu.no/projects/ccc/manual/index.html

EMEP (2016): Internetauftritt, (Stand 29.08.2016): http://www.emep.int/

ePRTR (2016): European Pollutant Release and Transfer Register, http://prtr.ec.europa.eu/#/home

European Commission Report on Implementation of the Thematic Strategy of 2012 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0046&rid=1

FGG Elbe (2017): Flussgebietsgemeinschaft Elbe (FGG Elbe), Internetauftritt, http://www.fgg-elbe.de/fgg-elbe.html

FGG Weser (2017): Flussgebietsgemeinschaft Weser (FGG Weser), Internetauftritt, http://www.fgg-weser.de/

First Regulations on Implementation of the Federal Imissions Control Act (ERSTE VERORDNUNG zur Durchführung des Bundes-Immissionsschutzgesetzes -Verordnung über kleine und mittlere Feuerungsanlagen - 1. BImSchV) vom 26. Januar 2010 (BGBl. I S. 38), http://www.gesetze-im-internet.de/bundesrecht/bimschv_1_2010/gesamt.pdf

Freie und Hansestadt Hamburg (2002): Behörde für Umwelt und Gesundheit: PCB, Die Entsorgung PCB-haltiger elektrischer Geräte und Bauteile, Freie und Hansestadt Hamburg, Behörde für Umwelt und Gesundheit (BUG), Amt für Immissionsschutz und Betriebe, Referat E 33, (Stand August 2002) http://www.hamburg.de/contentblob/135744/data/merkblatt-pcb.pdf

FUTTERMITTELVERORDNUNG (FuttMV), Ausfertigungsdatum 08.04.1981, in der Fassung der Bekanntmachung vom 24. Mai 2007 (BGBl. I S. 770), die zuletzt durch Artikel 2 Absatz 86 des Gesetzes vom 22. Dezember 2011 (BGBl. I S. 3044) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/futtmv_1981/gesamt.pdf

GADSL (2016): Global Automotive Declarable Substance List, http://www.gadsl.org/

Gesetz zur Ausführung des Protokolls über Schadstofffreisetzungs- und -verbringungsregister vom 21. Mai 2003 sowie zur Durchführung der Verordnung (EG) Nr. 166/2006 vom 6. Juni 2007 (BGBl. I S. 1002) (SchadRegProtAG) http://www.gesetze-im-internet.de/bundesrecht/schadregprotag/gesamt.pdf

Grundgesetz für die Bundesrepublik Deutschland in der im Bundesgesetzblatt Teil III, Gliederungsnummer 100-1, veröffentlichten bereinigten Fassung, das zuletzt durch Artikel 1 des Gesetzes vom 21. Juli 2010 (BGBl. I S. 944) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/gg/gesamt.pdf

GRUNDWASSERVERORDNUNG, Verordnung zum Schutz des Grundwassers (Grundwasserverordnung – GrwV) vom 9. November 2010 (BGBl. I S. 1513), http://www.gesetze-im-internet.de/bundesrecht/grwv_2010/gesamt.pdf

Hazardous Substances Regulation (GEFAHRSTOFFVERORDNUNG), Verordnung zum Schutz vor Gefahrstoffen (Gefahrstoffverordnung – Gef¬StoffV), vom 26. November 2010 (BGBl. I S. 1643, 1644), die durch Artikel 2 des Gesetzes vom 28. Juli 2011 (BGBl. I S. 1622) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/gefstoffv_2010/gesamt.pdf

Helsinki Convention http://www.helcom.fi/Documents/About%20us/Convention%20and%20commitments/Helsinki%20Convention/Helsinki%20Convention_July%202014.pdf

IKSD (2016): http://www.icpdr.org/,

IKSE (2016): http://www.ikse-mkol.org/

IKSO (2016): http://www.mkoo.pl/index.php

IKSR (2016): http://www.iksr.org/

IMDS (2016): International Material Data System, https://public.mdsystem.com/en/web/imds-public-pages/home

INFEKTIONSSCHUTZGESETZ, Gesetz zur Verhütung und Bekämpfung von Infektionskrankheiten beim Menschen (Infektionsschutzgesetz – IfSG) vom 20. Juli 2000 (BGBl. I S. 1045), das zuletzt durch Artikel 1 des Gesetzes vom 28. Juli 2011 (BGBl. I S. 1622) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/ifsg/gesamt.pdf

I&P Europe (2011): Persönliche Mitteilung von Markus Sude, Direktor I&P Europe; März 2011.

JRC (2001): Joint Research Center - European Union Risk Assessment Report: Diphenyl Ether, Pentabromo Derivate (Pentabromodiphenyl ether), 1st Priority List, Volume 5, Office of Official Publications of the European Communities Luxembourg, 2001.

KLÄRSCHLAMMVERORDNUNG (AbfKlärV) vom 15. April 1992 (BGBl. I S. 912), die zuletzt durch Artikel 9 der Ver-ordnung vom 9. November 2010 (BGBl. I S. 1504) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/abfkl_rv_1992/gesamt.pdf

KONTAMINANTENVERORDNUNG, Verordnung zur Begrenzung von Kontaminanten in Lebensmitteln (Kontaminanten-Verordnung – KmV), vom 19. März 2010 (BGBl. I S. 287), die zuletzt durch Artikel 1 der Verordnung vom 09.August 2012 (BGBl. I S. 1710 f.) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/kmv/gesamt.pdf

Kraftfahrt-Bundesamt (2016): Fahrzeugzulassungen (FZ). Bestand an Kraftfahrzeugen und Kraftfahrzeuganhängern nach Fahrzeugalter. 1. Januar 2016. FZ 15. Wiesbaden. Seite 7, www.kba.de/SharedDocs/Publikationen/DE/Statistik/Fahrzeuge/FZ/2016/fz15_2016_pdf.pdf?__blob=publicationFile&v=2

Kreislaufwirtschaftsgesetz (KrWG, 2012): Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen (Kreislaufwirtschaftsgesetz - KrWG) vom 24. Februar 2012 (BGBl. I S. 212), http://www.gesetze-im-internet.de/bundesrecht/krwg/gesamt.pdf

LABO (2016): Bund/Länder-Arbeitsgemeinschaft Bodenschutz (LABO) Internetauftritt, http://www.labo-deutschland.de/Startseite.html

LABO (2016a): Bericht des ALA über „Bundesweite Kennzahlen zur Altlastenstatistik, (Stand 16.01.2017), https://www.labo-deutschland.de/documents/Anlage_6-3-1_Altlastenstatistik_2016-1.pdf

LAGA (2010) Bund/Länder-Arbeitsgemeinschaft Abfall - Jahresbericht der Bund/Länder-Arbeitsgemeinschaft Abfall (LAGA) 2010, http://www.laga-online.de/servlet/is/23875/LAGA_JaBer_2010.pdf?command=downloadContent&filename=LAGA_JaBer_2010.pdf

LAGA (2011) Bund/Länder-Arbeitsgemeinschaft Abfall - Jahresbericht der Bund/Länder-Arbeitsgemeinschaft Abfall (LAGA) 2011, http://www.laga-online.de/servlet/is/23875/LAGA_JaBer_2011.pdf?command=downloadContent&filename=LAGA_JaBer_2011.pdf

LAGuS (2015): Landesamt für Gesundheit und Soziales Mecklenburg-Vorpommern - Informationsblatt Hylotox 59, DDT und Lindan in Innenräumen, (Stand 07.2015), http://www.lagus.mv-regierung.de/serviceassistent/download?id=136061

LANUV NRW (2017): Landesamt für Natur, Umwelt und Verbraucherschutz - Emmissionskataster Luft, https://www.lanuv.nrw.de/umwelt/luft/emissionen/emissionskataster-luft/

Lanxess (2010): Persönliche Mitteilung von Dr. Wolfgang Podesta, Lanxess Deutschland GmbH, 2010.

LEBENSMITTEL- und FUTTERMITTELGESETZBUCH, Lebensmittel-, Bedarfsgegenstände- und Futtermittelgesetzbuch (Lebensmittel- und Futtermittelgesetzbuch – LFGB) Ausfertigungsdatum: 01.09.2005, in der Fassung der Bekanntmachung vom 22. August 2011 (BGBl. I S.1770), das durch Artikel 2 Absatz 17 des Gesetzes vom 22. De-zember 2011 (BGBl. I S. 3044) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/lfgb/gesamt.pdf

LfU (2016): Untersuchungen zur Akkumulation verschiedener persistenter Schadstoffe in terrestrischen Wildtieren, Bayerisches Landesamt für Umwelt, http://www.bestellen.bayern.de/shoplink/lfu_all_00136.htm

Lower Saxony (2007): Kommission der Niedersächsischen Landesregierung „Umweltpolitik im Europäischen Wett-bewerb“ (5. Regierungskommission): Abschlussbericht des Arbeitskreises "Entsorgung von Altfahrzeugen unter Berücksichtigung von Lebenszyklusanalysen", 2007. Seite 20f. www.regierungskommission.niedersachsen.de/servlets/download?C=38867749&L=20

LRTAP (2006): Exploration of Management Options for PFOS. Proposal submitted by Sweden for the fifth meeting of the LRTAP Task Force on Persistance Organic Pollutants, Tallinn, 29 May-1 June 2006 and revised 15 June 2006.

LUNG (Hrsg.) (2016): Trendmonitoring von Schadstoffen in Fischen aus Gewässern Mecklenburg-Vorpommerns, Monitoring 2015, Zusammenfassung 2013 - 2015. - Institut für Angewandte Ökosystemforschung GmbH (IfAÖ), Neu Broderstorf, Bericht zur Gewässergüte im Auftrag des Landesamtes für Umwelt, Naturschutz und Geologie Mecklenburg-Vorpommern (LUNG), Güstrow, Schriftenreihe des Landesamtes für Umwelt, Naturschutz und Geo-logie Mecklenburg-Vorpommern 2016, Heft 3, 35 S. http://www.lung.mv-regierung.de/dateien/bzg_trendmonitoring_fische_mv_2015.pdf

MHB 2015 – BLMP-Monitoringhandbuch - http://www.meeresschutz.info/monitoringhandbuch.html

MKULNV und MAIS (2011): Ministerium für Arbeit, Integration und Soziales des Landes Nordrhein-Westfalen und Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein-Westfalen: Der Fall ENVIO /PCB in Dortmund Fachaufsichtliche Gesamtbewertung (07.04.2011) https://www.mais.nrw/pressemitteilung/envio-minister-schneider-und-minister-remmel-kuendigen-weitere-konsequenzen-aus-dem

MONARPOP (2009): MONARPOP Technical Report, revised edition July 2009, http://www.monarpop.at/downloads/MONARPOP_Technical_Report.pdf

MONARPOP on the fly (2017): http://www.monarpop.at/on_the_fly/MONARPOP_en.php

Morf, L. S.; Tremp, J.; Gloor, R.; Huber, Y.; Stengele, M.; Zennegg, M. (2005): Brominated Flame Retardants in Waste Electrical and Electronic Equipment: Substance Flows in a Recycling Plant. Environ Sci Technol. 2005 Nov 15;39(22):8691-9.

MUDAB 2016, Meeresumwelt-Datenbank http://geoportal.bafg.de/MUDABAnwendung/pages/main.jsf

NACHWEISVERORDNUNG, Verordnung über die Nachweisführung bei der Entsorgung von Abfällen (Nachweisver-ordnung - NachwV) vom 20. Oktober 2006 (BGBl. I S. 2298), die durch Artikel 97 der Verordnung vom 31. August 2015 (BGBl. I S. 1474) geändert worden istdie durch Artikel 4 des Gesetzes vom 19. Juli 2007 (BGBl. I S. 1462) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/nachwv_2007/gesamt.pdf

Nationalpark Wattenmeer (2011): http://www.nationalpark-wattenmeer.de/

NRW (2017): Richtlinie für die Bewertung und Sanierung PCB-belasteter Baustoffe und Bauteile in Gebäuden (PCB-Richtlinie NRW), https://recht.nrw.de/lmi/owa/br_bes_text?anw_nr=1&gld_nr=2&ugl_nr=23239&bes_id=2571&val=2571&ver=7&sg=&aufgehoben=N&menu=1

OBERFLÄCHENGEWÄSSERVERORDNUNG, Verordnung zum Schutz der Oberflächengewässer (Oberflächengewäs-serverordnung - OGewV) vom 20. Juli 2011 (BGBl. I S. 1429), https://www.gesetze-im-internet.de/bundesrecht/ogewv_2016/gesamt.pdf

Ospar Convention https://www.ospar.org/site/assets/files/1290/ospar_convention_e_updated_text_in_2007_no_revs.pdf

PCB/PCTAbfallverordnung – PCBAbfallV: Verordnung über die Entsorgung polychlorierter Biphenyle, polychlorierter Terphenyle und halogenierter Monomethyldiphenylmethane (Artikel 1 der Verordnung über die Entsorgung polychlorierter Biphenyle, polychlorierter Terphenyle sowie halogenierter Monomethyldiphenylmethane und zur Änderung chemikalienrechtlicher Vorschriften) (PCB/PCTAbfallverordnung - PCBAbfallV) "PCB/PCT-Abfallverordnung vom 26. Juni 2000 (BGBl. I S. 932), die zuletzt durch Artikel 5 Absatz 21 des Gesetzes vom 24. Februar 2012 (BGBl. I S. 212) geändert worden ist" http://www.gesetze-im-internet.de/bundesrecht/pcbabfallv/gesamt.pdf

PFLANZENSCHUTZ-ANWENDUNGSVERORDNUNG, Verordnung über Anwendungsverbote für Pflanzenschutzmittel (Pflanzenschutz-Anwendungsverordnung – PflSchAnwV 1992) vom 10. November 1992 (BGBl. I S. 1887), die zu-letzt durch Artikel 2 der Verordnung vom 22. Dezember 2011 (BGBl. I S. 2927) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/pflschanwv_1992/gesamt.pdf

Plant Protection Act (PFLANZENSCHUTZGESETZ), Gesetz zum Schutz der Kulturpflanzen (Pflanzenschutzgesetz - PflSchG) vom 6. Februar 2012 (BGBl. I S. 148), http://www.gesetze-im-internet.de/bundesrecht/pflschg_2012/gesamt.pdf

POP-Dioxin Informationsportal (2016): Internetauftritt, http://www.pop-dioxindb.de/

POPRC (2005): Persistent Organic Pollutants Review Committee, UNEP/POPS/POPRC.1/10: Decision POPRC-1/3: Pentabromodiphenyl ether, http://chm.pops.int/Convention/POPsReviewCommittee/POPRCMeetings/POPRC1/POPRC1ReportandDecisions/tabid/350/language/en-US/Default.aspx

POPRC (2008): Persistent Organic Pollutants Review Committee, UNEP/POPS/POPRC.4/15/Add.1: Report of the Persistent Organic Pollutants Review Committee on the work of its fourth meeting, Addendum: Risk management evaluation for commercial octabromodiphenyl ether, http://chm.pops.int/Convention/POPsReviewCommittee/POPRCMeetings/POPRC4/POPRC4ReportandDecisions/tabid/450/Default.aspx

POPs-Protokoll der CLRTAP (1979): Convention on Long-Range Transboundary Air Pollution http://www.unece.org/fileadmin/DAM/env/lrtap/full text/1979.CLRTAP.e.pdf

Quass et al. (2016): Quass, U., Meyer, J., Kuhlbusch, T.: Zuordnung und Quantifizierung der Dioxineinträge auf dem Luftpfad mittels Betrachtung der emissionsseitigen und immissionsseitigen Kongenerenmuster, Umweltforschungsplan Förderkennzeichen 3712 65 407 2, Umweltbundesamt Texte 23/2016 https://www.umweltbundesamt.de/publikationen/zuordnung-quantifizierung-der-dioxin-eintraege-auf

REGULATION (EC) No 178/2002 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02002R0178-20140630&qid=1498486940508&from=EN

REGULATION (EC) NO 850/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004 on persistent organic pollutants and amending Directive 79/117/EEC http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02004R0850-20160930&qid=1493891670475&from=EN

REGULATION (EC) No 396/2005 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC http://publications.europa.eu/resource/cellar/48e94fc3-e581-43f8-8df1-6bdf7f97d9b2.0020.03/DOC_1

REGULATION (EC) No 166/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006R0166-20090807&qid=1499065742042&from=EN

REGULATION (EC) No 1013/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 June 2006 on shipments of waste, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006R1013-20160101&qid=1498470441021&from=EN

REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:396:0001:0849:EN:PDF

REGULATION (EC) No 689/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 June 2008 concerning the export and import of dangerous chemicals http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0689&rid=1

REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008R1272-20170101&qid=1496328633621&from=EN

REGULATION (EC) No 1107/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02009R1107-20140630&qid=1496333261264&from=EN

REGULATION (EU) No 528/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 May 2012 concerning the making available on the market and use of biocidal products http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02012R0528-20140425&qid=1496333633797&from=EN

Rentz et al. (2010): Rentz, O., Karl, U., Haase, M., Koch, M.: Nationaler Durchführungsplan unter dem Stockholmer Abkommen zu persistenten organischen Schadstoffen (POPs), Umweltforschungsplan Förderkennzeichen 205 67 444), Umweltbundesamt, Dessau, 2010, https://www.umweltbundesamt.de/publikationen/nationaler-durchfuehrungsplan-unter-stockholmer

Röntgenverordnung: Verordnung über den Schutz vor Schäden durch Röntgenstrahlen (Röntgenverordnung - RöV) in der Fassung der Bekanntmachung vom 30. April 2003 (BGBl. I S. 604), die zuletzt durch Artikel 6 der Verordnung vom 11. Dezember 2014 (BGBl. I S. 2010) geändert worden ist" https://www.gesetze-im-internet.de/bundesrecht/r_v_1987/gesamt.pdf

Rotterdam Convention Secretariat (2008): Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (2008) http://www.pic.int/Portals/5/en/ConventionText/RC%20text_2008_E.pdf

RPA (2004): Perfluorooctane Sulphonate - Risk reduction strategy and analysis of advantages and drawbacks. Final Report prepared for Department for Environment, Food and Rural Affairs and the Environment Agency for England and Wales. Risk & Policy Analysts Limited (RPA) in association with BRE Environment, August 2004. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/183154/pfos-riskstrategy.pdf

Sander, K. & Schilling, S. (2010): Transboundary shipment of waste electrical and electronic equipment / electronic scrap, optimization of material flows and control (Umweltforschungsplan Förderkennzeichen 3708 93 300), Umweltbundesamt, Dessau, 2010, https://www.umweltbundesamt.de/publikationen/transboundary-shipment-of-waste-electrical

Schlummer, M.; Gruber, L.; Mäurer, A.; Wolz, G.; van Eldik, R. (2007): Characterisation of polymer fractions from waste electrical and electronic equipment (WEEE) and implications for waste management. Chemosphere. 2007 Apr;67(9):1866-76. Epub 2007 Jan 17.

Secretariat of the Basel Convention (2011b): Technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with polychlorinated biphenyls (PCBs), polychlorinated terphenyls (PCTs) or polybrominated biphenyls (PBBs) http://archive.basel.int/pub/techguid/tg-PCBs.pdf

Secretariat of the Basel Convention (2011c): Updated general technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (POPs), http://www.basel.int/Portals/4/Basel%20Convention/docs/pub/techguid/tg-POPs.pdf

Secretariat of the Basel Convention (2015): Technical Guidelines http://www.basel.int/TheConvention/Publications/TechnicalGuidelines/tabid/2362/Default.aspx

Secretariat of the Stockholm Convention (2009): Stockholm Convention on Persistent Organic Pollutants (POPs) - as amended in 2009 - Text and Annexes, http://chm.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx

Seventeenth Regulation on Implementation of the Imissions Control Act (SIEBZEHNTE VERORDNUNG zur Durchführung des Bundes-Immissionsschutzgesetzes -Verordnung über die Verbrennung und die Mitverbrennung von Abfällen – 17. BImSchV) Ausfertigungsdatum: 02.05.2013, https://www.gesetze-im-internet.de/bimschv_17_2013/index.html

Seventh Environment Action Programme http://ec.europa.eu/environment/pubs/pdf/factsheets/7eap/en.pdf

Technical Instructions on Air Quality Control (TA-Air -TA-LUFT), Erste Allgemeine Verwaltungsvorschrift zum Bundes–Immissionsschutzgesetz (Technische Anleitung zur Reinhaltung der Luft – TA Luft) vom 24. Juli 2002, http://www.verwaltungsvorschriften-im-internet.de/bsvwvbund_24072002_IGI2501391.htm

Thematic Strategy for Soil Protection, Communication from the Commission tot he Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52006DC0231&rid=1

Thirteenth Regulations on Implementation of the Imissions Control Act (DREIZEHNTE VERORDNUNG zur Durchführung des Bundes-Immissionsschutzgesetzes -Verordnung über Großfeuerungs- und Gasturbinenanlagen) (13. BImSchV) vom 20.07.2004 (BGBl. I S. 1717, 2847), die zuletzt durch Artikel 1 der Verordnung vom 27. Januar 2009 (BGBl. I S. 129) geändert worden ist, https://www.gesetze-im-internet.de/bimschv_13_2013/

THRUDE (2016): https://www.thru.de/3/thrude/

Twentyseventh Regulation on Implementation of the Imissions Control Act (SIEBENUNDZWANZIGSTE VERORDNUNG zur Durchführung des Bundes-Immissionsschutzgesetzes) (Artikel 1 der Verordnung über Anlagen zur Feuerbestattung und zur Änderung der Verordnung über genehmigungsbedürftige Anlagen) (Verordnung über Anlagen zur Feuerbestattung – 27. BImSchV) vom 19. März 1997 (BGBl. I S. 545), die durch Artikel 11 des Gesetzes vom 3. Mai 2000 (BGBl. I S. 632) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/bimschv_27/gesamt.pdf

UBA (2007a): Emissions reduction for priority and priority hazardous substances of the Water Framework Directive Research Report 203 21 280, Texte 28/2007, https://www.umweltbundesamt.de/publikationen/emissions-reduction-for-priority-priority-hazardous

UBA (2007b): Fachpapier: Bromierte Flammschutzmittel in Elektro- und Elektronikgeräten: Das Flammschutzmittel Decabromdiphenylether (DecaBDE) ist durch umweltverträglichere Alternativen ersetzbar, https://www.umweltbundesamt.de/sites/default/files/medien/419/dokumente/fachpapier_flammschutzmittel.pdf

UBA (2008): Bekanntmachung des Umweltbundesamtes: Aktualisierung der Referenzwerte für HCB, β-HCH, DDT und PCB in Frauenmilch, Stellungnahme der Kommission Human-Biomonitoring des Umweltbundesamtes, Bundesgesundheitsbl - Gesundheitsforsch - Gesundheitsschutz 2008 51:1239–1242 DOI 10.1007/s00103-008-0681-8, Springer Medizin Verlag 2008. https://www.umweltbundesamt.de/sites/default/files/medien/377/dokumente/referenzwerte-frauenmilch_2008.pdf

UBA (2010): Dioxine und dl-PCB in der Umwelt - Auswertung der Länderberichte, https://www.umweltbundesamt.de/publikationen/dioxine-dl-pcb-in-umwelt

UBA (2011): Altlastenverdachtsflächen im Verhältnis zur Anzahl der Sanierungen, (Stand Feb. 2011) http://www.umweltbundesamt-daten-zur-umwelt.de/umweltdaten/public/theme.do?nodeIdent=2900 und Bundesweite Übersicht zur Altlastenstatistik, http://www.umweltbundesamt.de/boden-und-altlasten/altlast/web1/deutsch/1_3.htm

UBA (2012): Nationale Umsetzung des Stockholmer Übereinkommens zu persistenten organischen Schadstoffen (POPs) – PBDE und PFOS in Erzeugnissen und im Recyclingkreislauf (FKZ 3710 63 415), http://www.bmub.bund.de/fileadmin/Daten_BMU/Pools/Forschungsdatenbank/3710_63_415_stockholm_bf.pdf

UBA (2015): Identification of potentially POP-containing Wastes and Recyclates – Derivation of Limit Values, Texte 35/2015, FKZ 3712 33 342 https://www.umweltbundesamt.de/en/publikationen/identification-of-potentially-pop-containing-wastes

UBA (2015a): Data on the Environment 2015 - Environmental Trends in Germany https://www.umweltbundesamt.de/publikationen/data-on-the-environment-2015

UBA (2016): Answers to frequently asked questions to Hexabromocyclododecane (HBCD) (as of December 2016) https://www.umweltbundesamt.de/publikationen/answers-to-frequently-asked-questions-to

UBA (2016a): Internetauftritt Luftmessnetz, (Stand 29.08.2016): https://www.umweltbundesamt.de/themen/luft/messenbeobachtenueberwachen/luftmessnetz-des-umweltbundesamtes

UBA (2016 b): Bundesweite Übersicht zur Altlastenstatistik, (Stand 16.01.2017)https://www.umweltbundesamt.de/daten/bodenbelastung-land-oekosysteme/altlasten-ihre-sanierung

UBA (2016c): Chemikalienpolitik und Schadstoffe, POPs, (Stand 25.06.2016) https://www.umweltbundesamt.de/themen/chemikalien/chemikalien-management/stockholm-konvention

UBA (2016d): Chemikalienpolitik und Schadstoffe, REACH, Dioxine, (Stand 13.07.2016) https://www.umweltbundesamt.de/themen/chemikalien/dioxine

UBA (2016e): Emissionen von Luftschadstoffen, Internetauftritt, http://www.umweltbundesamt.de/emissionen/publikationen.htm

UBA (2017): Competent Authorities in the Federal Republic of Germany for the Transboundary Movement of Waste (As of 01/2017) https://www.umweltbundesamt.de/sites/default/files/medien/2503/dokumente/competent_authorities_germany_2017.pdf

UBA (2017a) Statistics concerning transfrontier shipment of waste https://www.umweltbundesamt.de/en/topics/waste-resources/transfrontier-movement-of-wastes-destined-for/statistics-concerning-transfrontier-shipment-of

UBA (2017b) Wastes containing POPs and PCB https://www.umweltbundesamt.de/en/topics/waste-resources/waste-management/waste-types/hazardous-waste/wastes-containing-pops-pcb

UBA (2017c): Thermal treatment https://www.umweltbundesamt.de/en/topics/waste-resources/waste-disposal/thermal-treatment#textpart-1

UBA (2017d): Luft/Regelungen und Strategien/Internationale Übereinkommen – EMEP. https://www.umweltbundesamt.de/themen/luft/regelungen-strategien/internationale-uebereinkommen

UBA/Friedrich pers. Komm. (2011): Information von Jörg Friedrich, Umweltbundesamt, Email vom 08.02.2011

UMK (2011): Internetauftritt, http://www.umweltministerkonferenz.de/Willkommen.html

Umweltprobenbank (2016a): https://www.umweltprobenbank.de/en/documents

Umweltprobenbank (2016b) Probennahmegebiete der Umweltprobenbank, http://www.umweltproben-bank.de/de/documents/details/11263

UNECE (2011a): Übereinkommen über weiträumige grenzüberschreitende Luftverunreinigung (Convention on Long-Range Trans-boundary Air Pollution), http://live.unece.org/env/lrtap/welcome.html

UNECE (2011b): GHS Informationen, http://live.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

UNEP (2006): United Nations Environment Programme, Report of the Persistent Organic Pollutants Review Committee on the work of its second meeting – Addendum – Risk profile on hexabromobiphenyl, http://chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-POPRC.2-17-Add.3.English.pdf

UNEP (2009a): SC-4/18: Listing of tetrabromodiphenyl ether and pentabromodiphenyl ether, http://chm.pops.int/Conven-tion/COP/COPDecisions/tabid/208/Default.aspx

UNEP (2009b): SC-4/14: Listing of hexabromodiphenyl ether and heptabromodiphenyl ether, http://chm.pops.int/Conven-tion/COP/COPDecisions/tabid/208/Default.aspx

UNEP (undated): United Nations Environmental Programme: Destruction and Decontamination Technologies for PCBs and Other POPs Wastes. A Training Manual for Hazardous Waste Project Managers, Volume C – Annexes, Secretariat of the Basel Convention, http://www.basel.int/Implementation/Publications/TrainingManuals/tabid/2363/Default.aspx#

UNFCCC (1992): UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE http://unfccc.int/files/essential_back-ground/background_publications_htmlpdf/application/pdf/conveng.pdf

Verdugo-Raab, U., Gruber, L., Albrecht, M., Preiß, U., Mosch, C., Seckin, E., Nitschke, L., Zimmermann, S., Zirngibl, A., Völkel, W., Boehmer, S., Smolic, S., Schlummer, M. & Fromme, H. (2008): BAMBI 2007/2008 – Bayerisches Muttermilchmonitoring (Bavarian Monitoring of Breast Milk), Bayerisches Landesamt für Gesundheit und Lebensmittelsicherheit, http://www.lgl.bayern.de/gesund-heit/arbeitsplatz_umwelt/projekte_a_z/doc/bericht_bambi_kurz.pdf

Verordnung zu Mitteilungs- und Übermittlungspflichten zu gesundheitlich nicht erwünschten Stoffen (Mitteilungs- und Übermitt-lungsverordnung - MitÜbermitV) Ausfertigungsdatum: 28.12.2011 https://www.gesetze-im-internet.de/bundesrecht/mit_ber-mitv/gesamt.pdf

VERSATZVERORDNUNG, Verordnung über den Versatz von Abfällen unter Tage (Versatzverordnung – VersatzV)vom 24. Juli 2002 (BGBl. I S. 2833), die zuletzt durch Artikel 11 des Gesetzes vom 15. Juli 2006 (BGBl. I S. 1619) geändert worden ist, http://www.ge-setze-im-internet.de/bundesrecht/versatzv/gesamt.pdf

VerwAbk Meeresschutz 2012 - Verwaltungsabkommen für die Zusammenarbeit von Bund und Ländern zum Meeresschutz insbe-sondere zur Umsetzung der Richtlinie 2008/56/EG des Europäischen Parlaments und des Rates vom 17. Juni 2008 zur Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Meeresumwelt (Meeresstrategie-Rahmenrichtlinie, MSRL)

VIERTE VERORDNUNG zur Durchführung des Bundes-Immissionsschutzgesetzes (Art. 1 d. V zur Neufassung und Änderung von Ver-ordnungen zur Durchführung des Bundes-Immissionsschutzgesetzes) (Verordnung über genehmigungsbedürftige Anlagen – 4. BIm-SchV), Ausfertigungsdatum: 24.07.1985, in der Fassung der Bekanntmachung vom 14. März 1997 (BGBl. I S. 504), die zuletzt durch Artikel 5 Absatz 2 der Verordnung vom 26. November 2010 (BGBl. I S. 1643) geändert worden ist, https://www.gesetze-im-inter-net.de/bundesrecht/bimschv_4_2013/gesamt.pdf

Vijgen, J. (2006): The Legacy of Lindane HCH Isomer Production. A Global Overview of Residue Management, Formu-lation and Dis-posal. Main Report. International HCH & Pesticides Association, January 2006, http://www.ihpa.info/docs/library/reports/Lin-dane%20Main%20Report%20DEF20JAN06.pdf

VWI (2011): Persönliche Mitteilung des Verbands der Polyurethan-Weichschaum-Industrie e.V.

Wäger, P.; Schluep, M.; Müller, E. (2010): RoHS substances in mixed plastics from Waste Electrical and Electronic Equipment. St. Gallen http://www.ewasteguide.info/files/Waeger_2010_Empa-WEEEForum.pdf

WASSERHAUSHALTSGESETZ, Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz - WHG) vom 31. Juli 2009 (BGBl. I S. 2585), das durch Artikel 2 Absatz 67 des Gesetzes vom 22. Dezember 2011 (BGBl. I S. 3044) geändert worden ist, http://www.gesetze-im-internet.de/bundesrecht/whg_2009/gesamt.pdf

Weber et al. (2015): Weber, R., Hollert, H., Kamphues, J., Ballschmiter, K., Blepp, M., Herold, C.: Analyse und Trendabschätzung der Belastung der Umwelt und von Lebensmitteln mit ausgewählten POPs und Erweiterung des Datenbestandes der POP-Dioxin-Datenbank des Bundes und der Länder mit dem Ziel pfadbezogener Ursachenaufklärung, Umweltbundesamt Dokumentationen 114/2015 Forschungskennzahl 3712 65 407 1, https://www.umweltbundesamt.de/publikationen/analyse-trendabschaetzung-der-belastung-der-umwelt

WEEE-RL: Richtlinie 2002/96/EG des Europäischen Parlaments und des Rates vom 27. Januar 2003 über Elektro- und Elektronik-Altgeräte (wird lt. Neufassung mit Wirkung zum 15.02.2014 aufgehoben) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:037:0024:0038:DE:PDF

WHO (2007): Fourth WHO-Coordinated Survey of Human Milk for Persistent Organic Pollutants in Cooperation with UNEP, http://www.who.int/entity/foodsafety/chem/POPprotocol.pdf

WHO-TEF 2005: The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds, TOXICOLOGICAL SCIENCES 93(2), 223–241 (2006), doi:10.1093/toxsci/kfl055 http://toxsci.oxfordjournals.org/content/93/2/223.long

Wiechmann et al. 2013: Sewage sludge management in Germany https://www.umweltbundesamt.de/publikationen/sewage-sludge-management-in-germany

Wolf, Julia; Nellesen, Lisa (noch unveröffentlicht): Anforderungen an die Behandlung spezifischer Elektroaltgeräte unter Ressourcen- und Schadstoffaspekten.

10 Annex:

Table 15: Research and monitoring projects on POPs in the Länder

Land	Research project	POPs concerned and website
Baden-Württemberg	Electrochemical degradation of PFC in sewage waters from plating plants and development of a PFC recycling plant	https://um.baden-wuerttemberg.de/de/service/publikation/did/elektrochemischer-pft-abbau-in-galvanikindustrieabwaessern-und-entwicklung-einer-pft-recyclinganlage/
Bavaria	PureAlps: Protection of the Bavarian Alps from harmful chemicals	PCDD/F, dl-PCB, PCB_6, PBDE (Tri- bis HeptaBDE and DecaBDE), Hexabromocyclododecane (HBCD), PFOS, PFOA, DDT, α-HCH, β-HCH, γ-HCH, Pentachloro benzene, Hexachloro benzene, Chlordane, Heptachlor, Aldrin, Dieldrin, Endosulfane, Mirex http://www.lfu.bayern.de/analytik_stoffe/purealps/english/index.htm
	Monitoring of persistant organic and anorganic pollutants in background areas and with source specific contamination	PCDD/F, dl-PCB, PCB_6, PBDE
	EMPOP: Monitoring of emerging contaminants in the Bavarian Alps	PCDD/F, dl-PCB, PCB_6, PBDE, HBCD, DDT, α-HCH, β-HCH, γ-HCH, Pentachloro benzene, Hexachloro benzene, Chlordane, Heptachlor, Aldrin, Dieldrin, Mirex, Endosulfane http://www.bestellen.bayern.de/shoplink/lfu_all_00126.htm
	Investigation and assessment of samples from various environmental compartments for PCDD/F and PCB, considering the new WHO TEF values	PCDD/F, dl-PCB, PCB_6 http://www.lfu.bayern.de/analytik_stoffe/untersuchung_bewertung_proben/doc/pcb_abschlussbericht_100807.pdf
	Investigations on the accumulation of various persistant pollutants in terrestrial wildlife	Among others: PFC, PBDE, HBCD, PCB_6, dl-PCB, PCDD/F http://www.bestellen.bayern.de/shoplink/lfu_all_00136.htm
	Analysis of emerging pollutants – methods development and atmospheric deposition	PBDE (Tri- to HeptaBDE and DecaBDE), Hexabromocyclododecane and other flame retardants in air http://www.bestellen.bayern.de/shoplink/lfu_all_00132.htm
	Determination of immission contamination with dioxins, furans and dl-PCB in Bavaria	PCDD/F, dl-PCB, PCB_6

Land	Research project	POPs concerned and website
		http://www.lfu.bayern.de/analytik_stoffe/analytik_org_stoffe_dioxine_pcb/ermittlung_immissionsbelastung/index.htm
	Organic trace contaminants in sewage sludge	PCDD/F, dl-PCB, PCB, PBDE, PFOS http://www.lfu.bayern.de/analytik_stoffe/pft_verteilungsverhalten/doc/endbericht_teil1_klaerschlamm.pdf
	Background values of organic contaminants in soils (Hintergrundwerte organischer Schadstoffe in Böden (Projekt GRABEN))	PAH_{16}, PCB_6, DDT, HCB; dl-PCB, PCDD/F http://www.lfu.bayern.de/boden/hintergrundwerte/doc/hintergrundwert_umweltspezial.pdf
	Organic contaminants in humous soils (Project arsenic in Southern Bavaria)	PAH_{16}, PCB_6, DDT, HCB
	Determination of persistant, bioaccumulating PFC in various matrices	PFC http://www.bestellen.bayern.de/shoplink/lfu_all_00085.htm
	Determination of persistant PFC in variours matrices and determination of (semi)volatile precursors	PFC in surface water, sewage water, air, technical Products and consumer products http://www.bestellen.bayern.de/shoplink/lfu_all_00110.htm
	Effects of PFOS on rainbow trout	PFOS http://www.bestellen.bayern.de/shoplink/lfu_all_00094.htm
	Determination of polybrominated flame retardants in variours matrices	PBDE (Tri- to HeptaBDE and DecaBDE), Hexabromocyclododecane and others http://www.bestellen.bayern.de/shoplink/lfu_all_00109.htm
	Investigation of surface, ground and raw water samples in the vicinity of drinking water plants influenced by bank filtration in the context of the R+D project „adaptation to climate change and public water supply“ (2015 - 2020)	Among others: 20 single substances of PFC, e.g. PFOS, PFBS and PFOA
	Pollution burden of asylum seekers with chlorinated pesticides	PCB, Lindane, DDT http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/hbm_pestizide_asylbewerber.htm
	Perfluorinated compounds in house dust of Bavarian homes	Perfluorinated substances such as PFOS and PFOA

Land	Research project	POPs concerned and website
		http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/ir_perfluorierte_verbindungen_hausstaub.htm
	Occurrence of perfluorinated substances in the blood of the Bavarian population	Perfluorinated substances such as PFOS and PFOA http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/hbm_pfc_studie_blut.htm
	Pre- and postnatal exposition to perfluorinated compounds	Perfluorinated substances such as PFOS and PFOA http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/hbm_pfc_prae_postnatale_exposition.htm
	Integrated Exposure Assessment Survey 1 (INES 1): Projects on the collection and assessment of the exposition to endocrine disruptors and persistent substances	PBDE, dl-PCB, PCB, PCDD/F and PFC http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/ueb_ines_1.htm
	Chlorinated paraffins in food, breast milk and in the environment	Short and medium chain chlorinated paraffins http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/ueb_chlorparaffine.htm
	Contamination of schools and homes with “new” substances (LUPE 4)	per- and polyfluorinated carbonhydrates (PFAS) in house dust and polyfluorinated compounds in airborne dust http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/ir_lupe_4_neue_substanzen.htm
	Human biomonitoring for „new“ and health-relevant substances in the context of health protection	PCDDs/Fs, dlPCBs, ndl-PCBs, PBDDs/Fs, PBDEs, HBCDs, Polychlorinated naphthalenes, Dechloranes in plasma samples http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/hbm_substanzen.htm
	BAMBI 1 - Bavarian Monitoring of Breast Milk	Dioxins und Furanes, polychlorinated biphenyls, organochlorine pesticides, perfluorinated substances http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/mms_muttermilchmonitoring_bambi_2008.htm
	Persistent substances in the blood of a rural population sample	PCBs, PCDDs/Fs, PBDEs
	Determination of PBDE and new brominated flame retardants in various media	PBDE, cycloaliphatic hexabromo cyclododecane, tetrabromobisphenol A, 2,4,6-Tribromophenol, 2,2-Bis(bromomethyl)propane-1,3-diol http://www.lgl.bayern.de/gesundheit/arbeitsplatz_umwelt/projekte_a_z/ueb_pbde_flammschutzmittel.htm
Berlin	Planned for 2013: investigation of mineral construction wastes	

Land	Research project	POPs concerned and website
Bremen		
Hamburg	PCB in upper soils of Hamburg	PCB http://www.hamburg.de/bgv/umweltberichte/4076634/pcb-oberboeden-2013/
Lower Saxony	Determination of PCDD/F and PCB in ambient air and in deposition in Lower Saxony	PCDD/F, PCB, dl-PCB Zeitraum: Dez. 2008 – Dez. 2009 http://www.mu.niedersachsen.de/download/51604
	Research project on the evidence of estrogen effects in drinking, mineral and table waters and associated well waters	PCDD/F, PCB, dl-PCB http://www.laves.niedersachsen.de/live/live.php?navigation_id=20039&article_id=73684&psmand=23
	Survey on East Frisian ground water – plant protection products, pharmaceuticals, PFCs PFOS, PFOA and other PFC	Publication to follow
	Report on the quality of the Weser (Wesergüteberichte – Thüringer Ministerium für Landwirtschaft, Naturschutz und Umwelt)	Chlorinated benzenes, PCB, Organochlor pesticides, Chlorophenols, PCDD/F http://www.fgg-weser.de/messprogramm_neu.html
Northrhine–Westfalia	Monitoring of surface waters in Northrhine–Westfalia	PCDD/F, PCB http://www.lanuv.nrw.de/veroeffentlichungen/gewgue01/gewgue01_018.pdf
Rhineland-Palatinate	Background values in the soils of Rhineland-Palatinate, 2nd revised edition 2013	Organochlorinated pesticides, PCB, PCDD/F https://mueef.rlp.de/de/themen/klima-und-ressourcenschutz/bodenschutz/bodeninformation/hintergrundwerte-der-boeden/
Saarland		
Saxony	Trace contaminants in the effluent of domestic sewage treatment plants	Aldrin, Dieldrin, Endrin, Chlordane, Heptachlor, BDE, HCB, HCH, PeCB, PFOS, DDT, Mirex, PCB, Endosulfane http://www.umwelt.sachsen.de/umwelt/wasser/6795.htm
	Dioxins in the effect pathway soil-pasture-beef	PCDD/F, dl-PCB, PCB, HCH, HCB, DDT, Aldrin, Chlordane, Endrin, Heptachlor, PAH
Saxony -Anhalt		
Thüringen	Investigation of the state-of-the-art of the determinaiton of surveillance values in sewage waters	PFOS

Land	Research project	POPs concerned and website
	Construction and testing of a pilot plant for the removal of PFC from sewage waters	PFC
	Background values in soils in Thüringen (2015-2017)	Chlordane, Heptachlor, Endosulfane, Methoxychlor, Aldrin, Dieldrin, Endrin ,DDT, HCB, HCH, PCB, PAH, dl-PCB, PCDD/F

Table 16: Monitoring projects on POPs in the Länder

Land	Monitoring projects	POPs concerned and website
Baden-Württemberg	POP-Monitoring of peregrine falcon eggs in the framework of environmental, cross-media monitoring	PBDE, PFOS, DDT, Chlordane, HCH, Dieldrin, Endrin, Heptachlor, HCB, Chlordecone, Aldrin, PeCB, PCB, Mirex, Toxaphene, Hexabromobiphenyl, PCDD/F http://www.lubw.baden-wuerttemberg.de/servlet/is/56143/
	dl-PCB in the soils of Baden-Württemberg	PCB, dl-PCB, PCDD/F http://www.lubw.baden-wuerttemberg.de/servlet/is/71184/
	Surface water monitoring programmes	PBDE, Endosulfane, HCB, HCH, PeCB, Aldrin, Dieldrin, Endrin, DDT
	River waters monitoring (2007-2010)	PBDE, DDT, HCH, Chlordane, HCB, PeCB, Heptachlor, PFOS, Aldrin, Dieldrin, Endrin
	Suspended matter and sediment monitoring (2007-2010)	PBDE, PCB, DDT, HCH, Chlordane, Endrin, Dieldrin, Aldrin, HCB, PeCB, Heptachlor http://jdkfg.lubw.baden-wuerttemberg.de/servlet/is/300/
	Ground water monitoring programmes	2003: DDT, HCH, Dieldrin, Endrin, Heptachlor, HCB, Aldrin 2006, 2007, 2010: PFOS, PFOA http://www.lubw.baden-wuerttemberg.de/servlet/is/9162
	Continues soil monitoring	Chlordane, DDT, HCB, HCH, PCB, dl-PCB, PCDD/F http://www.lubw.baden-wuerttemberg.de/servlet/is/50596/20_jahre_bodendauerbeobachtung.pdf?command=downloadContent&filename=20_jahre_bodendauerbeobachtung.pdf
	Contaminants in crop soils after fertilisation with sewage sludge in Baden-Württemberg	PCDD/F, PCB, DEHP, PBDE, NP + NPE, TBT, and others http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/20082/?COMMAND=DisplayBericht&FIS=199&OBJECT=20082&MODE=METADATA

Land	Monitoring projects	POPs concerned and website
	PFC – background values in soils Investigations at the sites of the continuous soil monitoring programme of Baden-Württemberg	20 per- and polyfluorinated compounds in solid matter and in aqueous eluate http://www.fachdokumente.lubw.baden-wuerttemberg.de/servlet/is/118077/?COMMAND=DisplayBericht&FIS=199&OBJECT=118077&MODE=METADATA
	Industrial sewage waters 2007-2010: investigation of effluent and sludge in selected sewage treatment plants	various PFC
	Project public health offices 2005/06: analysis of 15 pooled blood samples (which represent 411 fourth grade students)	PBDE
	Project public health offices 2008/09: blood samples of 803 fourth grade students	DDE, HCB, PCB, PCDD/F, dl-PCB, PBDE
	Sampling and analysis campaigns of PFC entry into soils through compost (2015) and sewage sludge (2016)	PFOS
	Screening of pollutants in compost and digestates	PFOS
	Project „Concentration and effect monitoring in adults“ 2010/2011: analysis of the blood of 1400 adults	PBDE
Bavaria	Surface water monitoring in the context of the technical water authorities duties	Priority substances according to WFD and PCB, PFOS
	Ground water monitoring in the context of the technical water authorities duties	Aldrin, Dieldrin, Endrin, Heptachlor, Hexachlorobenzol, Polychlorinated biphenyls (PCB), DDT, α-Hexachlorocyclohexane, β-Hexachlorocyclohexane, Lindane, Pentachlorebenzene, Endosulfane, Hexachlorobutadiene
	Continuous immission ecological monitoring: Biomonitoring (rye grass, Curly Kale) at 6 sites	PCDD/F, dl-PCB, PCB6
	AbfKlärV	PCB and PCDD/F

Land	Monitoring projects	POPs concerned and website
	Monitoring obligation for PFC where sewage sludge is to be used in agriculture or in landscape construction	11 PFC-substances (PFOS among others) http://www.lfu.bayern.de/analytik_stoffe/analytik_org_stoffe_perfluorierte_chemikalien/pfc_belastung_abwasser_klaerschlamm/index.htm
	Monitoring biogenous wastes	PFOS, PCDD/F, dl-PCB, PCB, PBDE, HCB, PCP, HBCD http://www.bestellen.bayern.de/shoplink/lfu_abfall_00227.htm
	Fish monitoring in the context of the technical water authorities duties; monitoring of EQS in fish (WFD)	Heptachlor, HCB, 6 Indicator-PCB, dl-PCB, PCDD/F, alpha-, beta-, gamma-(Lindane)-HCH; BDE 28, BDE 47, BDE 99, BDE 100, BDE 153, BDE 154, Pentachlorobenzene, PFOS, HBCD, HCBD
	Mussels-monitoring in the context of the technical water authorities duties; Trendmonitoring in Biota (mussels)/WFD	Heptachlor, HCB, 6 Indicator-PCB, alpha-, beta-, gamma-(Lindane)-HCH, Pentachlorobenzene, PFOS, HCBD
	Suspended sediment monitoring in the context of the technical water authorities duties; Trendmonitoring in suspended sediment (WFD)	Suspended sediment monitoring in the context of the technical water authorities duties; Trendmonitoring in suspended sed-iment (WFD)
	Continuous soil monitoring	PAH_{16}, PCB_6, HCB, Pentachlorobenzene, DDT, alpha-, beta-, gamma-(Lindane)-HCH, Aldrin
Berlin		
Bremen	1993 and 1995 monitoring programme for soil protection	PCDD/F
	Surface water monitoring	Chlordane, Heptachlor, PCB, PBDE, Endosulfane, HCB, HCH, PeCB, Aldrin, Dieldrin, Endrin, DDT
	Ground water monitoring	
Hamburg	Surface soil monitoring	PCB http://www.hamburg.de/bgv/umweltberichte/4076634/pcb-oberboeden-2013/

Land	Monitoring projects	POPs concerned and website
Hessen	Monitoring in the river Main in the context of supervision and monitoring programmes of the „International Commission for the protection of the Rhine“ (IKSR)	Aldrin, Endrin, Dieldrin, HCB, HCH, PCB, PCDD/F, DDT, PFOS, PeCB, PBDE, Endosulfane
	Measurement of samples from around 75 sampling sites in Hessen in the context of monitoring of organic trace contaminants	HCH, DDT, PFOS, Heptachlor, Endosulfane
	Measurement of samples from around 20 sampling sites in Hessen in the context of monitoring of the biota monitoring programme	Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, BDE, HCB, HCH, PeCB, PFOS, DDT, Toxaphene, Mirex, PCB, PCDD/F
	Monitoring programe throughout Hessen on the quality of ground water	Plant protection products and Metabolites, selected pharmaceuticals (Carbamazepin, Diclofenac, Clofibrinic acid) http://www.hlnug.de/fileadmin/dokumente/wasser/grundwasser/Grundwasserbeschaffenheitsbericht_2012_final.pdf Per- and polyfluorinated chemikals (p. 52) http://www.hlnug.de/fileadmin/dokumente/wasser/jahresberichte/gwjb_2015_web.pdf
	Continuous soil monitoring	Aldrin, α-, β-,γ-HCH, Dieldrin, Heptachlor, HCB, DDT, PCB, PCDD/F, dl-PCB http://www.hlnug.de/themen/boden/erhebung/boden-dauerbeobachtung.html
	Persistent organic pollutants in agricultural soils in Hessen	Aldrin, α-, β-,γ-HCH, Dieldrin, Heptachlor, HCB, DDT, PCB, PCDD/F, dl-PCB http://www.hlnug.de/fileadmin/dokumente/boden/heft11.pdf
	Dioxin monitoring programme air	http://atlas.umwelt.hessen.de/atlas/
	Breast milk monitoring programme in Hessen	
Lower Saxony	Air quality monitoring	http://www.mu.niedersachsen.de/live/live.php?navigation_id=2165&article_id=9123&_psmand=10 http://www.mu.niedersachsen.de/live/live.php?navigation_id=2655&article_id=9127&_psmand=10

Land	Monitoring projects	POPs concerned and website
		http://www.mu.niedersachsen.de/live/live.php?navigation_id=2656&article_id=8888&_psmand=10
	Surface water monitoring in the context of OGewV	Aldrin, Diendrin, Endrin, HCB, DDT, Chlordane, Heptachlor, PCB, PBDE, Endosulfane, HCH, PeCB Results: www.nlwkn.niedersachsen.de example : http://www.nlwkn.niedersachsen.de/live/live.php?navigation_id=8007&article_id=39452&psamd=26
	Monitoring of sediments/suspended sediments of the river Ems for PCDD/F and dl-PCB	PCDD/F, dl-PCB http://www.umwelt.niedersachsen.de/live/live.php?navigation_id=2457&article_id=8865&_psmand=10 http://www.bmu.de/files/pdfs/allgemein/application/pdf/3709_72_228_pcb_bf.pdf
	Continuous soil monitoring	Aldrin, α-, β-,γ-HCH, Dieldrin, Heptachlor, HCB, DDT, PCB, PCDD/F
	Routine pesticide monitoring in the context of the surface water surveillance system	Aldrin, β-HCH, Chlordane and PeCB
North Rhine–Westfalia	Information system material soil contamination NRW Organochlorinated pesticides, Chlorobenzenes, PCB, PCDD/F	http://www.lanuv.nrw.de/boden/boschu-lua/fisstobo.html
	Immission and Deposition surveillance of PCDD/F and PCB in North Rhine–Westfalia	PCDD/F, PCB
Rheinland-Pfalz	Long term study of PCB contaminated Bworkers of all Länder (RWTH Aachen)	PCB
	Long term study of PFC in surface waters (flowing and standing waters) in the vicinity of airports (military, civilian)	PFC
		PCDD/F, dl-PCB, Indicator-PCB, WHO-PCB,

Land	Monitoring projects	POPs concerned and website
	Programme for the identification of contaminations with dioxins and PCB in surface waters (investigation of solid particles and the water phase)	
	Investigation of suspended solidy for various POPs in flowing surface waters	HCB, Lindane, PeCB, Indicator-PCB, DDT-isomers, PAH,
	POP in flowing surface waters (water phase and Biota)	PBDE, Aldrin, Dieldrin, Endrin, HCH, Endosulfane, Heptachlor, HCB, PAH, PFC, HCB, HCBD, PCDD/F; from 2018: PCB, DDT-isomers, Isodrin, PeCB, Heptachlor, HBCDD,
	Ground water monitoring 2011/12 for pesticides, relevant and „non-relevant“ metabolites, residues of pharmaceuticals as well as perfluorinated compounds	PFC
Saarland	Surface water monitoring	PeCB, HCB, PCB
	Special programme „PCBs in mine waters from the Saarland and in waters influenced by mine waters“	PCB
	Continuous soil monitoring	PCB, HCB, PAH
Saxony	Surface water monitoring programmes	PBDE, Endosulfan, HCB, HCH, PeCB http://www.umwelt.sachsen.de/umwelt/wasser/7112.htm
	Continuous soil monitoring	PCB, HCB, HCH, DDT, PCDD/F
	Investigation and remediation of contaminated sites as required by BBodSchG	
	Ground water monitoring	Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, HCB, Mirex, HCH, PeCB, PCB, Hexabromobiphenyl, PBDE, PFOS

Land	Monitoring projects	POPs concerned and website
	Registration of pollution of fish in Saxonian waters	Lindane, HCB, PCB, dl-PCB, PCDD/F, DDT (incl. metabolites)
	Continuous soil monitoring	PCDD/F, dl-PCB, PCB, HCB, HCH, DDT, PAH
	Establishment of background values	PCDD/F, dl-PCB, PCB, DDT, PAH
Saxony-Anhalt	Surface water monitoring programmes	Aldrin, α-, β-,γ-HCH, Dieldrin, Endrin, Heptachlor, HCB, PeCB, PCB, DDT http://www.lhw.sachsen-anhalt.de/untersuchen-bewerten/gewaesserueberwachung/
	Continuous soil monitoring	PCDD/F, dl-PCB, PAH, PCB, DDT, HCB, HCH
	Immission and Depositionmonitoring	PCDD/F, dl-PCB, PAH
Schleswig-Holstein	Continuous soil monitoring	PCB, PAH, PCDDD/F, dl-PCB
	Soil contamination register	PAH, PCB, PCDD/F, dl-PCB, DDT, HCB, HCH
	Surface water monitoring (flowing waters, estuary) in the context of the OGewV	Aldrin, Dieldrin, Endrin, Heptachlor, Hexa- und Heptabromodiphenyl Ether, HCH, Pentachlorobenzene, PCB, Endosulfane, PBDE, HCBD, PCP, DDT, HCB
	Monitoring of sediment and suspended sediment (flowing waters, marine waters, estuary) in the context of the OGewV and for the establishment of trends	HCB, Pentachlorobenzene, HCH, PCB, HBCD, HCBD, PCP, DDT, PFOS, PCDD/F, dl-PCB
	Biota monitoring in the context of the OGewV (flowing waters, marine waters, estuary PAH only)	PAH, PFOS, PCDD/F, dl-PCB, PBDE, HCB, HCBD, HBCD, Heptachlor
Thüringen	Continuous soil monitoring	Chlordane, Heptachlor, Endosulfane, Methoxychlor, Aldrin, Dieldrin, Endrin , DDT, HCB, HCH, PCB, PAK, dl-PCB, PCDD/F
	Monitoring of chlorinated aromatic dioxins (since 2011 only in soil)	PCDD/F, dl-PCB, PCB, PAH, HCB, HCH, DDT

Land	Monitoring projects	POPs concerned and website
	Ground water monitoring	PFOS, 9 perfluorinated compounds (PFC) in 30 sampling sites, PAH (16 single substances) in 214 sampling sites, annually
	Surface water monitoring in the context of the OGewV	Drine, Chlordane, Heptachlor, PBDE, HCH, HCB, DDT, Pentachlorobenzene, Endosulfane, PFOS in water Dioxins, dl-PCB, PFOS in suspended sediment Biota sampling

Table 17: Information portals for the public

Land	description	Information portal for the public
Bavaria		www.lfu.bayern.de www.lgl.bayern.de
Baden-Württem-berg		www.lubw.baden-wuerttemberg.de
Hamburg		http://www.hamburg.de/bgv/umweltberichte/
Thüringen		www.tlug-jena.de
Lower Saxony	Risk assessment of pollutants bound to particles in the Elbe catchment area	http://www.fgg-elbe.de
Hessen	General overview of monitoring programmes and results	www.hlnug.de
Rhineland-Palati-nate		www.geoportal-wasser.rlp.de www.lfu.rlp.de www.lfu.rlp.de/Service/Downloads/Wasserwirtschaft/Grundwasser/
Saxony		www.umwelt.-sachsen.de
Saxony-Anhalt	Results of surface water monitoring Results of continuous soil monitoring Results of air quality monitoring and deposition monitoring	http://www.lhw.sachsen-anhalt.de/untersuchen-bewerten/monitoringergebnisse/ http://www.lau.sachsen-anhalt.de/boden-wasser-abfall/bodenschutz/bodenbeobachtung/boden-dauerbeobachtung/ http://www.lau.sachsen-anhalt.de/luft-klima-laerm/fachberichte/
Schleswig-Hol-stein	Documentation of the soil condition and soil monitoring Agricultural and environmental atlas Schleswig-Holstein	http://www.schleswig-holstein.de/DE/Fachinhalte/B/boden/bodenzustandserfas-sungUntersuchung.html http://www.umweltdaten.landsh.de/atlas/script/index.php http://www.umweltdaten.landsh.de/atlas/script/index.php