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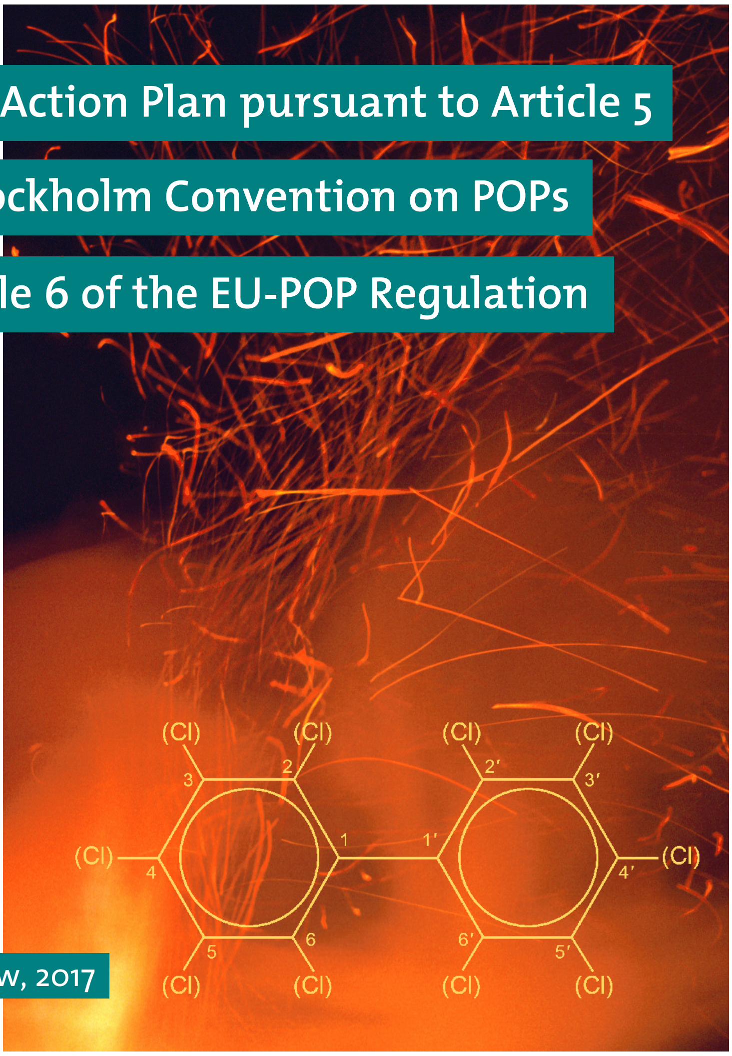
National Action Plan pursuant to Article 5 of the Stockholm Convention on POPs and Article 6 of the EU-POP Regulation



Second Review, 2017

MINISTERIUM
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ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

NATIONAL ACTION PLAN PURSUANT TO ARTICLE 5 OF THE STOCKHOLM CONVENTION ON POPS AND ARTICLE 6 OF THE EU-POP REGULATION

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EXECUTIVE SUMMARY

A Introduction

This report covers the second review of the National Action Plan for POPs which was published in 2008. Article 5 of the Stockholm Convention requires Parties to develop an Action Plan to identify, characterise and address the release of chemicals listed in Annex C. Article 5 further requires a review of the National Action Plan every five years, including the strategies and their success in meeting the relevant obligations.

Currently listed in Annex C are polychlorinated dibenzo(p)dioxins (PCDD), polychlorinated dibenzofurans (PCDF), hexachlorobenzene (HCB), polychlorinated biphenyls (PCB) and pentachlorobenzene (PeCB) when produced unintentionally. Polychlorinated Naphthalenes (PCN) have been part of Annex C since the end of 2016.

In line with the European POP Regulation (850/2004) polyaromatic hydrocarbons (namely the substances benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene) shall be included in the Action Plan as well.

The definition of the term “release” includes emissions of POPs into air, water and soil as well as releases via residues and waste and releases via products.

The Action Plan is part of the Party’s National Implementation Plan as specified in Article 7 of the Convention and includes strategies for meeting obligations to reduce or eliminate releases of chemicals listed in Annex C of the Stockholm Convention (including PAH as an additional requirement under the EU POP Regulation), and a schedule for the Action Plan. The Plan identifies priorities for action and includes those source categories that provide the most cost-effective opportunities for release reduction or elimination. It also includes an inventory of the releases of chemicals listed in Annex C.

For the second review of the National Action Plan the inventory (2004, 2009 and 2014) of POP releases has been updated. Based on this inventory instruments and measures aiming at the reduction of POP releases are described. In particular, the effectiveness of national legal regulations is assessed and the report examines whether Best Available Techniques (BAT) in combination with Best Environmental Practices (BEP) have already been applied in the source categories defined by the Stockholm Convention. If applicable, recommendations on how BAT and BEP can be implemented are given. In addition, data gaps are identified and proposals for the improvement of data quality elaborated.

Concerning emissions into air, the data are of sufficient quality for establishing an inventory for the POPs PCDD/F, PAH, HCB, PCB and PeCB (in descending order by data quality). However, due to a general lack of data, this could not be achieved in the case of PCN.

Whereas data on environmental concentrations (e.g. air) is available for most of the substances of concern, fewer data are available on releases into water and waste. For the latter, a plausible estimation of releases has been made for PCDD/F and PeCB.

Direct releases of POPs into soil arise from the source category ”open burning of waste, including burning of landfill sites” (this includes the burning of straw and stubble as well). However, if residues and waste from processes are released into the environment, releases of POPs may also occur indirectly (e.g. when using ashes from small scale residential combustion sources or biomass plants for fertilising purposes).

There are some data available in the literature on concentrations of POPs in cement and pulp and paper which are presented in this report.

In 2011 the Environment Agency Austria conducted analyses of cardboard boxes produced from waste paper (possibly contaminated with PCDD/F from printer’s ink). The results did not show a PCDD/F contamination of the printer’s ink.

The Action Plan will be reviewed and updated on a periodic basis.

B Inventory of emissions into air

Trends in POP emissions into air

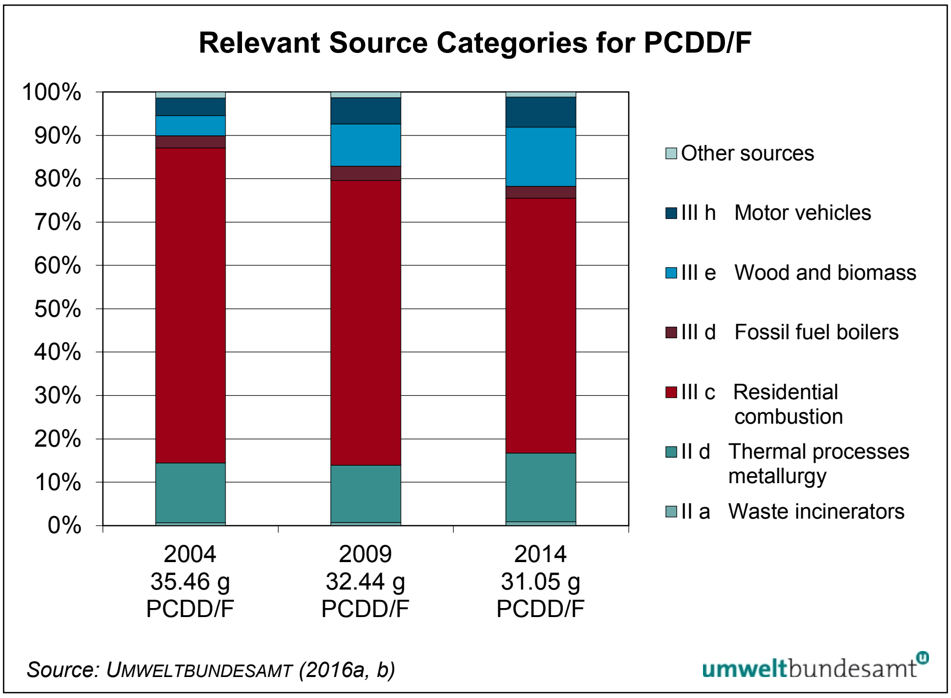
PCDD/F and PAH emissions of major (industrial) sources decreased steadily in the years 1990-2014 with a significant drop between the years 1990 and 1994. Emissions of PCB declined significantly from 1990 to 1993, then increased slowly from 1994 to 2014 and at 180 kg/a they are now 7% lower than in 1990 (but 11% higher than in 1995). Emissions of HCB declined from 1990 to 2011, and then increased strongly in the years 2012, 2013 and 2014. This increase is due to an unintentional release of HCB in an Austrian cement installation which was caused by the input of HCB containing waste and incomplete destruction of HCB.

In 2009 emissions of PAH, HCB and PCDD/F dropped significantly due to reduced economic activity.

Dioxins and furans (PCDD/F, I-TEQ)

In the year 2014 a total of 31.05 g PCDD/F (I-TEQ) was emitted in Austria from the source categories according to the Stockholm Convention. In the Austrian Air Emissions Inventory (OLI) PCDD/F emissions into air were calculated to be 31.61 g (I-TEQ, 2009). The difference can be explained by the fact that the OLI is more comprehensive (i.e. more activities are covered). On the other hand, some emission factors have been updated for this report (see description of source categories).

Only a few source categories contribute significantly to the total emissions of dioxins and furans, the most important being residential combustion sources with a share of 58% and thermal processes in the metallurgical sector with a share of 17%. Other sources are motor vehicles with 7%, biomass combustion (13%) and fossil fuel use in industry (3%) (see figure A and tables A and B).



Source: UMWELTBUNDESAMT (2016a, b)

Figure A: Relevant source categories for PCDD/F.

Table A: PCDD/F emissions from source categories part II for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part II	**2004 [g I-TEQ]**	**2009 [g I-TEQ]**	**2014 [g I-TEQ]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	0.230	0.229	0.267
Cement kilns firing hazardous waste[1]	0.119	0.131	0.121
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching[2]	IE	IE	IE
The following thermal processes in the metallurgical industry			
(i) Secondary copper production	0.279	0.279	0.279
(ii) Sinter plants in the iron and steel industry	3.106	2.538	3.353
(iii) Secondary aluminium production	1.309	1.282	1.256
(iv) Secondary zinc production	NO	NO	NO
Total (Part II)	**5.043**	**4.459**	**5.275**

[1] *figures represent total emissions from cement kilns*

[2] *only process emissions are covered here; PCDD/F emissions from combustion processes are included in fossil fuel fired utility and industrial boilers, and in firing installations for wood and other biomass fuels.*

NO: not occurring

IE: included elsewhere

Table B: PCDD/F emissions from source categories part III for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part III	**2004 [g I-TEQ]**	**2009 [g I-TEQ]**	**2014 [g I-TEQ]**
Open burning of waste*	0.223	0.132	0.069
Thermal processes in the metallurgical industry not mentioned in Part II	0.204	0.191	0.213
Residential combustion sources	25.748	21.295	18.127
Fossil fuel-fired utility and industrial boilers	0.989	1.079	0.856
Firing installations for wood and other biomass fuels	1.644	3.147	4.192
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA	NA
Crematoria	0.154	0.164	0.164
Motor vehicles, particularly those burning leaded gasoline	1.451	1.972	2.155
Destruction of animal carcasses	NA	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA	NA
Shredder plants for treatment of end of life vehicles	NE	NE	NE
Smouldering of copper cables	NO	NO	NO
Waste oil refineries	NO	NO	NO
Total (Part III)	**30.414**	**27.980**	**25.776**

* *without burning of landfill sites and accidental fires*

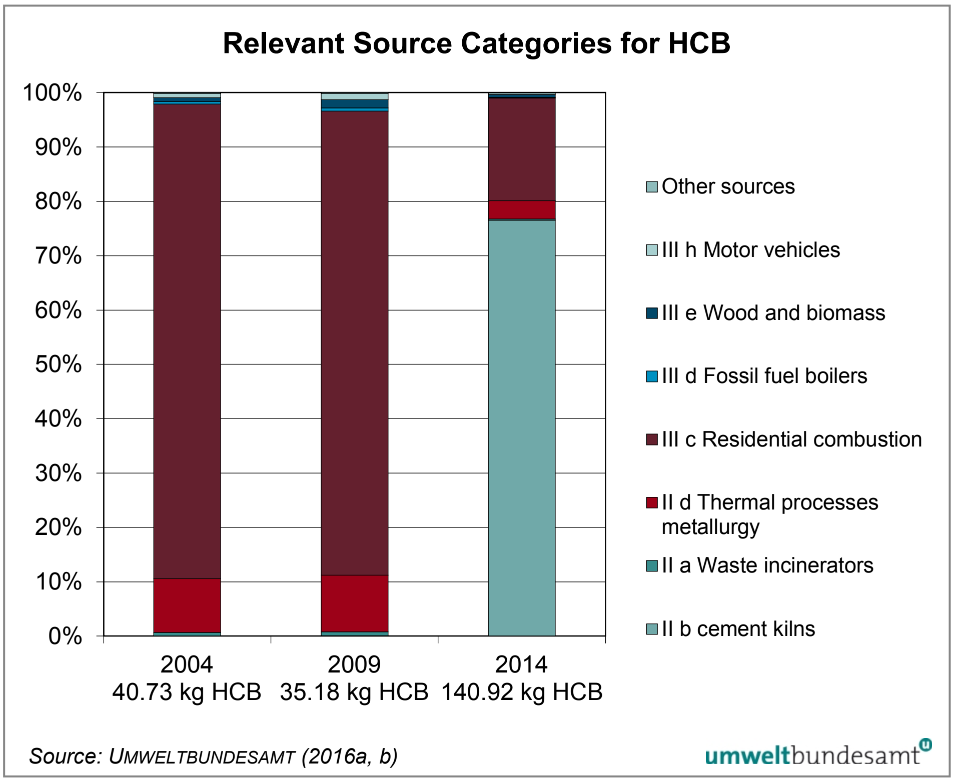
NA: not applicable

NO: not occurring

NE: not estimated

Hexachlorobenzene (HCB)

In Austria only a few source categories contribute significantly to the total emissions of HCB. In the year 2014, 140.92 kg were emitted in total (see Table C, D and Figure B). Cement kilns sources had the lion's share (76.5%) while residential combustion sources accounted for 19%. Thermal processes in the metallurgical industries emitted 3.4% of the total emissions. All other sources were well below 1%. The situation is totally different than in the years 2004 and 2009 when the lion's share of HCB came from residential combustion sources. The increase in 2014 is due to an unintentional release of HCB in an Austrian cement plant.



Source: UMWELTBUNDESAMT (2016a, b)

Figure B: Relevant source categories for HCB.

Table C: HCB emissions from source categories part II for 2004, 2009 and 2014 (Umweltbundesamt 2016a, b).

Source Category Part II	**2004 [kg HCB]**	**2009 [kg HCB]**	**2014 [kg HCB]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	0.253	0.262	0.301
Cement kilns firing hazardous waste[1]	0.018	0.020	107.851
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching[2]	IE	IE	IE
The following thermal processes in the metallurgical industry			
(i) Secondary copper production	0.091	0.091	0.091
(ii) Sinter plants in the iron and steel industry	3.261	2.926	4.031
(iii) Secondary aluminium production	0.654	0.641	0.628
(iv) Secondary zinc production	NO	NO	NO
Total (Part II)	**4.277**	**3.939**	**112.902**

[1] figures represent total emissions from cement kilns

[2] only process emissions are covered here; HCB emissions from combustion processes are included in fossil fuel fired utility and industrial boilers, and in firing installations for wood and other biomass fuels.

NO: not occurring

IE: included elsewhere.

Table D: HCB emissions from source categories part III for 2004, 2009 and 2014 (Umweltbundesamt 2016a, b).

Source Category Part III	**2004 [kg HCB]**	**2009 [kg HCB]**	**2014 [kg HCB]**
Open burning of waste*	0.045	0.026	0.014
Thermal processes in the metallurgical industry not mentioned in Part II	0.016	0.014	0.017
Residential combustion sources	35.586	30.032	26.657
Fossil fuel-fired utility and industrial boilers	0.197	0.195	0.152
Firing installations for wood and other biomass fuels	0.287	0.543	0.715
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA	NA
Crematoria	0.031	0.033	0.033
Motor vehicles, particularly those burning leaded gasoline	0.290	0.394	0.431
Destruction of animal carcasses	NA	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA	NA
Shredder plants for treatment of end of life vehicles	NE	NE	NE
Smouldering of copper cables	NO	NO	NO
Waste oil refineries	NO	NO	NO
Total (Part III)	**36.451**	**31.238**	**28.019**

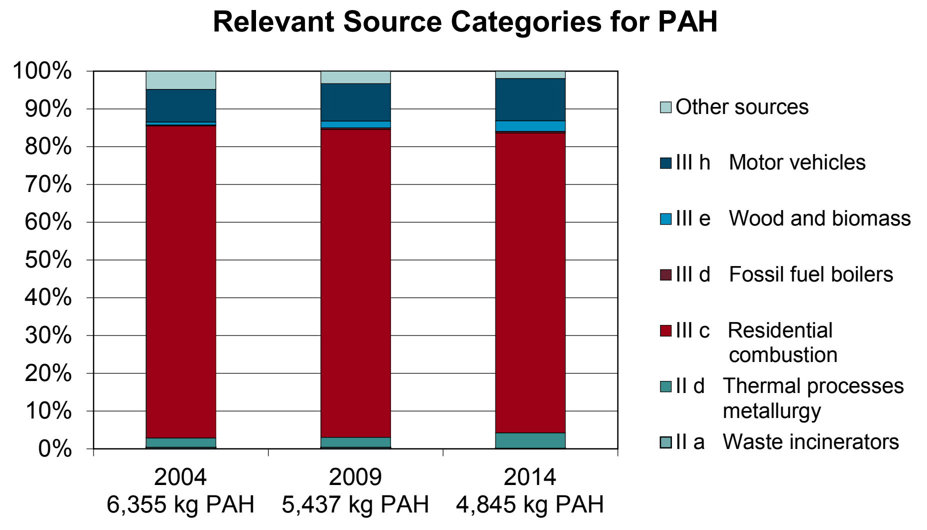
** without burning of landfill sites and accidental fires*

NA: not applicable, NE: not estimated, NO: not occurring

Polycyclic aromatic hydrocarbons (PAH)

In the year 2014, 4,845 kg PAH were emitted in Austria. PAH emissions are mainly caused by two source categories (see Figure C, Table E and F). Residential combustion sources accounted for 79% and mobile vehicles for 11%. Other notable sources were firing installations for wood and biomass (2.7%) and sinter plants (4%).

Figure C: Relevant source categories for PAH.



Source: Umweltbundesamt (2016a, b)

Table E: PAH emissions from source categories part II for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016 a, b).

Source Category Part II	**2004 [kg PAH]**	**2009 [kg PAH]**	**2014 [kg PAH]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	24.066	24.095	9.443
Cement kilns firing hazardous waste[1]	3.332	3.663	3.385
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching[2]	IE	IE	IE
The following thermal processes in the metallurgical industry			
(i) Secondary copper production	NE	NE	NE
(ii) Sinter plants in the iron and steel industry	156.484	140.891	193.647
(iii) Secondary aluminium production	NE	NE	NE
(iv) Secondary zinc production	NO	NO	NO
Total (Part II)	**183.872**	**168.649**	**206.476**

1 figures represent total emissions from cement kilns

2 only process emissions are covered here; PAH emissions from combustion processes are included in fossil fuel fired utility and industrial boilers and in firing installations for wood and other biomass fuels.

NO: not occurring; NE: not estimated; IE: included elsewhere.

Table F: PAH emissions from source categories part III for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016 a, b).

Source Category Part III	**2004 [kg PAH]**	**2009 [kg PAH]**	**2014 [kg PAH]**
Open burning of waste*	305.551	178.625	90.885
Thermal processes in the metallurgical industry not mentioned in Part II	2.909	2.763	3.250
Residential combustion sources	5,250.076	4428.292	3,846.067
Fossil fuel-fired utility and industrial boilers	16.925	25.973	20.121
Firing installations for wood and other biomass fuels	46.961	96.496	133.194
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA	NA
Crematoria	0.007	0.008	0.008
Motor vehicles, particularly those burning leaded gasoline	548.220	536.494	545.0025
Destruction of animal carcasses	NA	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA	NA
Shredder plants for treatment of end of life vehicles	NE	NE	NE
Smouldering of copper cables	NO	NO	NO
Waste oil refineries	NO	NO	NO
Total (Part III)	**6,170.651**	**5,268.651**	**4,638.550**

NA: not applicable

NE: not estimated

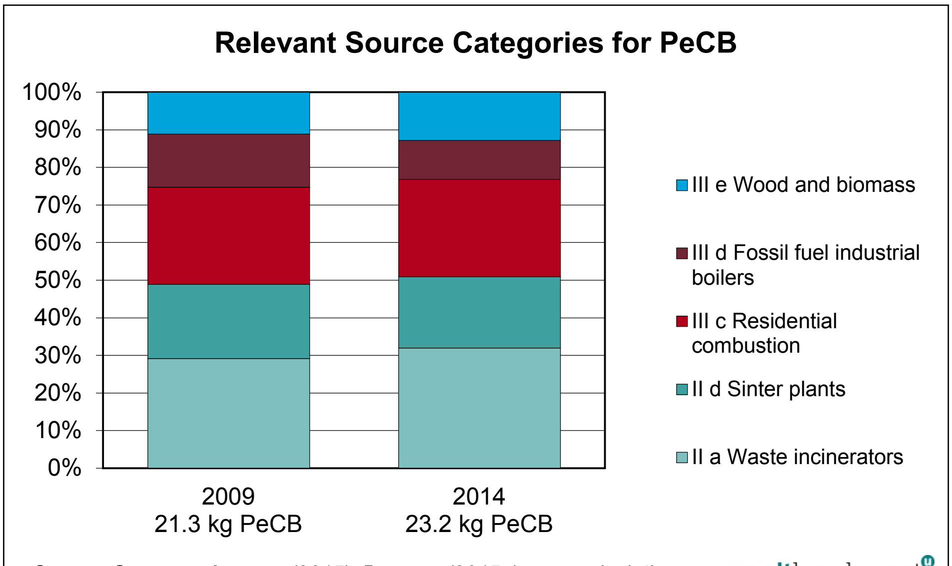
NO: not occurring

Pentachlorobenzene (PeCB)

In the year 2014, a total of 23.2 kg of PeCB was emitted in Austria from the source categories according to the Stockholm Convention.

PeCB emissions are not available from the Austrian inventory but have been calculated using default emission factors from the literature and given activity data. Therefore, there are some uncertainties in the calculated PeCB emissions.

Figure D: Relevant source categories for PeCB.



Source: Statistik Austria (2015), Bmlfuw (2015a); own calculation

Table G: PeCB emissions from source categories part II for 2009 and 2014 (Statistik Austria 2015, Bmlfuw 2015a, own calculation).

Source Category Part II	2009 [kg PeCB]	2014 [kg PeCB]
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	6.21	7.42
Cement kilns firing hazardous waste	NA	NA
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching	NA	NA
The following thermal processes in the metallurgical industry		
(i) Secondary copper production	NA	NA
(ii) Sinter plants in the iron and steel industry	4.2	4.4
(iii) Secondary aluminium production	NA	NA
(iv) Secondary zinc production	NO	NO
Total (Part II)	**10.41**	**11.82**

NO: not occurring

NA: not applicable.

Table H: PeCB emissions from source categories part III for 2009 and 2014 (STATISTIK AUSTRIA 2015, BMLFUW 2015a; own calculation).

Source Category Part III	**2009 [kg PeCB]**	**2014 [kg PeCB]**
Open burning of waste, including burning of landfill sites	NA	NA
Thermal processes in the metallurgical industry not mentioned in Part II	NA	NA
Residential combustion sources	5.5	6.0
Fossil fuel-fired utility and industrial boilers	3.00	2.4
Firing installations for wood and other biomass fuels	2.37	2.98
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA
Crematoria	NA	NA
Motor vehicles, particularly those burning leaded gasoline	NA	NA
Destruction of animal carcasses	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA
Shredder plants for treatment of end of life vehicles	NA	NA
Smouldering of copper cables	NO	NO
Waste oil refineries	NO	NO
Total (Part III)	**10.87**	**11.38**

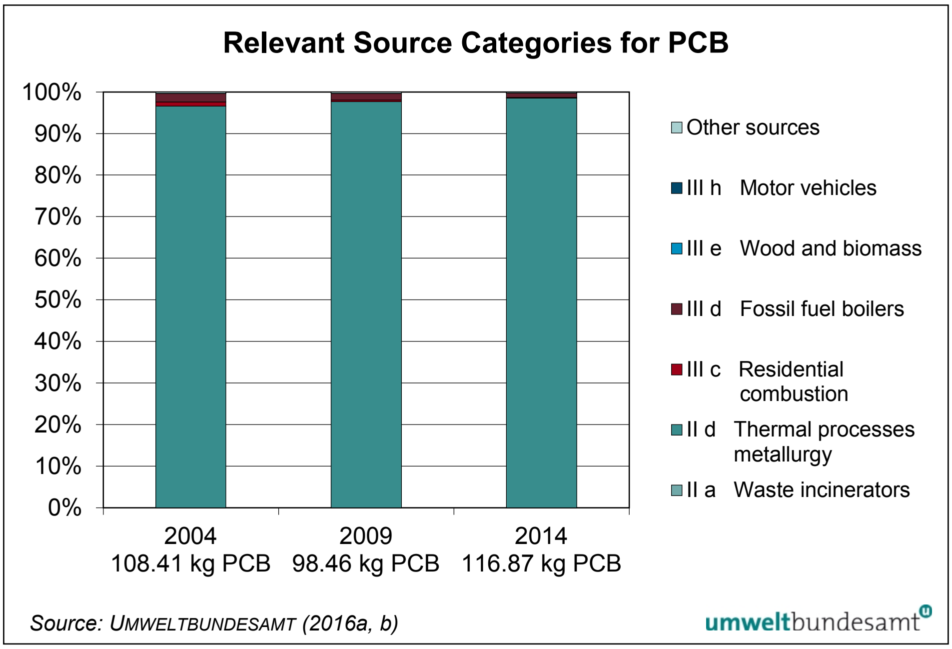
NA: not applicable.

NO: not occurring

Polychlorinated bipenyls (PCB)

In Austria only a few source categories contribute significantly to the total emissions of PCB. In the year 2014, 116.87 kg were emitted in total. Thermal processes in the metallurgical industry had the lion’s share (99%). All other sources were well below 1%.

Figurae E: Relevant source categories for PCB.



Source: UMWELTBUNDESAMT (2016a, b)

Table I: PCB emissions from source categories Part II for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part II	**2004 [g PCB]**	**2009 [g PCB]**	**2014 [g PCB]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	0.065	0.068	0.053
Cement kilns firing hazardous waste[1]	331.949	353.098	323.780
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching[2]	IE	IE	IE
The following thermal processes in the metallurgical industry			
(i) Secondary copper production	NA	NA	NA
(ii) Sinter plants in the iron and steel industry	26,903.600	23,633.234	33,000.000
(iii) Secondary aluminium production	NA	NA	NA
(iv) Secondary zinc production	NO	NO	NO
Total (Part II)	**27,235.614**	**23,986.401**	**33,323.833**

[1] *figures represent total emissions from cement kilns*

[2] *only process emissions are covered here; PCB emissions from combustion processes are included in fossil fuel fired utility and industrial boilers and in firing installations for wood and other biomass fuels.*

NA: not applicable

NO: not occurring

IE: included elsewhere

Table J: PCB emissions from source categories Part III for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part III	**2004 [g PCB]**	**2009 [g PCB]**	**2014 [g PCB]**
Open burning of waste*	NA	NA	NA
Thermal processes in the metallurgical industry not mentioned in Part II	77,779.105	72,499.525	82,162.70
Residential combustion sources	1,091.570	426.201	190.817
Fossil fuel-fired utility and industrial boilers	2,298.303	1,547.341	1,196.029
Firing installations for wood and other biomass fuels	0.128	0.261	0.351
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA	NA
Crematoria	NA	NA	NA
Motor vehicles, particularly those burning leaded gasoline	0.924	0.841	0.508
Destruction of animal carcasses	NA	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA	NA
Shredder plants for treatment of end of life vehicles	NE	NE	NE
Smouldering of copper cables	NO	NO	NO
Waste oil refineries	NO	NO	NO
Total (Part III)	**81,170.031**	**74,474.169**	**83,550.405**

** without burning of landfills sites and accidential fires*

NA: not applicable

NO: not occurring

NE: not estimated

Polychlorinated naphthales (PCN)

Due to the limited availability of qualified data, releases of PCN have not been calculated.

C Inventory of emissions into water

Data on sources for POPs releases into water are held in two registers in Austria:

In principle, point sources and emissions to water for all POPs are included in the European Pollutant Release and Transfer Register (PRTR). In practice, a reporting obligation to PRTR exists (for most industrial sectors) only for facilities exceeding a certain production capacity threshold and for emissions which exceed a pollutant release threshold. For Austria, approximately 70 facilities with emissions to water or waste water are listed in the PRTR. None of these facilities have reported emissions to water for the pollutants HCB, PeCB and PCB. Two PRTR facilities reported PCDD/PCDF emissions to water; one PRTR-facility reported PAH emissions to water. So far, no data on diffuse sources of POPs have been entered in the PRTR.

Additional information on POP releases was gathered as part of a project undertaken to set up the national emissions inventory in 2007/2008. Some 70 substances were analysed at the inlet and outlet of 15 urban waste water treatment plants with different capacities, purification technologies and waste water composition. The analytical programme comprised the priority substances and certain other substances listed in the daughter Directive 2008/105/EC of the Water Framework Directive and pollutants of national relevance regulated in the Austrian Ordinance on Quality Standards for Surface Waters. DDT, chlordane, aldrin, dieldrin, endrin, heptachlor, hexachlorobenzene and pentachlorobenzene could not be detected in untreatedwaste water. With the exception of one facility, PAHs were only detectable in untreatedwaste water. Only polybrominated diphenylethers were detected in effluents in the sub-ng/l range and hexachlorcyclohexane (lindane) in the ng/l range. The use of lindane had been allowed for some selected minor applications until January 1st 2008.

In 2009 a national inventory on pollutant emissions to surface waters was established. This national register comprises emissions of the following point sources: PRTR facilities, urban waste water treatment plants with a capacity from 2,000 population equivalents upwards and waste incineration facilities with a capacity of more than 2 tonnes of waste per hour. There is no release threshold for reporting. The lower release limit is determined by the limit of quantification of the specified analytical method and the waste water discharge. The first reporting cycle (for the data for 2009) covered only basic waste water parameters. Since 2010 discharges have been reported for a number of substances including POPs. The emissions are reported as annual load data.

By 2014, the remediation of a historical landfill had to be stopped as off-site thermal treatment of HCB-contaminated lime sludge from a cement kiln caused unintended releases to air. As a new tender for ex-situ treatment of sludges failed, a containment system to minimise pollutant releases from the abandoned landfill is now being installed.

It can be concluded that underground pollution by PAHs causes local impacts on soil and groundwater. Nevertheless, it should be pointed out that, depending on the site-specific situation and whether sensitive land uses are concerned, an analysis of the risks to human health or ecosystems is required.

Whereas underground pollution by PAH is a well known problem, available information on sites contaminated by PCDD/F, HCB and PCB is scarce.

D Inventory of releases via residues and waste

An inventory of releases via residues and waste can be established for PCDD/F and PeCB. In the case of the other POPs, qualified data are not available.

Dioxins and furans (PCDD/F)

In the year 2014 a total of 302.7 g PCDD/F I-TEQ was emitted, which is approximately ten times as much as for the emissions to air. Solid waste from waste incineration contributed most (63%) of the overall releases. Waste from residential sources was responsible for another significant release (25%). Other releases arose from thermal processes in the metallurgical sector and from fossil fuel and biomass combustion (see Figure F, Table K).

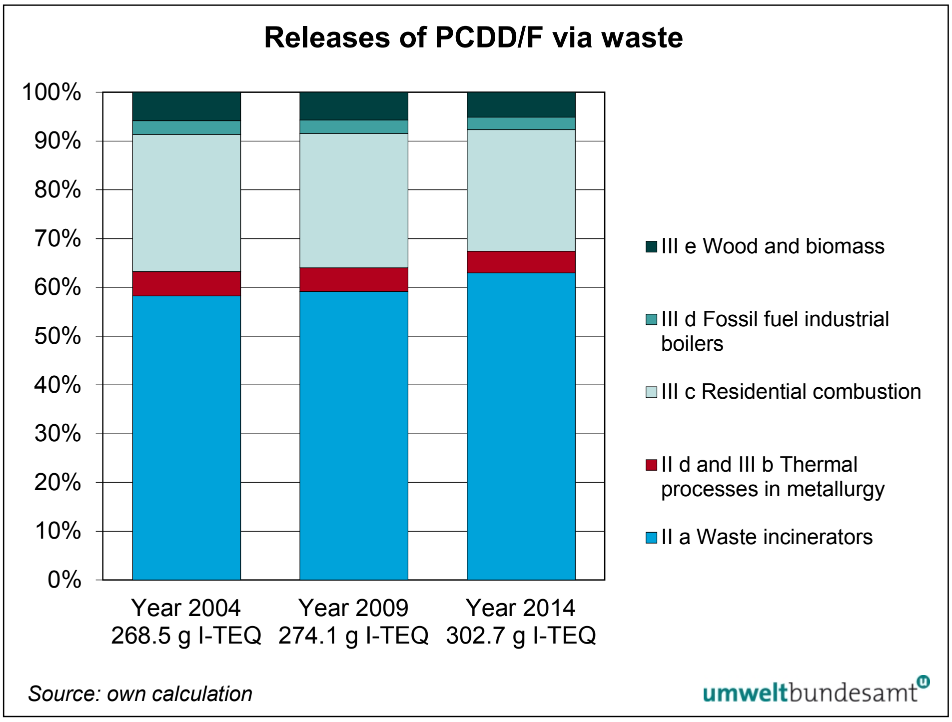


Figure F: Releases (though hardly bio-available) of PCDD/F via waste.

Note: Total releases may be higher since for many source categories (e.g. the metallurgical sector) with a potential for POPs releases via waste qualified emission factors are not available.

Table K: Releases of PCDD/F via waste (own calculation).

Source Category	**2004 g I-TEQ**	**2009 g I-TEQ**	**2014 g I-TEQ**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	156.37	162.1	190.7
Thermal processes in the metallurgical industry	13.3	13.3	13.3
Residential combustion	75.5	75.5	75.5
Fossil fuel industrial boilers	7.7	7.7	7.7
Wood and biomass	15.6	15.6	15.6
Total	**268.5**	**274.1**	**302.7**

However, there are **distinct differences** to other releases with regard to uptake by organisms and impact on human health: Many waste types are disposed of in landfills and thus removed from regular material flows and are **no longer bioavailable**, provided that the landfills are correctly designed and operated:

Waste from waste incinerators is generally disposed of in landfills (landfills for residual waste, mass waste or underground disposal). 87% of the PCDD/F releases occur via fly ash, which is often sent to underground disposal.

Very high PCDD/F concentrations were found in soot from small scale combustion sources. It is not known in detail how this type of waste is treated, but it is assumed that the major part is disposed of via the typical municipal solid waste routes. Where municipal solid waste undergoes thermal treatment, POPs are either oxidised or – if captured in the ashes – sent to landfill. In the case of mechanical-biological treatment, soot accumulates in the fraction which is usually sent to landfill.

Waste from metallurgical processes – which is contaminated to some extent– is either returned to the process or sent to external treatment and/or disposal. There are major data gaps with respect to POP concentrations and the treatment of POP containing waste types.

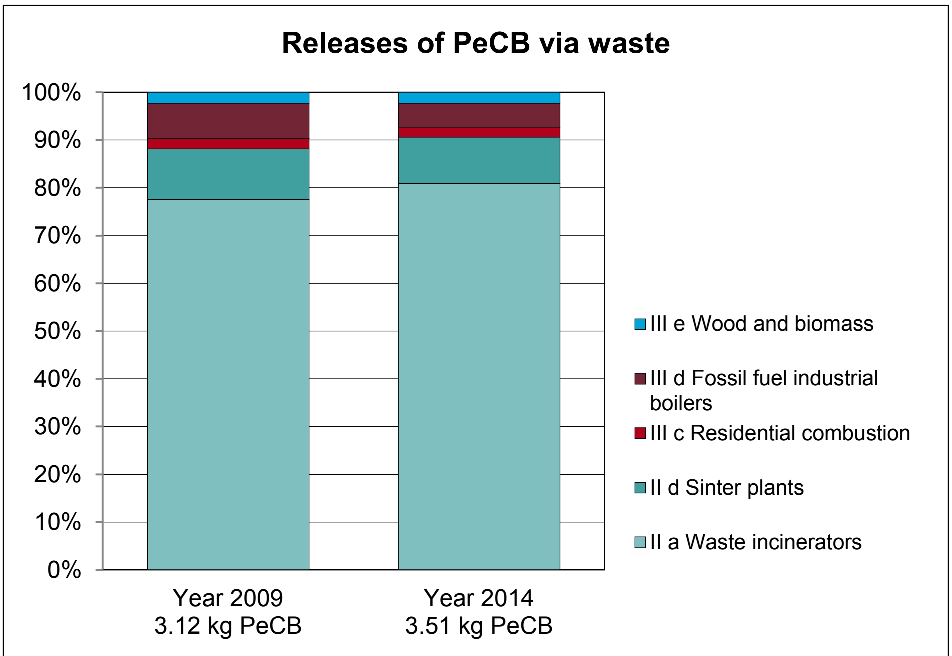
Fly ash from thermal power plants is used in the cement and construction industry, whereas fly ash from biomass plants has to be disposed of in landfills.

Releases of POPs into the environment via waste can occur when POP containing waste types end up in the environment. This can be the case when ash from small scale firing installations (which can contain considerable high concentrations of POPs) is used for “fertilising” purposes or used as an agent for sanding the pavement during the winter season. Coarse ashes from biomass plants are used as additional material for preparing compost. In general, there are also major data gaps concerning the concentrations of POPs in ashes from residential combustion sources. Release estimates are associated with great uncertainties. The reasons for these uncertainties are (among others) the many different types and varieties in the quality of the fuels (and waste types) used (e.g. water content, ash content, calorific value, chlorine content), the wide variety of firing systems with different conditions of combustion and the wide variety of “local” factors (such as manual loading of the firing system, co-incineration of waste).

These releases are relevant when a certain part of the waste is used in the environment (e.g. when using ash as “fertiliser” in private gardens).

Pentachlorobenzene (PeCB)

In the year 2014 a total of 3.51 kg PeCB was emitted. Solid waste from waste incineration contributed most (81%) of the overall releases. Other releases came from thermal processes in the metallurgical sector and from fossil fuel and biomass combustion. It should be mentioned that the data available were scarce.



Source: own calculation

Figure G: Releases (though hardly bio-available) of PeCB via waste.

Table L: Releases of PeCB via waste for 2009 and 2014 (own calculation)

Source Category	**2009 [kg PeCB]**	**2014 [kg PeCB]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	2.42	2.84
The following thermal processes in the metallurgical industry (ii) Sinter plants in the iron and steel industry	0.33	0.34
Residential combustion sources	0.07	0.07
Fossil fuel-fired utility and industrial boilers	0.23	0.18
Firing installations for wood and other biomass fuels	0.07	0.08
Total	**3.12**	**3.51**

E Releases via products

Action on POPs in products is specified in Annex C Part V A (g) of Stockholm the Convention ("minimization of these chemicals as contaminants in products"). Some data can be found in the literature relating to concentrations of PCDD/F in sold cement, pulp and paper products (see Table M). No data are available on the other POPs described in this report.

However, for most source categories there are no relevant product releases.

Table M: PCDD/F-releases via the products cement and pulp and paper – calculations were based on data from literature (Karstensen 2006, Unep 2013, Gruber 1996).

	Release (g I-TEQ/a)
Cement	4.04
Paper	4.46

Releases via pulp which is not exported are included in the value given for paper.

PCDD/F releases via cement, pulp and paper products in 2014 were almost the same as in 2009 and 2004 since there were no significant changes in production.

Concentrations of PCDD/F in cement are considered to be low and can be explained by the fact that filter dust from the clinker process (average PCDD/F concentration: 6.7 ng I-TEQ/kg) is added to the product and that secondary raw materials (e.g. fly ash, gypsum from flue gas desulphurisation) are used. Consequently, the cement is contaminated with low concentrations of PCDD/F (average: 0.91 ng I-TEQ/kg cement) (Karstensen 2006).

It should be mentioned that the bio-availability of POPs in cement has been greatly reduced.

Austria participated in the revision of the Dioxin Toolkit (Unep 2013). Unep 2013 states under “mineral products”: ”This section summarises high-temperature processes in the mineral industry. Raw materials or fuels that contain chlorides may potentially cause the formation of PCDD/PCDF at various steps of the processes, e.g. during the cooling phase of the gases or in the heat zone. Due to the long residence time in kilns and the high temperatures needed for the product, emissions of PCDD/PCDF are generally low in these processes.”

Cement kilns firing hazardous waste are a source covered in Annex C Part II (b) of the Convention concerning emissions of PCDD/F, HCB, PAH, PCB and PeCB. Therefore, the quantification of these POPs in environmental media, as well as in residues and products, is desirable.

In pulp and paper production PCDD/F is introduced into the products mainly via bleached (Kraft-)pulp and recycled papers.

In Austria, total pulp production (reference year 2014) amounted to 1,571 kt (2009: 1,514 kt; 2004: 1,509 kt) with bleached pulp having a share of 36%, unbleached pulp 35% and textile pulp 28% (Austropapier 2015).

The releases from pulp were calculated based on emission factors of 0.5 µg/t (bleached Kraft-pulp) and 0.1 µg/t (other pulp) (Unep 2013). Thus, the total releases via pulp amounted to 0.39 g in the year 2014.

Relevant raw materials for paper production are pulp (both from national production and from imports), wood pulp and recovered paper (both de-inked and not de-inked).

In addition to pulp produced in Austria (see above), imported pulp has to be taken into account: In 2014 about 662,330 t of bleached (Kraft-)pulp were imported. Part of the imported pulp came from countries where chlorine is still used as a bleaching agent. For the calculation of the PCDD/F content it is assumed that the emission factor is 0.5 µg/t for 10% of the imported pulp, whereas the other imported pulp is less contaminated (0.1 µg/t). This leads to a total of 0.093 g I-TEQ imported via pulp.

Input of PCDD/F via wood-pulp has been calculated using an emission factor of 0.1 µg/t (UNEP 2013; total input: 0.037 g I-TEQ).

On the other hand, PCDD/F is introduced via recycled paper and more specifically via impurities in used inks. Where de-inking is applied (about 40% of recovered paper is de-inked in Austria), the PCDD/F content is reduced by a factor of 3 (GRUBER 1996). Comparably high concentrations (up to 2 ng/kg) were found in packaging papers and paper board in the early 1990s. In general, there was a sharp decline in average concentrations between 1989 and 1994 whereas concentrations have been decreasing slowly since 1994 (GRUBER 1996).

Based on the information above and on data given in the Dioxin Toolkit (UNEP 2013), it has been assumed that the PCDD/F concentration in recovered paper is 3 µg/t (without de-inking) and 0.99 µg/t (with de-inking). These assumptions result in an average emission factor of 2.18 µg/t (for de-inked and non de-inked paper). Thus the total release of PCDD/F via paper amounts to 4.46 g (reference year: 2014).

Publications in the scientific literature give some indication that waste paper could be contaminated by printing inks containing significant residues of PCDD/F, e.g. through pigments. In 2011 the Environment Agency Austria conducted a survey assessing the PCDD/F content of cardboard boxes known to be produced from waste paper as the predominant raw material. Comparing the PCDD/F content of brand-new non printed cardboard boxes with used cardboard boxes imprinted to a large extent this limited study did not show any indication of PCDD/F input via printing inks. The cardboard box samples analysed for this study showed PCDD/F contents in a range of 1.2 to 1.9 ng TEQ/kg (UMWELTBUNDESAMT 2011c).

In 2010 Austropapier, the Association of the Austrian Paper Industry, submitted new data on the PCDD/F content of selected paper products in order to refine calculations based on the emissions factors taken from the Dioxin Toolkit (UNEP 2005). The emission factors derived from the new data indicate a reduction in the overall PCDD/F release via paper products by a factor of three.

A new calculation was performed in 2011:

Table N: Releases of PCDD/F via products (calculation on the basis of the output of Austropapier and the results of analysis).

Product	**Production (t/a)**	**Emission factor (µg TEQ/t)**	**Releases (g PCDD/F TEQ/a)**	**Percentage (%)**
Newspaper printing paper	299,205	0.068	0.02	1.2
Printing and writing paper				
● deinked	902,421	0.068	0.06	3.7
● from pulp	1,346,070	0.050	0.07	4.0
Folding box cardboard	487,214	0.723	0.35	21.1
Packaging paper	676,177	1.141	0.77	46.2
Kraft paper				0.0
● with recovered paper	374,855	0.858	0.32	19.3
● only from pulp	250,743	0.050	0.01	0.8
Thin- and special papers				0.0
Sanitary paper	128,660	0.068	0.01	0.5
Others	126,896	0.050	0.01	0.4
Packing and spezial board	13,299	0.858	0.01	0.7
Market pulp exported	95,471	0.070	0.01	0.4
Market pulp (ECF)	313,818	0.090	0.03	1.7
Total	**5,014,829**		**1.67**	**100.0**

F Evaluation of the efficacy of national laws and policies and strategies for meeting the obligations of the Stockholm Convention and the EU POP Regulation

Considering the findings of this report for POPs release inventories, availability of data, measures already implemented or planned, it can be concluded that Austria complies to a great extent with the provisions of the Stockholm Convention and the EU POP Regulation. Nevertheless, as one of the goals of the Convention is the “continuous reduction of POP releases”, further efforts are necessary.

PCDD/F and PAH emissions of major (industrial) sources decreased steadily in the years 1990-2014 with a significant drop between the years 1990 and 1994. Emissions of PCB declined significantly from 1990 to 1993, then increased slowly from 1994 to 2014 and, at 180 kg/a, are now 7% lower than in 1990 (but 11% higher than in 1995). Emissions of HCB declined from 1990 to 2011, and then increased strongly in the years 2012, 2013 and 2014. This increase was due to an unintentional release of HCB in an Austrian cement installation which was caused by the input of HCB containing waste and incomplete destruction of HCB.

If there are changes in the best available techniques allowing for lower or zero emissions from relevant sources, policy makers have to react and to adapt the relevant legal provisions accordingly (e.g. by laying down stricter emission limit values).

The NAPs 2008 and 2012 identify small residential combustion plants as an important target area. In 2014 they still are responsible for 58% of the PCDD/F emissions, 79% of the PAH emissions and 26% of the PeCB emissions into air. All possible measures have to be investigated and explored to reduce POP emissions from these sources.

PCDD/F emissions from biomass combustion have more than doubled from 2004 to 2014 and are responsible for 13% of the overall PCDD/F emissions. PAH emissions from biomass combustion almost tripled from 2004 to 2014, but are still only responsible for 3% of the overall PAH emissions.

It should be mentioned that in order to comply with certain national and international obligations a variety of comprehensive and to some extent cross-sectoral measures and instruments are being developed in Austria. These measures are aimed at the reduction of greenhouse gases, NO_x and (fine) particulate matter. Some of these measures (described e.g. in the Climate Strategy 2007 or in the Programme of the Federal Government (FEDERAL GOVERNMENT 2007)) will lead to an indirect reduction of POPs releases (e.g. by reducing energy consumption or by prescribing stricter air emission limit values for dust), others (such as the increased use of biomass in small scale firing installations) will lead to an increase in POP releases.

Moreover, it is important to gain more in-depth knowledge in fields where reliable data are limited or missing. Specific studies e.g. of POP concentrations in certain wastes as well as further POP related monitoring activities are formulated below.

Evaluation of Measures proposed in NAP 2012 (according to § 20 (2) Chemicals Act 1996)

NAP 2008 and NAP 2012 list a variety of measures which help to lower POPs emissions from relevant sources on the one hand, and would improve the availability of data on POP in the environment on the other hand.

Releases of POPs from source categories

The following table gives an overview of measures proposed in the NAP 2012 and implemented in the period 2012-2016.

National legislation	Contents relating to POPs	Measures proposed in NAP 2012	Current status
Industrial Code 1994 and specific ordinances according to § 82 para 1	ELV for various air pollutants, eg dust, PCDD/F	Continuous evaluation with regard to BAT	Amendment of Iron and Steel Ordinance (Fed. Law Gaz. II No. 54/2016) Repeal of ordinance for Sinter Plants (Fed. Law Gaz. II No. 303/2014) Ordinance on Foundries (Fed. Law Gaz. II No. 264/2014)
Ordinance on combustion plants (Fed. Law Gaz. II No. 331/1997)	ELVs for dust, CO, Corg, NO_x	Adaptation to BAT necessary (stricter ELVs for dust)	The process of implementation of the MCPD into national law is currently (2017) under way (amending the ordinance on combustion plants).
Waste incineration ordinance (Fed. Law Gaz. II No. 2002/389)	ELVs for dust, CO, Corg, NO_x, heavy metals, PCDD/F	Stricter ELVs for dust for co-incineration plants	Revised ordinance (Fed. Law Gaz. II No. 135/2013)
Austrian Water Act and specific Ordinances:	ELVs for AOX and POX in the sector specific ordinances		
Ordinance on the limitation of waste water emissions from flue gas treatment (Fed. Law Gaz. II No. 271/2003)	ELVs for PCDD/F	Continuous evaluation with regard to BAT	Amendment (Fed. Law Gaz. II No. 201/2014)
Ordinance on the limitation of waste water emissions from processing of coal (Fed. Law Gaz. II No. 346/1997)	ELVs for PAHs	Continuous evaluation with regard to BAT	Amendment in preparation
Ordinance on the limitation of waste water emissions from the production of plant protecting agents and crop sprayings (Fed. Law Gaz. No. 668/1996)	ELVs for AOX and specific POPs	Continuous evaluation with regard to BAT	None
Ordinance on the determination of the target state for surface waters (Fed. Law Gaz. II No. 96/2006)	Environmental quality standard for HCB	For PAHs: community environmental quality standards determined (in 2008)	Ordinance was amended in 2010 according to Directive 2008/105/EC (Fed. Law Gaz. II No. 461/2010) and in 2016 (Fed. Law Gaz. II No. 363/2016)
Ordinance on landfills (Fed. Law Gaz. II No. 39/2008)	Limit values for the content of PAH in wastes		Amended by Fed. Law Gaz. II No. 291/2016
Compost ordinance (Fed. Law Gaz. II No. 292/2001)	Limit values for the content of POPs in composts	Continuous evaluation of the limit values necessary	None

Other relevant legal provisions	**Contents relating to POPs**	**Measures proposed in NAP 2012**	**Current status**
BAT Conclusions, already published in the Official Journal of the European Commission	Limit values for POPs	New measure	Implementation in national law (ordinances, permits)
Cement, lime and magnesia	ELV for POPs	New measure	Implemented via waste incineration ordinance (Fed. Law Gaz. II No. 135/2013)
Non ferrous metals	ELV for POPs	New measure	Implementation for air-emissions in non ferrous metals ordinance (Fed. Law Gaz. II No. 86/2008), for water emissions in AEV non ferrous metals (Fed. Law Gaz. II No. 889/1995) and/or in individual permits required by 30 June 2020
Iron and steel	ELV for POPs	New measure	Implemented for air emissions with amendment to iron and steel ordinance (Fed. Law Gaz. II No. 54/2016) and for water emissions with amendment to AEV iron metal industry (Fed. Law Gaz. II No. 202/2014)
Ordinances on sewage sludge and compost of the Federal Provinces	Limit values for POP	Continuous evaluation of the limit values necessary	Some Austrian provinces limit POPs in sewage sludge
Ambient Air Quality Act (IG-L)	§ 21 IG-L: Legal basis for an ordinance	Evaluation whether generally binding ELVs for crematoria are necessary in an ordinance according to § 21 IG-L	Not implemented, no general binding rule for crematoria
Laws of the Federal Provinces concerning residential combustion sources	PM emission thresholds for new installation of small scale combustion equipment	Agreement pursuant to Art. 15a Federal Constitution Law concerning the placing on the market and the inspection of combustion installations, rapid transposition of the requirements of this agreement into the law of the federal provinces	Signed by governors of federal provinces governors of the federal provinces in 2011 Amended by Federal provinces individually by ordinance or law starting from 2012
Act on Air Pollution Prevention (Fed. Law Gaz. I No. 137/2002, as amended (Fed. Law Gaz. I No. 50/2012))	Prohibiting the burning of biogenic materials, many exemptions possible	Evaluation with respect to exemptions	Prohibition integrated in Act on Air Pollution Prevention
Permitting process	Content relating to POPs	Comments/Specific Steps	Ongoing
Landfill sites	Fire protection requirements	Implementation of effective fire protection requirements for landfills and intermediate storage sites for waste	No new information

Implemented measures for residential combustion plants

Standard eco-design emission requirements for the placing on the market and putting into service of solid fuel local space heaters[1] and solid fuel boilers[2] will enter into force on 1 January 2020 (2015/1189) and on 1 January 2022 (2015/1185) and gradually repeal the current national standard emission requirements (Article 15a Agreement).

However, the Austrian Ecolabel N°37 on biomass heating[3] sets more ambitious PM emission thresholds for new installations, as well as defining other environment-friendly criteria. The Ecolabel is a mandatory requirement for new installations with biomass combustion systems if they are supported by funding programmes promoting the exchange of old fossil-fuel based heating systems.

Another set of measures is concerned with awareness raising to encourage low-emission incineration in wood stoves in households or the use of ashes from these stoves for fertilising purposes.

An initiative of Federal Ministry of Agriculture and Forestry, Environment and Water Management entitled “Richtig heizen” (“Proper Heating”) was launched in 2009 and is still running in 2017. An important output is a booklet published in 2010 containing information on the effects of emissions from household stoves on human health and the environment as well as tips and advice on how heating with low emissions can be achieved by simple measures (e.g. light from above). The booklet has been distributed to the public by doctors and chimney sweepers.

Furthermore, an internet site has been created where the proper use of household wood stoves as well as legal considerations are described. The internet site was further developed in 2013 by adding an interactive online calculator that allows users to calculate their energy demand, PM emissions and solid fuel used for heating. Subsequently, it gives advice on possible measures for reducing energy consumption and emissions (wood drying, thermal insulation, exchange of heating system). Information on Ecodesign provisions and PM filter systems for small scale heating appliances will be added in 2017.

Proposed measures for residential combustion plants and biomass plants

- Effective financial funding for the replacement of coal-fired small scale combustion systems and old (probably high emission) biomass heating systems with modern, low emission biomass heating systems, district heating or renewable energy systems.
- Periodic reviews and improvements of the criteria for the funding of biomass plants (including biomass plants operated in the agricultural sector) with respect to operating conditions, energy efficiency (including district heating systems), quality of fuels and emission limit values for dust.

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[1] Commission Regulation (EU) 2015/1185 of 24 April 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for solid fuel local space heaters.

[2] Commission Regulation (EU) 2015/1189 of 28 April 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for solid fuel boilers.

[3] Österreichisches Umweltzeichen Richtlinie UZ 37 Holzheizungen, Version 6.0 vom 1. Jänner 2017

- Providing further information (awareness raising) concerning the prevention of co-incineration of waste in small scale firing installations.
- Providing further information (awareness raising) concerning the final disposal of ashes/soot from small scale firing installations.
- Emission behaviour of small scale combustion installations (esp. in case of firing cereals): → still partly unknown for POPs, a literature study is currently underway.

Data availability on POP releases into the environment

For the following sources the availability of data is still limited or missing. Therefore, to assess whether releases of POPs are relevant and to improve and complete Austrian inventories on POPs, the following specific steps are desirable/necessary to improve data quality. However, the implementation of these measures often depends on available budget resources.

- Improvement of data quality with respect to releases of HCB, PCB, PeCB and, if feasible, PCN into air (e.g. by planning and carrying out measurement programmes for sources with a high priority, such as residential combustion sources, industrial processes).
- Verification of the emission factor for PCB in the source category Part III "thermal processes in the metallurgical industry" (especially for the sector secondary lead production).
- Establishment of emission monitoring programmes in the neighbourhood of POP relevant emitters: identification of relevant sites for sampling and measurements campaigns (winter/summer).
- Continuation of ambient air and deposition monitoring for POPs.
- Continuation of monitoring programmes in food (meat, milk,..).
- Food and Feed Monitoring in the neighbourhood of POP relevant emitters, identification of relevant sites for sampling.
- Implementation of a national monitoring programme to investigate the distribution of deposited POPs.
- Continuation of monitoring programmes in soil and bioindicators (Norway spruce needles and/or grass) close to POP sources.
- Improvement of data quality with respect to releases of POPs from landfills and abandoned industrial sites and known contaminated sites (e.g. PAH content of landfill gases).
- Determination of POP concentrations in waste streams from small scale combustion installations in the sectors residential combustion, services and agriculture which have a high probability of being released into the environment (e.g. bottom ash and fly ash).
- Determination of POP concentrations in waste streams from fossil fuel fired utilities and industrial boilers (including co-incineration of waste) which are recovered in other production processes or which have a high probability of being released into the environment (e.g. fly ash from co-incineration plants).
- Determination of POP concentrations in waste streams from biomass fired combustion installations which are recovered in other production processes or which have a high probability of being released into the environment (e.g. bottom ash).

- Quantification of POP emissions (esp. PCDD/F and PCB) from Platformer 3 of the OMV refinery in Schwechat.
- Measurement of emissions from motor vehicles and update of emission factors to improve the quality of forecasts.

  → The Handbook on Emission Factors for Road Transport (HBEFA) provides emission factors for all current vehicle categories (PC, LDV, HGV, urban buses, coaches and motor cycles), each divided into different categories, for a wide variety of traffic situations. Emission factors for all regulated (and the most important non-regulated) pollutants as well as fuel consumption and CO_2 are included. The latest HBEFA version 3.2 was updated in 2014. All emission factors have been recalculated (based on a broader set of emission data, new measurements of motor vehicle emissions; and new emission factor models have been applied). For calibrating the model, a broad set of emission measurements up to Euro 6 has been used.

Proposed measures with regard to industrial plants

- Limitation of POP contaminated waste/residues in co-incineration plants and industrial plants. Representative sampling of individual batches of POP contaminated waste/residues is necessary before using them as input material.
- Avoid/prohibit highly contaminated waste/residues in co-incineration plants.
- Before treating POP contaminated waste/residues in industrial plants, test runs (including monitoring of POP emissions) have to be conducted.
- If POP contaminated waste/residues are used as input materials in industrial plants, regular/continuous monitoring of POP emissions is necessary. If a destruction of these POPs cannot be ensured in the industrial plant, the POP residues/waste must not be used as input material.
- If there are any changes in the process involving POP contaminated waste/residues, test runs (including monitoring of POP emissions) have to be conducted.

Proposed other measures

- Successive reduction of diesel powered vehicles through increased market penetration of electrically vehicles.

Soil Protection Laws of the Federal Provinces: Burgenländisches Bodenschutzgesetz (LGBl. Nr. 87/1990) Niederösterreichisches Bodenschutzgesetz (LGBl. Nr. 6160-0) Oberösterreichisches Bodenschutzgesetz (LGBl. Nr. 63/1997) Bodenschutzgesetz Salzburg (LGBl Nr. 80/2001) Steiermärkisches landwirtschaftliches Bodenschutzgesetz (LGBl. Nr. 66/1987)	Setting of target values for organic pollutants (including polybrominated diphenylethers, perfluorinated tensides and pesticides) with the aim to reduce pollution of soils	AustroPOPs project aiming at implementing a national soil POP monitoring system is under discusssion

ZUSAMMENFASSUNG

A Einleitung

A Einleitung

Dieser Bericht ist der 2. Review des Nationalen Aktionsplans POPs, der 2008 veröffentlicht wurde. Artikel 5 des Stockholmer Übereinkommens verpflichtet die Vertragsparteien zur Erarbeitung eines Aktionsplanes, der unbeabsichtigt freigesetzte POPs (laut Anhang C) beschreibt und näher behandelt. Artikel 5 sieht darüber hinaus alle 5 Jahre eine regelmäßige Überprüfung (Revision) des Aktionsplanes und der erfolgreichen Umsetzung der Verpflichtungen des Übereinkommens vor.

In Anhang C sind derzeit folgende unbeabsichtigt freigesetzte Chemikalien enthalten: polychlorierte Dibenzo(p)dioxine (PCDD), polychlorierte Dibenzofurane (PCDF), Hexachlorbenzol (HCB), polychlorierte Biphenyle (PCBs) und Pentachlorbenzol (PeCB). Polychlorierte Naphthaline (PCN) sind seit Ende 2016 Teil des Anhangs.

Ferner behandelt der Nationale Aktionsplan auch die Freisetzung von polyzyklischen aromatischen Kohlenwasserstoffen (Benzo(a)pyren, Benzo(b)fluoranthen, Benzo(k)fluoranthen und Indeno(1,2,3-cd)pyren), da diese in der EU POP-Verordnung ((EG) Nr. 850/2004) genannt sind.

Die Bezeichnung „Freisetzung" umfasst POP-Emissionen in Luft, Wasser und Boden sowie Freisetzungen aus Abfällen, Rückständen und Produkten.

Der Nationale Aktionsplan ist Teil des Nationalen Durchführungsplans gemäß Artikel 7 des Übereinkommens und beinhaltet Strategien zur Verminderung oder Eliminierung der Freisetzung der in Anhang C genannten Chemikalien (einschließlich PAHs) sowie einen Zeitplan. Der Plan identifiziert Handlungsprioritäten, unter anderem für diejenigen Quellkategorien, die eine möglichst kosteneffiziente Verminderung oder Eliminierung von Freisetzungen versprechen. Zudem enthält er Freisetzungsinventare für die in Anhang C gelisteten Chemikalien.

Der 2. Review des Nationalen Aktionsplanes enthält eine Aktualisierung der Quellverzeichnisse und der Emissionsabschätzungen (2004, 2009 und 2014). Auf deren Grundlage werden Instrumente und Maßnahmen vorgeschlagen, die zur Reduzierung von POP-Freisetzungen führen sollen. Insbesondere werden die Wirksamkeit der bisherigen gesetzlichen Regelungen und auch die Anwendung von BAT (Best Available Techniques – Beste Verfügbare Techniken) und BEP (Best Environmental Practice – Beste Umweltschutzpraktiken) in den Quellkategorien des Stockholmer Übereinkommens (laut Anhang C) überprüft. Zudem werden Empfehlungen gegeben, wie BAT und BEP einzusetzen sind. Des Weiteren werden noch bestehende Datenlücken identifiziert und Vorschläge zur Verbesserung der Datenqualität ausgearbeitet.

Ein Quellverzeichnis kann für folgende POP-Emissionen in die Luft erstellt werden: PCDD/F, PAHs, HCB, PCB und PeCB. Für PCN ist dies aufgrund mangelnder Daten jedoch nicht möglich.

Zum Eintrag von POPs in Gewässer und zur Freisetzung aus Abfällen existieren wenige Daten. In Bezug auf Abfälle kann lediglich für PCDD/F und PeCB eine Abschätzung getroffen werden.

Eine direkte Kontamination von Böden erfolgt durch die Quellkategorie “offene Verbrennung von Abfällen, einschließlich Verbrennung auf Deponien“ (dies beinhaltet auch die offene Verbrennung biogener Materialien wie etwa Stroh). Jedoch können auch POPs in den Boden eingetragen werden, wenn Prozessrückstände wieder in die Umwelt gelangen (z. B. Verwendung von Asche aus Kleinfeuerungsanlagen für Düngezwecke).

Der Nationale Aktionsplan enthält außerdem einige Literaturdaten zu Gehalten von POPs in den Produkten Zement, Zellstoff und Papier.

Das Umweltbundesamt untersuchte im Jahr 2011 Kartonagen aus recycliertem Papier auf eine mögliche Kontamination mit PCDD/F durch Druckfarben. Es konnten keine Verunreinigung nachgewiesen werden.

Der Nationale Aktionsplan wird periodisch überarbeitet.

B Emissionsverzeichnis Luft

Trends für POP-Emissionen in die Luft

PCDD/F und PAH-Emissionen aus industriellen Prozessen sind von 1990 bis 2014 stetig – mit einer signifikaten Reduktion zwichen 1990 und 1994 – gesunken. PCB-Emissionen nahmen zwischen 1990 und 1993 signifikant ab, erhöhten sich von 1994 bis 2014 jedoch langsam. Mit 180 kg/a liegt ihr Wert nun um 7 % unter jenem von 1990, jedoch um 11 % höher als 1995.

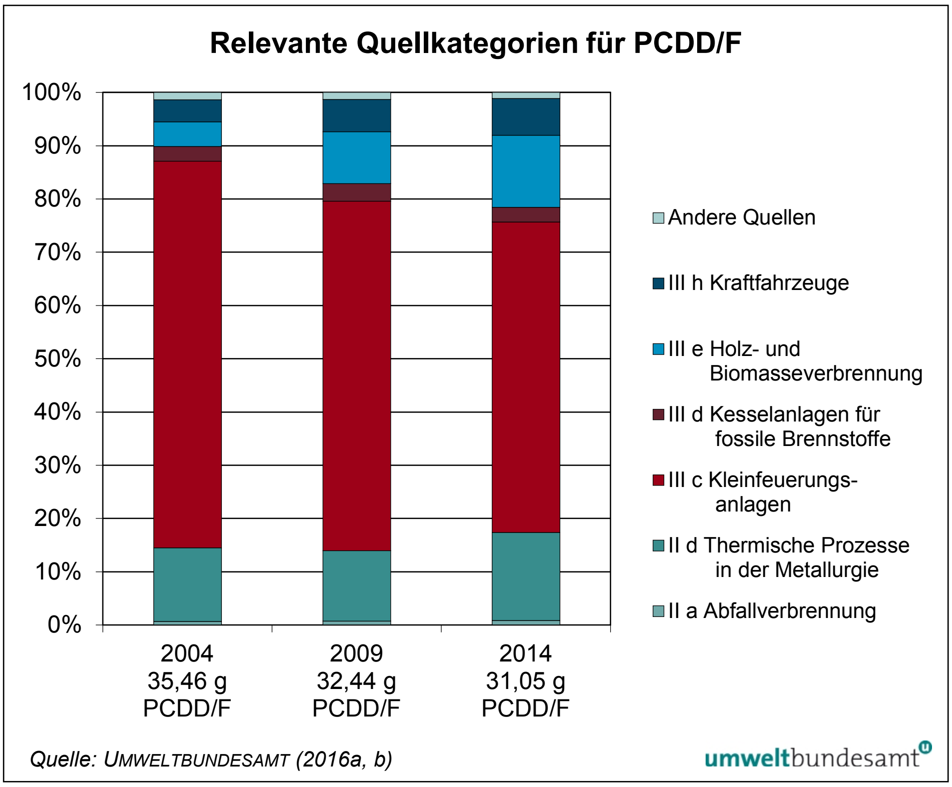
Die HCB-Emissionen sanken von 1990 bis 2011. In den Jahren 2012, 2013 und 2014 kam es aufgrund einer unbeabsichtigten Freisetzung von HCB in einer österreichischen Zementanlage zu einem starken Anstieg. Die Emission wurde durch den Einsatz von HCB-haltigem Abfall und eine unvollständige Zerstörung von HCB verursacht.

Durch die verringerte Wirtschaftstätigkeit im Krisenjahr 2009 fielen die PAH-, HCB- und PCDD/F-Emissionen in signifikantem Ausmaß.

Dioxine und Furane (PCDD/F; I-TEQ)

Im Jahr 2014 wurden 31,05 g PCDD/F (I-TEQ) aus den in Anhang C des Stockholmer Übereinkommens angeführten Quellkategorien emittiert. Gemäß der Österreichischen Luftschadstoffinventur (OLI) betrugen die PCDD/F-Emissionen in die Luft im Jahr 2014 31,61 g (I-TEQ). Diese Differenz ergibt sich einerseits durch den breiteren Anwendungsbereich der OLI, andererseits durch teilweise adaptierte Emissionsfaktoren, die für diesen Bericht verwendet wurden.

Einen wesentlichen Beitrag zur Emission von Dioxinen und Furanen liefern nur einige wenige Quellkategorien. Am größten sind hierbei die Anteile der Kleinfeuerungsanlagen (häusliche Quellen) mit 58 % und jene der thermischen Prozesse in der metallurgischen Industrie mit 17 %. Andere Verursacher sind Kraftfahrzeuge (7 %), die Verbrennung von Biomasse (13 %) und der Einsatz von fossilen Brennstoffen in der Industrie (3 %) (siehe Abbildung A und Tabellen A und B).



Quelle: UMWELTBUNDESAMT (2016a, b)

Abbildung A: Relevante Quellkategorien für PCDD/F.

Tabelle A: PCDD/F-Emissionen aus Quellkategorien Teil II für 2004, 2009 und 2014 (UMWELTBUNDESAMT 2016 a, b).

Quellkategorien Teil II	**2004 [g I-TEQ]**	**2009 [g I-TEQ]**	**2014 [g I-TEQ]**
Abfallverbrennungsanlagen, einschließlich Anlagen zur Mitverbrennung von Siedlungsabfällen, gefährlichen Abfällen, Abfällen aus dem medizinischen Bereich oder Klärschlamm	0,230	0,229	0,267
mit gefährlichen Abfällen befeuerte Zementöfen[1]	0,119	0,131	0,121
Zellstoffproduktion unter Verwendung von elementarem Chlor oder von Chemikalien, bei denen elementares Chlor erzeugt wird, für Bleichzwecke[2]	IE	IE	IE
folgende thermische Prozesse in der metallurgischen Industrie:			
(i) Sekundärkupferproduktion	0,279	0,279	0,279
(ii) Sinteranlagen in der Eisen- und Stahlindustrie	3,106	2,538	3,353
(iii) Sekundäraluminiumproduktion	1,309	1,282	1,256
(iv) Sekundärzinkproduktion	NO	NO	NO
Gesamt (Teil II)	**5,043**	**4,459**	**5,275**

[1] gesamte PCDD/F-Emissionen der österreichischen Zementöfen

[2] nur Prozessemissionen; PCDD/F-Emissionen aus Verbrennungsprozessen werden bei den relevanten Quellkategorien des Teil III betrachtet.

IE: inkludiert in anderer Emissionsquelle

NO: not occurring (Emissionsquelle in Österreich nicht vorhanden)

Tabelle B: PCDD/F-Emissionen aus Quellkategorien Teil III für 2004, 2009 und 2014 (UMWELTBUNDESAMT 2016a, b).

Quellkategorien Teil III	**2004 [g I-TEQ]**	**2009 [g I-TEQ]**	**2014 [g I-TEQ]**
offene Verbrennung von Abfall, einschließlich Verbrennung auf Deponien*	0,223	0,132	0,069
in Teil II nicht genannte thermische Prozesse in der metallurgischen Industrie	0,204	0,191	0,213
häusliche Verbrennungsquellen	25,748	21,295	18,127
mit fossilen Brennstoffen befeuerte Kesselanlagen von Versorgungs- und Industrieunternehmen	0,989	1,079	0,856
Feuerungsanlagen für Holz und sonstige Biomassebrennstoffe	1,644	3,147	4,192
spezifische chemische Produktionsprozesse, bei denen unbeabsichtigt gebildete persistente organische Schadstoffe freigesetzt werden, insbesondere bei der Produktion von Chlorphenolen und Chloranil	NA	NA	NA
Krematorien	0,154	0,164	0,164
Kraftfahrzeuge, insbesondere bei Verbrennung von verbleitem Ottokraftstoff	1,451	1,972	2,155
Tierkörperbeseitigung	NA	NA	NA
Färben (mit Chloranil) und Endbehandlung (durch alkalische Extraktion) von Textilien und Leder	NA	NA	NA
Shredderanlagen zur Behandlung von Altfahrzeugen	NE	NE	NE
Kupferkabelverschwelung	NO	NO	NO
Altölaufbereitungsanlagen	NO	NO	NO
Gesamt (Teil III)	**30,414**	**27,980**	**25,776**

* *ohne Brände (einschließlich Deponiebrände)*

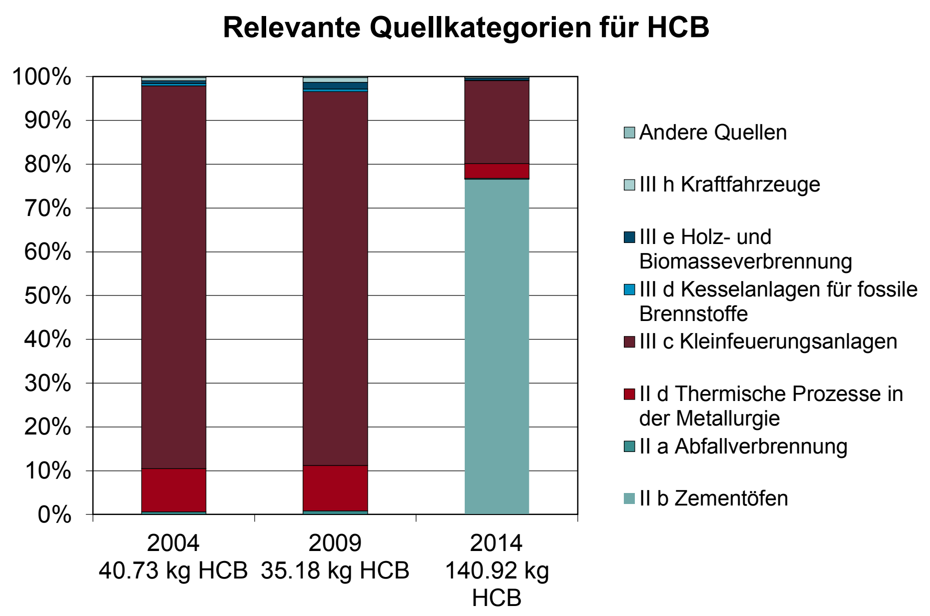
NA: not applicable – als vernachlässigbar betrachtet.

NE: not estimated – nicht abgeschätzt

NO: not occurring – Emissionsquelle in Österreich nicht vorhanden

Hexachlorbenzol (HCB)

In Österreich tragen nur wenige Quellkategorien signifikant zu den Gesamtemissionen an HCB bei. Im Jahr 2014 wurden 140,92 kg HCB emittiert (siehe Tabellen C, D und Abbildung B). Hauptverantwortliche Quellkategorien sind die Zementöfen mit 76,5 % und die Kleinfeuerungsanlagen mit 19 %.Thermische Prozesse in der metallurgischen Industrie trugen mit 3,4 % zu den Gesamtemissionen bei. Der Anteil aller anderen Quellkategorien betrug unter 1 %. Die Situation ist völlig anders als in den Jahren 2004 und 2009 – damals waren Kleinfeuerungsanlagen die hauptverantwortliche Quellkategorie für HCB-Emissionen. Die Zunahme der HCB-Emissionen erfolgte aufgrund einer unbeabsichtigten Freisetzung von HCB in einer österreichischen Zementanlage.



Quelle: U*MWELTBUNDESAMT (2016a, b)*

Abbildung B: Relevante Quellkategorien für HCB.

*Tabelle C: HCB-Emissionen aus Quellkategorien Teil II für 2004, 2009 und 2014 (*U*MWELTBUNDESAMT 2016a, b).*

Quellkategorien Teil II	**2004 [kg HCB]**	**2009 [kg HCB]**	**2014 [kg HCB]**
Abfallverbrennungsanlagen, einschließlich Anlagen zur Mitverbrennung von Siedlungsabfällen, gefährlichen Abfällen, Abfällen aus dem medizinischen Bereich oder Klärschlamm	0,253	0,262	0,301
mit gefährlichen Abfällen befeuerte Zementöfen[1]	0,018	0,020	107,851
Zellstoffproduktion unter Verwendung von elementarem Chlor oder von Chemikalien, bei denen elementares Chlor erzeugt wird, für Bleichzwecke[2]	IE	IE	IE
folgende thermische Prozesse in der metallurgischen Industrie:			
(i) Sekundärkupferproduktion	0,091	0,091	0,091
(ii) Sinteranlagen in der Eisen- und Stahlindustrie	3,261	2,926	4,031
(iii) Sekundäraluminiumproduktion	0,654	0,641	0,628
(iv) Sekundärzinkproduktion	NO	NO	NO
Gesamt (Teil II)	**4,277**	**3,939**	**112,902**

[1] gesamte HCB-Emissionen der österreichischen Zementöfen

[2] nur Prozessemissionen; HCB-Emissionen aus Verbrennungsprozessen werden bei den relevanten Quellkategorien des Teil III betrachtet.

IE: inkludiert in anderer Emissionsquelle

NO: not occurring (Emissionsquelle in Österreich nicht vorhanden)

Tabelle D: HCB-Emissionen aus Quellkategorien Teil III für 2004, 2009 und 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part III	**2004 [kg HCB]**	**2009 [kg HCB]**	**2014 [kg HCB]**
offene Verbrennung von Abfall, einschl. Verbrennung auf Deponien*	0,045	0,026	0,014
in Teil II nicht genannte thermische Prozesse in der metallurg. Industrie	0,016	0,014	0,017
häusliche Verbrennungsquellen	35,586	30,032	26,657
mit fossilen Brennstoffen befeuerte Kesselanlagen von Versorgungs- und Industrieunternehmen	0,197	0,195	0,152
Feuerungsanlagen für Holz und sonstige Biomassebrennstoffe	0,287	0,543	0,715
spezifische chemische Produktionsprozesse, bei denen unbeabsichtigt gebildete persistente organische Schadstoffe freigesetzt werden, insbesondere bei der Produktion von Chlorphenolen und Chloranil	NA	NA	NA
Krematorien	0,031	0,033	0,033
Kraftfahrzeuge, insbes. bei Verbrennung von verbleitem Ottokraftstoff	0,290	0,394	0,431
Tierkörperbeseitigung	NA	NA	NA
Färben (mit Chloranil) und Endbehandlung (durch alkalische Extraktion) von Textilien und Leder	NA	NA	NA
Shredderanlagen zur Behandlung von Altfahrzeugen	NE	NE	NE
Kupferkabelverschwelung	NO	NO	NO
Altölaufbereitungsanlagen	NO	NO	NO
Gesamt (Teil III)	**36,451**	**31,238**	**28,019**

** ohne Brände (einschließlich Deponiebrände)*

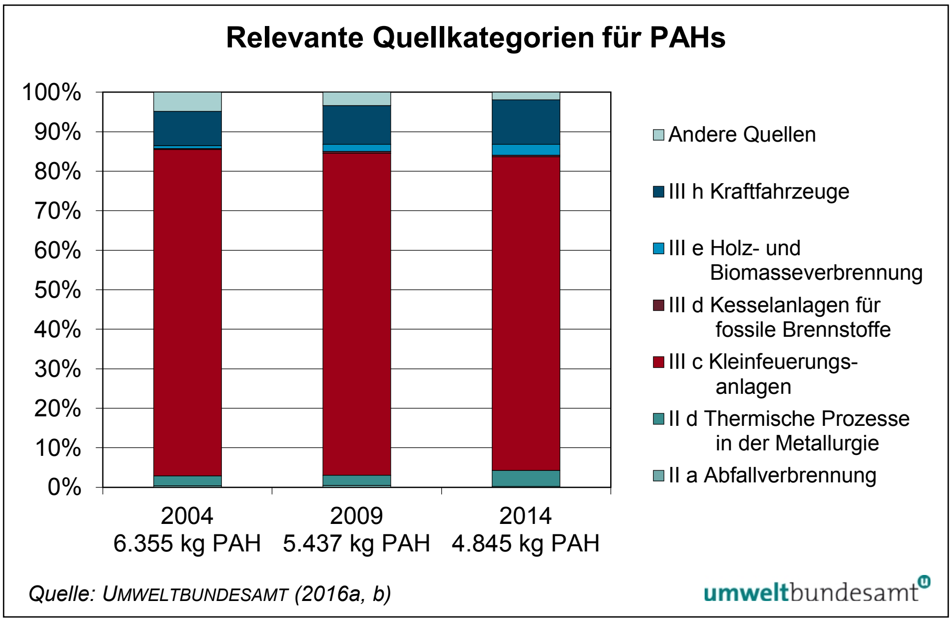
NA: not applicable – als vernachlässigbar betrachte

NE: not estimated – nicht abgeschätzt

NO: not occurring – Emissionsquelle in Österreich nicht vorhanden

Polyzyklische aromatische Kohlenwasserstoffe (PAH)

Im Jahr 2014 wurden 4.845 kg PAHs in Österreich emittiert. Hauptverantwortlich für die PAH-Emissionen sind v. a. die Kleinfeuerungsanlagen mit einem Anteil von 79 % sowie Kraftfahrzeuge mit einem Beitrag von 11 % an den Gesamtemissionen (siehe Abbildung C, Tabellen E and F). Andere nennenswerte Verursacher sind Feuerungsanlagen für Holz und sonstige Biomassebrennstoffe (2,7 %) sowie Sinteranlagen (4 %).



Quelle: UMWELTBUNDESAMT (2016a, b)

Abbildung C: Relevante Quellkategorien für PAHs.

Tabelle E: PAH-Emissionen aus Quellkategorien Teil II für 2004, 2009 und 2014 (UMWELTBUNDESAMT 2016a, b).

Quellkategorien Teil II	**2004 [kg PAH]**	**2009 [kg PAH]**	**2014 [kg PAH]**
Abfallverbrennungsanlagen, einschließlich Anlagen zur Mitverbrennung von Siedlungsabfällen, gefährlichen Abfällen, Abfällen aus dem medizinischen Bereich oder Klärschlamm	24,066	24,095	9,443
mit gefährlichen Abfällen befeuerte Zementöfen[1]	3,332	3,663	3,385
Zellstoffproduktion unter Verwendung von elementarem Chlor oder von Chemikalien, bei denen elementares Chlor erzeugt wird, für Bleichzwecke[2]	IE	IE	IE
folgende thermische Prozesse in der metallurgischen Industrie:			
(i) Sekundärkupferproduktion	NE	NE	NE
(ii) Sinteranlagen in der Eisen- und Stahlindustrie	156,484	140,891	193,647
(iii) Sekundäraluminiumproduktion	NE	NE	NE
(iv) Sekundärzinkproduktion	NO	NO	NO
Gesamt (Teil II)	**183,872**	**168,649**	**206,476**

[1] gesamte PAH-Emissionen der österreichischen Zementöfen

[2] nur Prozessemissionen; PAH-Emissionen aus Verbrennungsprozessen werden bei den relevanten Quellkategorien des Teil III betrachtet.

IE: inkludiert in anderer Emissionsquelle
NO: not occurring (Emissionsquelle in Österreich nicht vorhanden)
NE: not estimated - nicht abgeschätzt

Tabelle F: PAH-Emissionen aus Quellkategorien Teil III für 2004, 2009 und 2014 (Umweltbundesamt 2016a, b).

Quellkategorien Teil III	**2004 [kg PAH]**	**2009 [kg PAH]**	**2014 [kg PAH]**
offene Verbrennung von Abfall, einschl. Verbrennung auf Deponien*	305,551	178,625	90,885
in Teil II nicht genannte thermische Prozesse in der metallurg. Industrie	2,909	2,763	3,250
häusliche Verbrennungsquellen	5.250,076	4428,292	3.846,067
mit fossilen Brennstoffen befeuerte Kesselanlagen von Versorgungs- und Industrieunternehmen	16,925	25,973	20,121
Feuerungsanlagen für Holz und sonstige Biomassebrennstoffe	46,961	96,496	133,194
spezifische chemische Produktionsprozesse, bei denen unbeabsichtigt gebildete persistente organische Schadstoffe freigesetzt werden, insbesondere bei der Produktion von Chlorphenolen und Chloranil	NA	NA	NA
Krematorien	0,007	0,008	0,008
Kraftfahrzeuge, insbes. bei Verbrennung von verbleitem Ottokraftstoff	548,220	536,494	545,0025
Tierkörperbeseitigung	NA	NA	NA
Färben (mit Chloranil) und Endbehandlung (durch alkalische Extraktion) von Textilien und Leder	NA	NA	NA
Shredderanlagen zur Behandlung von Altfahrzeugen	NE	NE	NE
Kupferkabelverschwelung	NO	NO	NO
Altölaufbereitungsanlagen	NO	NO	NO
Gesamt (Teil III)	**6.170,651**	**5.268,651**	**4.638,550**

** ohne Brände (einschließlich Deponiebrände)*

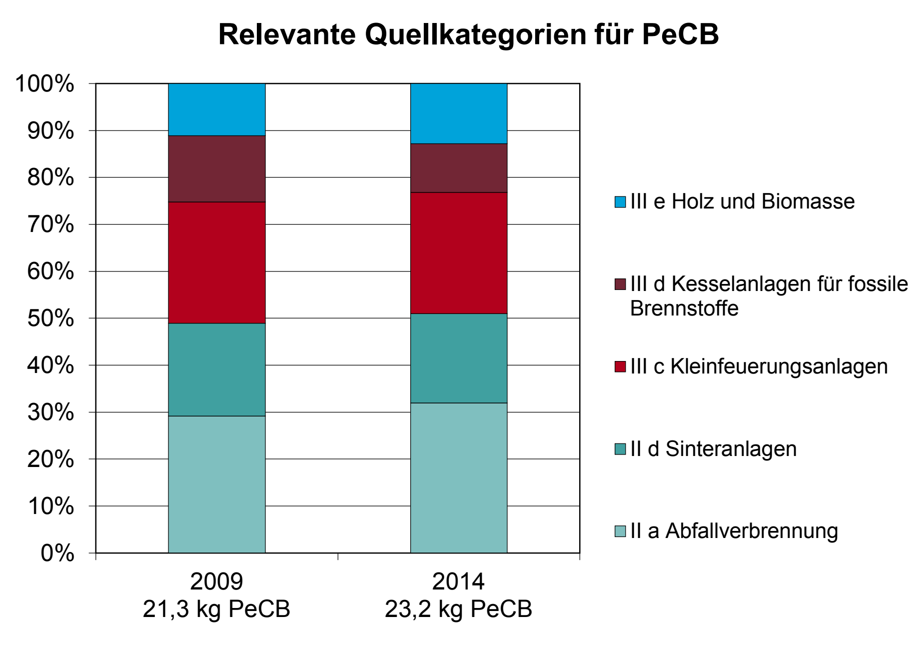
NA: not applicable – als vernachlässigbar betrachtet.

NE: not estimated – nicht abgeschätzt

NO: Not occurring – Emissionsquelle in Österreich nicht vorhanden

Pentachlorbenzol (PeCB)

Im Jahr 2009 wurden 23,2 kg an PeCB aus den Quellkategorien emittiert. PeCB-Emissionen werden nicht in der österreichischen Inventur angeführt. Die Emissionen wurden mittels Default-Emissionsfaktoren aus der Literatur und gegebenen Aktivitätszahlen berechnet. Daher beinhalten die berechneten PeCB-Emissionen einige Unsicherheiten.



Quelle: Umweltbundesamt (2016a, b)

Abbildung D: Relevante Quellkategorien für PeCB.

Tabelle G: PeCB-Emissionen aus Quellkategorien Teil II für 2009 und 2014 (Statistik Austria 2015, BMLFUW 2015a; eigene Berechnung).

Quellkategorien Teil II	**2009 [kg PeCB]**	**2014 [kg PeCB]**
Abfallverbrennungsanlagen, einschließlich Anlagen zur Mitverbrennung von Siedlungsabfällen, gefährlichen Abfällen, Abfällen aus dem medizinischen Bereich oder Klärschlamm	6,21	7,42
mit gefährlichen Abfällen befeuerte Zementöfen	NA	NA
Zellstoffproduktion unter Verwendung von elementarem Chlor oder von Chemikalien, bei denen elementares Chlor erzeugt wird, für Bleichzwecke	NA	NA
folgende thermische Prozesse in der metallurgischen Industrie:		
(i) Sekundärkupferproduktion	NA	NA
(ii) Sinteranlagen in der Eisen- und Stahlindustrie	4,2	4,4
(iii) Sekundäraluminiumproduktion	NA	NA
(iv) Sekundärzinkproduktion	NO	NO
Gesamt (Teil II)	**10,41**	**11,82**

NA: not applicable – als vernachlässigbar betrachtet

NO: not occurring – Emissionsquelle in Österreich nicht vorhanden

Tabelle H: PeCB-Emissionen aus Quellkategorien Teil III für 2009 und 2014 (Statistik Austria 2015, BMLFUW 2015a; eigene Berechnung).

Quellkategorien Teil III	**2009 [kg PeCB]**	**2014 [kg PeCB]**
offene Verbrennung von Abfall, einschließlich Verbrennung auf Deponien*	NA	NA
in Teil II nicht genannte thermische Prozesse in der metallurgischen Industrie	NA	NA
häusliche Verbrennungsquellen	5,5	6,0
mit fossilen Brennstoffen befeuerte Kesselanlagen von Versorgungs- und Industrieunternehmen	3,00	2,4
Feuerungsanlagen für Holz und sonstige Biomassebrennstoffe	2,37	2,98
spezifische chemische Produktionsprozesse, bei denen unbeabsichtigt gebildete persistente organische Schadstoffe freigesetzt werden, insbesondere bei der Produktion von Chlorphenolen und Chloranil	NA	NA
Krematorien	NA	NA
Kraftfahrzeuge, insbesondere bei Verbrennung von verbleitem Ottokraftstoff	NA	NA
Tierkörperbeseitigung	NA	NA
Färben (mit Chloranil) und Endbehandlung (durch alkalische Extraktion) von Textilien und Leder	NA	NA
Shredderanlagen zur Behandlung von Altfahrzeugen	NA	NA
Kupferkabelverschwelung	NO	NO
Altölaufbereitungsanlagen	NO	NO
Gesamt (Teil III)	**10,87**	**11,38**

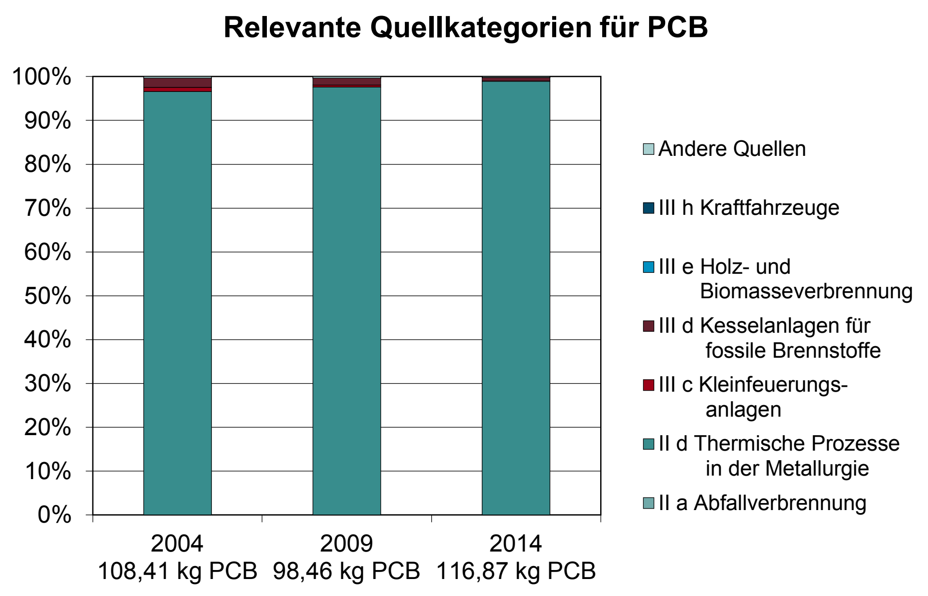
** ohne Brände (einschließlich Deponiebrände)*

NA: not applicable – als vernachlässigbar betrachtet.

NO: not occurring – Emissionsquelle in Österreich nicht vorhanden

Polychlorierte Biphenyle (PCB)

Nur wenige Quellkategorien tragen significant zu den PCB-Gesamtemissionen in Österreich bei. 2014 wurden 116,87 kg PCB emittiert. Hauptverantwortlich waren die thermischen Prozesse in der metallurgischen Industrie mit einem Anteil von 99 %. Der Anteil aller anderen Quellkategorien betrug unter 1 %.



Quelle: UMWELTBUNDESAMT (2016a, b)

Abbildung E: Relevante Quellkategorien für PCB.

Tabelle I: PCB-Emissionen aus Quellkategorien Teil II für 2004, 2009 und 2014 (UMWELTBUNDESAMT 2016a, b).

Quellkategorien Teil II	**2004 [g PCB]**	**2009 [g PCB]**	**2014 [g PCB]**
Abfallverbrennungsanlagen, einschließlich Anlagen zur Mitverbrennung von Siedlungsabfällen, gefährlichen Abfällen, Abfällen aus dem medizinischen Bereich oder Klärschlamm	0,065	0,068	0,053
mit gefährlichen Abfällen befeuerte Zementöfen[1]	331,949	353,098	323,780
Zellstoffproduktion unter Verwendung von elementarem Chlor oder von Chemikalien, bei denen elementares Chlor erzeugt wird, für Bleichzwecke[2]	IE	IE	IE
folgende thermische Prozesse in der metallurgischen Industrie:			
(i) Sekundärkupferproduktion	NA	NA	NA
(ii) Sinteranlagen in der Eisen- und Stahlindustrie	26.903,600	23.633,234	33.000,000
(iii) Sekundäraluminiumproduktion	NA	NA	NA
(iv) Sekundärzinkproduktion	NO	NO	NO
Gesamt (Teil II)	**27.235,614**	**23.986,401**	**33.323,833**

[1] gesamte PCB-Emissionen der österreichischen Zementöfen

[2] nur Prozessemissionen; PCB-Emissionen aus Verbrennungsprozessen werden bei den relevanten Quellkategorien des Teil III betrachtet.

IE: inkludiert in anderer Emissionsquelle

NA: not applicable – als vernachlässigbar betrachtet

NO: not occurring (Emissionsquelle in Österreich nicht vorhanden)

Tablle J: PCB-Emissionen aus Quellkategorien Teil III für 2004, 2009 und 2014 (Umweltbundesamt 2016a, b).

Quellkategorien Teil III	**2004 [g PCB]**	**2009 [g PCB]**	**2014 [g PCB]**
offene Verbrennung von Abfall, einschließlich Verbrennung auf Deponien*	NA	NA	NA
in Teil II nicht genannte thermische Prozesse in der metallurgischen Industrie	77.779,105	72.499,525	82.162,70
häusliche Verbrennungsquellen	1.091,570	426,201	190,817
mit fossilen Brennstoffen befeuerte Kesselanlagen von Versorgungs- und Industrieunternehmen	2.298,303	1.547,341	1.196,029
Feuerungsanlagen für Holz und sonstige Biomassebrennstoffe	0,128	0,261	0,351
spezifische chemische Produktionsprozesse, bei denen unbeabsichtigt gebildete persistente organische Schadstoffe freigesetzt werden, insbesondere bei der Produktion von Chlorphenolen und Chloranil	NA	NA	NA
Krematorien	NA	NA	NA
Kraftfahrzeuge, insbesondere bei Verbrennung von verbleitem Ottokraftstoff	0,924	0,841	0,508
Tierkörperbeseitigung	NA	NA	NA
Färben (mit Chloranil) und Endbehandlung (durch alkalische Extraktion) von Textilien und Leder	NA	NA	NA
Shredderanlagen zur Behandlung von Altfahrzeugen	NE	NE	NE
Kupferkabelverschwelung	NO	NO	NO
Altölaufbereitungsanlagen	NO	NO	NO
Gesamt (Teil III)	**81.170,031**	**74.474,169**	**83.550,405**

** ohne Brände (einschließlich Deponiebrände)*

NA: not applicable – als vernachlässigbar betrachtet

NE: not estimated – nicht abgeschätzt

NO: not occurring – Emissionsquelle in Österreich nicht vorhanden

Polychlorierte Naphthaline (PCN)

Aufgrund der beschränkten Verfügbarkeit an Daten konnte für diese Stoffgruppe kein Freisetzungsinventar erstellt werden.

C Emissionsverzeichnis Wasser

In Österreich werden Freisetzungen von POPs in zwei verschiedenen Registern erfasst:

Im Europäischen Schadstofffreisetzungs- und Verbringungsregister (Pollutant Release and Transfer Register – PRTR) werden prinzipiell für alle POPs Punktquellen und deren Emissionen in Gewässer erfasst. In der Praxis unterliegen allerdings die meisten Industriezweige nur dann einer Berichtspflicht, wenn bestimmte Produktionskapazitäten oder Emissionsschwellen überschritten werden. Es sind ungefähr 70 Anlagen mit Freisetzungen in Wasser oder Abwasser im PRTR gelistet. Keine dieser Anlagen meldete HCB-, PeCB- und PCB-Emissionen in Gewässer. Zwei PRTR-Anlagen gaben PCDD/F-Emissionen bekannt, eine Anlage PAH-Emissionen. Derzeit sind noch keine Daten über diffuse Quellen verfügbar.

In den Jahren 2007 und 2008 wurden im Rahmen der Erstellung eines nationalen Emissionsinventars zusätzliche Daten zu POP-Freisetzungen in Gewässer erhoben. Einlauf und Abfluss von 15 städtischen Abwasserreinigungsanlagen mit verschiedener Kapazität, unterschiedlichen Reinigungsverfahren und unterschiedlicher Abwasserzusammensetzung wurden auf ca. 70 Stoffe hin untersucht. Das Analyseprogramm umfasste prioritäre Stoffe und bestimmte andere Stoffe gemäß der Tochterrichtlinie 2008/105/EG der Wasserrahmenrichtlinie, aber auch national relevante Schadstoffe gemäß der österreichischen Qualitätszielverordnung Chemie. DDT, Chlordan, Aldrin, Dieldrin, Endrin, Heptachlor, Hexachlorbenzol und Pentachlorbenzol wurden im Rohabwasser nicht gefunden. PAHs wurden mit einer Ausnahme nur im Rohabwasser gefunden. Im Abwasserauslauf konnten nur PBDEs (< ng/l) und Lindan (γ-Hexachlorcyclohexan – ng/l) analysiert werden. Die Verwendung von Lindan war für einige Verwendungen im pharmazeutischen Bereich bis 1. Jänner 2008 zugelassen.

Im Jahr 2009 wurde ein nationales Emissionsverzeichnis (Oberflächengewässer) eingerichtet. Dieses Verzeichnis umfasst Emissionen folgender Punktquellen: Anlagen gemäß PRTR, städtische Wasseraufbereitungsanlagen mit einer Kapazität von mehr als 2.000 Einwohnergleichwerten (EGW) und Abfallverbrennungsanlagen mit einer Kapazität von mehr als 2 Tonnen Abfall pro Stunde. Es gibt keine Freisetzungsschwellen für die Berichtspflicht. Die untere Grenze ergibt sich allerdings in der Praxis aus der Bestimmungsgrenze der jeweiligen Analysemethode und aus der Ablaufmenge des Abwassers. Im ersten Berichtszeitraum (2009) wurden nur grundlegende Abwasserparameter erfasst. Seit 2010 werden Freisetzungen für eine Vielzahl von Substanzen inkl. POPs berichtet. Die Emissionen werden als Jahresfrachten berichtet.

Im Jahr 2014 musste die Sanierung einer Altlast, die HCB-haltigen Kalkschlamm enthielt, eingestellt werden. Bei dessen thermischer Behandlung in einer Zementanlage kam es zu unkontrollierten Emissionen von HCB in die Luft. Eine neue Ausschreibung für eine ex-situ Behandlung des Kalkschlammes scheiterte. In Folge wurde ein umfassendes Sicherungskonzept entwickelt. Zur Vermeidung weiterer Emissionen durch die aufgelassene Deponie wird aktuell u. a. eine Oberflächenabdichtung errichtet.

Freisetzungen von PAHs auf kontaminierten Flächen können zu lokalen Beeinträchtigungen des Bodens und des Grundwassers führen. Abhängig von der spezifischen Situation und der Frage, auf welche Weise das betroffene Gebiet genutzt wird, müssen mögliche Risiken für die menschliche Gesundheit und das Ökosystem untersucht und sodann hintangehalten werden.

Während Freisetzungen von PAHs in Boden und Grundwasser ein bekanntes Problem sind, sind nur sehr wenige Informationen zu Altlasten verfügbar, die mit den Schadstoffen PCDD/F, HCB und PCB kontaminiert sind.

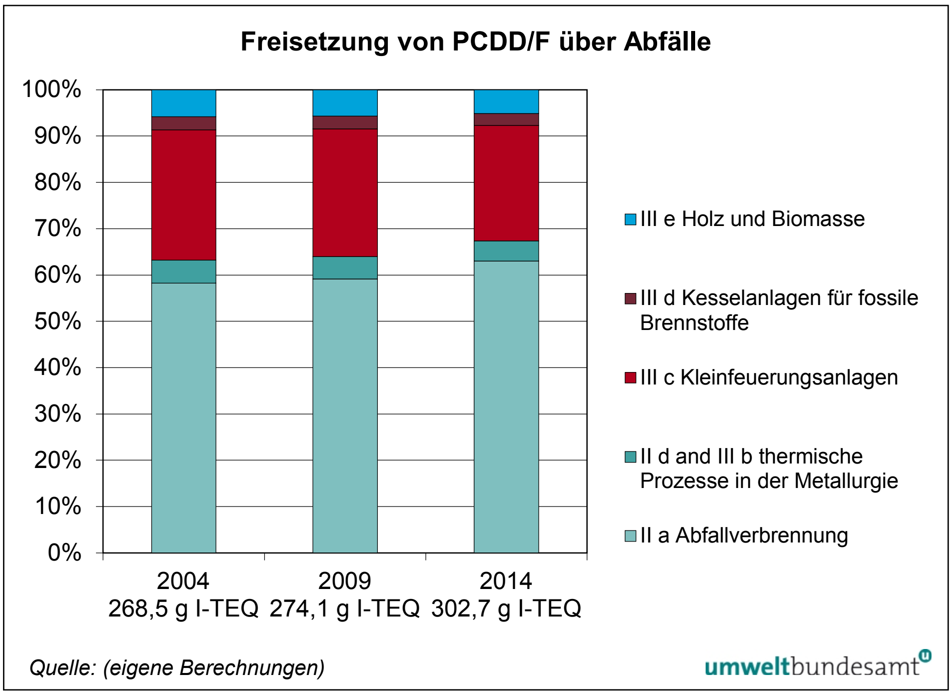
D Emissionen aus Abfällen und Rückständen

Ein entsprechendes Emissionsverzeichnis kann nur für PCDD/F und PeCB erstellt werden. Für die weiteren POPs sind keine qualifizierten Daten verfügbar.

Dioxine und Furane (PCDD/F)

Im Jahr 2014 wurden insgesamt 302,7 g PCDD/F I-TEQ emittiert, ein Zehnfaches der Emissionen in die Luft. Der Anteil fester Abfälle aus der Abfallverbrennung ist hierbei mit 63 % am größten, erheblich ist auch der Anteil von Abfällen aus Kleinfeuerungsanlagen (25 %). Andere Quellen sind Abfälle aus thermischen Prozessen der metallurgischen Industrie sowie aus dem Einsatz fossiler Brennstoffe und Biomasse (siehe Abbildung F, Tabelle K).

Abbildung F: Freisetzungen (jedoch überwiegend nicht bioverfügbar) von PCDD/F über Abfälle (eigene Berechnungen).



Quelle: (eigene Berechnungen)

Anmerkung: Die Gesamt-Emissionen können höher sein, da für viele Quellkategorien (z. B. metallurgischer Sektor), die potenziell POPs aus Abfällen freisetzen könnten, keine qualifizierten Emissionsfaktoren vorhanden sind.

Tabelle K: PCDD/F-Freisetzung aus Abfällen für 2004, 2009 und 2014 (eigene Berechnungen).

Quellkategorien	**2004 g I-TEQ**	**2009 g I-TEQ**	**2014 g I-TEQ**
Abfallverbrennungsanlagen, einschließlich Anlagen zur Mitverbrennung von Siedlungsabfällen, gefährlichen Abfällen, Abfällen aus dem medizinischen Bereich oder Klärschlamm	156,37	162,1	190,7
thermische Prozesse in der metallurgischen Industrie	13,3	13,3	13,3
Kleinfeuerungsanlagen	75,5	75,5	75,5
Kesselanlagen für fossile Brennstoffe	7,7	7,7	7,7
Holz und Biomasse	15,6	15,6	15,6
Gesamt	**268,5**	**274,1**	**302,7**

Es muss hervorgehoben werden, dass POP-Freisetzungen über Abfälle grundsätzlich anders zu betrachten sind als Emissionen in die Medien Luft und Wasser: Die überwiegende Mehrheit der Abfälle wird auf Deponien abgelagert. Eine

Bioverfügbarkeit der möglicherweise enthaltenen POPs ist dadurch nicht mehr gegeben, vorausgesetzt die Deponien wurden und werden ordnungsgemäß errichtet und betrieben.

Rückstände aus der Abfallverbrennung werden im Allgemeinen auf Deponien entsorgt (Restmülldeponien oder Untertagedeponien). Die Flugasche, in der 87 % der PCDD/F enthalten sind, wird oft einer Untertagedeponie zugeführt.

Sehr hohe PCDD/F-Konzentrationen finden sich in Ruß aus Kleinfeuerungsanlagen. Vermutlich wird ein Großteil des Rußes über den Hausmüll entsorgt. Bei der thermischen Behandlung dieses Hausmülls werden die POPs entweder oxidiert oder mit der Asche auf Deponien entsorgt. Auch im Fall einer mechanisch-biologischen Behandlung des Hausmülls gelangen die POPs letztendlich in jene Fraktion, die auf der Deponie endgelagert wird.

Abfälle aus der metallurgischen Industrie, die zu einem gewissen Ausmaß kontaminiert sein können, werden entweder wieder in den Prozess zurückgeführt oder einer externen Behandlung/Entsorgung zugeführt. Diesbezüglich bestehen jedoch noch Unklarheiten über die Höhe der POP-Konzentrationen und die in Österreich praktizierte Behandlung der Abfälle.

Die Flugasche aus Kraftwerken wird in der Zement- und Baustoffindustrie weiterverwendet, Flugasche aus der Verbrennung von Biomasse muss jedoch über Deponien entsorgt werden.

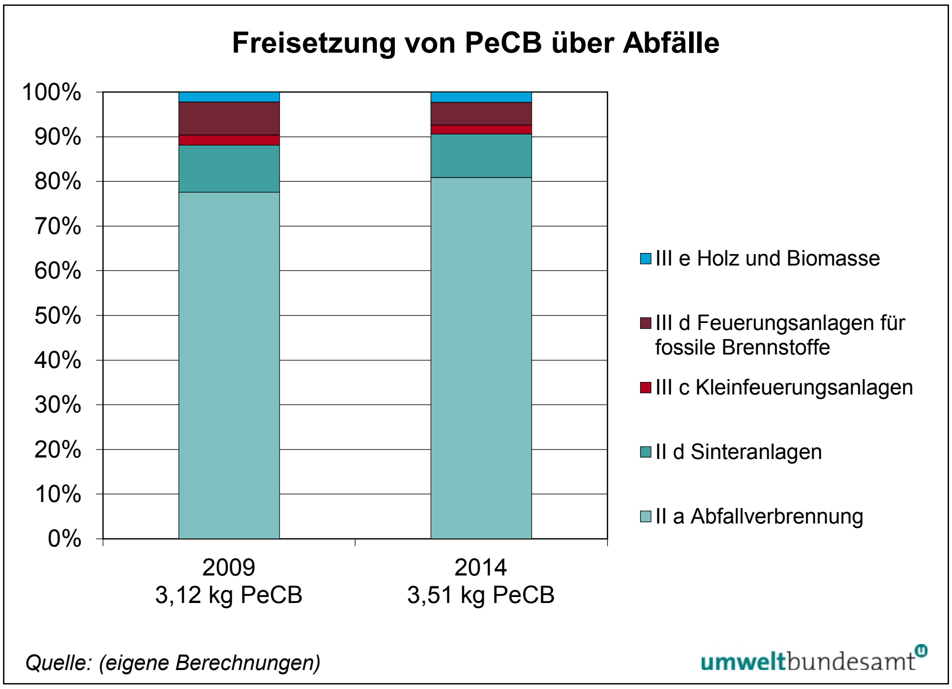
Auch Abfälle, die absichtlich in die Umwelt eingetragen werden, können zur Freisetzung von POPs führen. Beispiele dafür sind die Verwendung von Aschen aus Kleinfeuerungsanlagen (die beträchtliche Mengen an POPs enthalten können) zur Düngung bzw. für Streuzwecke im Winter oder die Verwendung grober Aschen aus Biomasseverbrennungsanlagen als Zusatzstoffe für Kompost. Da große Datenlücken hinsichtlich der Höhe der POP-Konzentrationen in Aschen existieren, sind Freisetzungsabschätzungen generell mit hohen Unsicherheiten behaftet. Ausschlaggebend für die Höhe der POP-Konzentrationen in Aschen sind insbesondere die unterschiedliche Art und Qualität des Brennstoffes (Feuchtegehalt, Aschegehalt, Heizwert, Chlorgehalt), das verwendete Feuerungssystem sowie die Menge mitverbrannter Abfälle.

Diese Freisetzungen sind jedoch relevant, da ein Teil der Rückstände/Abfälle in die Umwelt rückgeführt wird (z. B. Verwendung von Asche als Dünger in Privatgärten).

Pentachlorbenzol (PeCB)

Im Jahr 2014 wurden insgesamt 3,51 kg PeCB emittiert. Der Anteil fester Abfälle aus der Abfallverbrennung ist hierbei mit 81 % am größten. Abfälle aus thermischen Prozessen der metallurgischen Industrie, aus Kleinfeuerungsanlagen sowie aus dem Einsatz fossiler Brennstoffe und Biomasse tragen zu einem geringeren Anteil zu den Emissionen bei. Es ist allerdings anzumerken, dass für Freisetzungen an PeCB nur wenige Daten verfügbar sind.

Abbildung G: Freisetzungen von PeCB (jedoch überwiegend nicht bioverfügbar) aus Abfällen (eigene Berechnungen).



Quelle: (eigene Berechnungen)

Tabelle L: PeCB-Freisetzung aus Abfällen für 2009 und 2014 (eigene Berechnung).

Quellkategorie	**2009 [kg PeCB]**	**2014 [kg PeCB]**
Abfallverbrennungsanlagen, einschließlich Anlagen zur Mitverbrennung von Siedlungsabfällen, gefährlichen Abfällen, Abfällen aus dem medizinischen Bereich oder Klärschlamm	2,42	2,84
folgende thermische Prozesse in der metallurgischen Industrie: (ii) Sinteranlagen in der Eisen- und Stahlindustrie	0,33	0,34
häusliche Verbrennungsquellen	0,07	0,07
mit fossilen Brennstoffen befeuerte Kesselanlagen von Versorgungs- und Industrieunternehmen	0,23	0,18
Feuerungsanlagen für Holz und sonstige Biomassebrennstoffe	0,07	0,08
Gesamt	**3,12**	**3,51**

E Freisetzungen aus Produkten

Der Handlungsbedarf betreffend POPs in Produkten ergibt sich u. a. aus Anhang C Teil V A (g) des Stockholmer Übereinkommens („minimization of these chemicals as contaminants in products“). In der Literatur finden sich einige Daten zu Gehalten von PCDD/F in den Produkten Zement, Zellstoff und Papier (siehe Tabelle M). Zu anderen POPs existieren keine Daten. Freisetzungen über Produkte sind jedoch bei den meisten Quellkategorien nicht relevant.

Tabelle M: PCDD/F-Gehalte in den Produkten Zement, Zellstoff und Papier. Berechnungen basieren auf Literaturdaten (KARSTENSEN 2006, UNEP 2013, GRUBER et al. 1996).

Produkt	Freisetzung(g I-TEQ/a)
Zement	4,04
Papier	4,46

Freisetzungen über den heimischen Zellstoff sind in den Angaben zu Papier enthalten.

Da es keine signifkanten Änderungen der Produktionsweise gegeben hat, ist das Ausmaß der Freisetzungen von PCDD/F über Zement, Zellstoff und Papier seit 2004 in etwa gleich geblieben.

PCDD/F-Gehalte im Zement sind gering und lassen sich durch die Tatsache erklären, dass die Filterstäube aus der Klinkerproduktion (durchschnittliche PCDD/F-Konzentration: 6,7 ng I-TEQ/kg) dem Produkt beigemengt werden und außerdem auch sekundäre Rohstoffe eingesetzt werden (z. B. Flugasche, Gips aus der Rauchgasentschwefelung). Somit ist auch der Zement selbst mit PCDD/F verunreinigt (durchschnittlich: 0,91 ng I-TEQ/kg Zement) (KARSTENSEN 2006).

Die Bioverfügbarkeit von im Zement gebundenen POPs ist jedoch sehr gering.

Österreich arbeitete aktiv an der Revision des Dioxin Toolkit (UNEP 2013) mit. Dort wird festgehalten: „*Dieser Abschnitt fasst Hochtemperaturprozesse in der Mineralindustrie zusammen. Chloridhaltige Rohstoffe oder Brennstoffe können möglicherweise die Bildung von PCDD/F in unterschiedlichen Produktionsschritten hervorrufen, z. B. während der Kühlphase oder in der Heizzone. Wegen der langen Verweilzeiten im Brennofen und der erforderlichen hohen Temperatur zur Herstellung dieser Produkte ist die Bildung von Dioxinen bei diesem Prozess relativ gering*“.[4]

Zementöfen, die mit gefährlichen Abfällen befeuert werden, sind eine Quellkategorie gemäß Anhang C Teil II (b) des Übereinkommens für Emissionen von PCDD/F, HCB, PAH, PCB und PeCB. Daher ist die Quantifizierung der verschiedenen POPs in den Umweltmedien sowie in Rückständen und Produkten wünschenswert.

Im Fall von Zellstoff und Papier können PCDD/F über die Zellstoffbleiche oder über Altpapier eingetragen werden.

Im Bezugsjahr 2014 betrug die Gesamtproduktion an Zellstoff in Österreich 1.571 kt (2009 waren es 1.514 kt, 2004 1.509 kt). 36 % davon entfielen auf gebleichten Zellstoff, 35 % auf ungebleichten Zellstoff und 28 % auf Textilzellstoff (AUSTROPAPIER 2015).

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[4] Zitat aus Dioxin Toolkit (Entwurf 2012) Kapitel 4 Mineral Products
„This section summarizes high-temperature processes in the mineral industry. Raw materials or fuels that contain chlorides may potentially cause the formation of PCDD/PCDF at various steps of the processes, e.g., during the cooling phase of the gases or in the heat zone. Due to the long residence time in kilns and the high temperatures needed for the product, emissions of PCDD/PCDF are generally low in these processes.”

Die Berechnung der Freisetzungen aus Zellstoff basieren auf folgenden Emissionsfaktoren: 0,5 µg/t für gebleichten Sulfatzellstoff und 0,1 µg/t für andere Zellstoffe (UNEP 2013). Die Freisetzung von PCDD/F über Zellstoff betrug daher 0,39 g im Jahr 2014.

Als Rohstoffe in der Papierzeugung werden Zellstoff (heimisch oder importiert), Holzstoff und Altpapier (de-inkt oder nicht de-inkt) verwendet.

Daher ist auch der Eintrag über importierten Zellstoff in Betracht zu ziehen. Im Jahr 2014 wurden ungefähr 662.330 t gebleichter Zellstoff importiert, teils aus Ländern, in denen Chlor noch zum Bleichen des Zellstoffs verwendet wird. Zur Berechnung des PCDD/F-Gehaltes wird für 10 % der Importware ein Emissionsfaktor von 0,5 µg/t angenommen und für den Großteil des importierten Zellstoffs ein Emissionsfaktor von 0,1 µg/t. Damit ergibt sich eine Gesamteinfuhr von 0,093 g I-TEQ über Zellstoff.

Der Eintrag von PCDD/F über Holzstoff wurde mit einem Emissionsfaktor von 0,1 µg/t (UNEP 2013) berechnet, daraus ergibt sich ein Gesamteintrag von 0,037 g I-TEQ.

Zusätzlich ist auch der Eintrag von POPs über das Altpapier (insbesondere über Verunreinigungen in den verwendeten Druckfarben) relevant. Ein Deinking reduziert die PCDD/F-Konzentrationen um den Faktor 3 (ungefähr 40 % des Altpapiers in Österreich wird de-inkt) (GRUBER et al. 1996). Vergleichsweise hohe Konzentrationen von bis zu 12 ng/kg wurden in den frühen Neunzigerjahren in Verpackungspapieren und Karton gefunden. Zwischen 1989 und 1994 konnte ein drastischer Rückgang verzeichnet werden, seither sinken die Konzentrationen nur noch geringfügig.

Auf Basis dieser Studien sowie der im UNEP DioxinToolkit (UNEP 2013) angegebenen Emissionsfaktoren wurde die Konzentration an PCDD/F in Altpapier auf 3 µg/t ohne De-inking und auf 0,99 µg/t in de-inktem Papier geschätzt. Daraus ergeben sich ein durchschnittlicher Emissionsfaktor von 2,18 µg/t für Altpapier und eine Gesamtfreisetzung über Papier von 4,46 g I-TEQ (Referenzjahr: 2014).

Diverse wissenschaftliche Publikationen zeigen, dass Altpapier möglicherweise durch Verunreinigungen mit Druckerfarben (z. B. Pigmente) signifikante Spuren von PCDD/F enthalten kann. Im Jahr 2011 führte das Umweltbundesamt eine stichprobenartige Untersuchung der PCDD/F-Gehalte von Kartonagen aus Altpapier durch. Der Vergleich von neuen, unbedruckten Faltschachtelkartons mit bedruckten Schachteln aus der Altpapiersammlung ergab keinen Hinweis auf einen PCDD/F-Eintrag durch Druckerfarben. Die Kartonagenproben enthielten PCDD/F in einem Bereich von 1,2 bis 1,9 ng TEQ/kg (UMWELTBUNDESAMT 2011c).

Im Jahr 2010 legte Austropapier, die Vereinigung der österreichischen Papierindustrie, neue Daten zum PCDD/F-Gehalt bestimmter Produktsorten vor, mit dem Ziel, die im Dioxintoolkit (UNEP 2013) enthaltenen Emissionsfaktoren zu optimieren. Die daraus abgeleiteten Emissionsfaktoren würden die Gesamtfreisetzung von PCDD/F über Papiererzeugnisse um den Faktor 3 reduzieren.

Im Jahr 2011 erfolgte daher eine neuerliche Berechnung der PCDD/F-Freisetzungen über Papier.

Tabelle N: Freisetzungen vonPCDD/F über Produkte (eigene Berechnung auf Basis der Statistik von Austropapier und der übermittelten Analyseergebnisse).

Erzeugnis	**Produktion (t/a)**	**Emissionfaktor (µg TEQ/t)**	**Freisetzungen (g PCDD/F TEQ/a)**	**Prozentsatz (%)**
Zeitungsdruckpapier	299.205	0,068	0,02	1,2
Druck- und Schreibpapiere				
● de-inked	902.421	0,068	0,06	3,7
● aus Zellstoff	1.346.070	0,050	0,07	4,0
Faltschachtelkarton	487.214	0,723	0,35	21,1
Verpackungspapiere	676.177	1,141	0,77	46,2
Kraftpapiere				0.0
● mit Altpapieranteil	374.855	0,858	0,32	19,3
● aus reinem Zellstoff	250.743	0,050	0,01	0,8
Dünn und Spezialpapiere				0.0
Hygienepapier	128.660	0,068	0,01	0,5
Sonstige	126.896	0,050	0,01	0,4
Wickel- und Spezialpappe	13.299	0,858	0,01	0,7
Marktzellstoff – exportiert	95.471	0,070	0,01	0,4
Marktzellstoff (ECF-gebleicht)	313.818	0,090	0,03	1,7
Gesamt	**5.014.829**		**1,67**	**100,0**

F Bewertung der Wirksamkeit der Rechtsvorschriften und Politiken in Bezug auf die Verpflichtungen des Stockholmer Übereinkommens und der EU POP-Verordnung

Auf Basis der in diesem Report dokumentierten Ergebnisse hinsichtlich der Emissionsverzeichnisse, der Datenverfügbarkeit und der bereits getätigten sowie geplanten Maßnahmen ist zu schließen, dass Österreich die Vorschriften der Stockholm Konvention und der EU POP-Verordnung bereits großteils erfüllt. Nichtsdestotrotz sind weitere Anstrengungen notwendig, da das Stockholmer Übereinkommen „die kontinuierliche Verringerung von POP-Freisetzungen“ zum Ziel hat.

PCDD/F- und PAH-Emissionen aus industriellen Prozessen sind von 1990 bis 2014 stetig – mit einer signifikaten Reduktion zwichen 1990 und 1994 – gesunken. PCB-Emissionen nahmen signifikant zwischen 1990 und 1993 ab, erhöhten sich dann langsam von 1994 bis 2014. Mit 180 kg/a sind sie nun 7 % niedriger als 1990, jedoch 11 % höher als 1995.

HCB-Emissionen sanken von 1990 bis 2011, erhöhten sich dann stark in den Jahren 2012, 2013 und 2014 aufgrund einer unbeabsichtigten Freisetzung von HCB in einer österreichischen Zementanlage verursacht durch den Einsatz von HCB-hältigem Abfall und einer unvollständigen Zerstörung von HCB.

Sollten jedoch Weiterentwicklungen im Stand der Technik geringere Emissionen oder sogar eine vollständige Vermeidung derselben bewirken, muss die Politik darauf reagieren und die relevanten Rechtsvorschriften entsprechend anpassen (z. B. durch Einführung strengerer Emissionsgrenzwerte).

Die Nationalen Aktionspläne 2008 und 2012 identifizierten Kleinfeuerungsanlagen als bedeutende Emissionsquellen. Diese waren 2014 für 58 % der PCDD/F-Emissionen, 79 % der PAH-Emissionen und 26 % der PeCB-Emissionen in die Luft verantwortlich. Alle möglichen Maßnahmen müssen untersucht und ausgeschöpft werden, um eine Reduktion dieser POP-Emissionen zu bewirken.

PCDD/F-Emissionen aus der Verbrennung von Biomasse haben sich von 2004 bis 2014 mehr als verdoppelt und sind für 13 % der Gesamtemissionen an PCDD/F verantwortlich. PAH-Emissionen aus der Biomasseverbrennung haben sich zwischen 2004 und 20014 fast verdreichfacht, sind jedoch nur für 3 % der gesamten PAH-Emissionen verantwortlich.

Derzeit wird in Österreich eine Reihe von umfassenden und sektorenübergreifenden Maßnahmen und Instrumenten entwickelt, um verschiedene nationale und internationale Verpflichtungen zu erfüllen. Ziel dieser Maßnahmen (enthalten etwa in der Klimastrategie 2007) ist die Reduktion von Treibhausgasen, NO_x und Feinstaub. Dadurch kann teilweise auch eine indirekte Reduktion von POP-Freisetzungen erreicht werden (z. B. durch die Reduktion des Energieverbrauchs oder durch strengere Luftemissionsgrenzwerte für Staub). Andere Maßnahmen, wie etwa der vermehrte Einsatz von Biomasse für Kleinfeuerungsanlagen, könnten jedoch zu einem Anstieg von POP-Emissionen führen.

Außerdem ist es wichtig, bessere Kenntnis in Bereichen zu erlangen, in denen bisher nur sehr begrenzt zuverlässige Daten zur Verfügung stehen. Deshalb wurden im Folgenden konkrete Vorschläge für Studien, z. B. betreffend POP-Konzentrationen in bestimmten Abfällen oder weitere Monitoringaktivitäten, formuliert.

Evaluierung des NAP 2012 und weiterer Handlungsbedarf (gemäß § 20 Abs. 2 Chemikaliengesetz 1996 i.d.g.F)

In den Nationalen Aktionsplänen (NAP) 2008 und 2012 wurde bereits eine Reihe von Maßnahmen angeführt, die einerseits eine Verringerung der POP-Emissionen erzielen und andererseits mehr Informationen bezüglich POPs in der Umwelt generieren sollen.

Freisetzungen von POPs aus den Quellkategorien

Die folgende Tabelle enthält eine Übersicht, welche der im NAP 2012 vorgeschlagenen Maßnahmen bereits im Zeitraum 2012–2016 umgesetzt wurden.

nationale Gesetze und Verordnungen	**POP-relevante Inhalte**	**vorgeschlagene Maßnahmen im NAP 2012**	**derzeitiger Status**
Gewerbeordnung 1994 und Verordnungen gemäß § 82 Abs. 1 GewO 1994	EGW für verschiedene Luftschadstoffe, z. B. Staub, PCDD/F	regelmäßige Überprüfung der Konformität mit BAT	Änderung der Eisen und Stahlverordnung (BGBl. II Nr. 54/2016) Aufhebung der Sinteranlagenverordnung (BGBl. II Nr. 303/2014) Gießerei-Verordnung (BGBl. II Nr. 264/2014)
Feuerungsanlagen-Verordnung (BGBl. II Nr. 331/1997)	EGW für Staub, CO, C_{org}, NO_x	Anpassung an BAT notwendig (strengere EGW für Staub)	Die Implementierung der MCPD in nationales Gesetz ist derzeit (2017) in Bearbeitung, indem die Feuerungsanlagen-Verordnung novelliert wird.
Abfallverbrennungsverordnung (BGBl. II Nr. 389/2002)	EGW für Staub, CO, C_{org}, NO_x, Schwermetalle, PCDD/F	strengere EGW für Staub bei Mitverbrennungsanlagen wünschenswert	Änderung der Verordnung (BGBl. II Nr. 135/2013)
Wasserrechtsgesetz und Verordnungen	EGW für AOX and POX sowie spezifische POPs in den branchenspezifischen Abwasseremissionsverordnungen		
Abwasseremissionsverordnung Verbrennungsgas (BGBl. II Nr. 271/2003)	EGW für PCDD/F	regelmäßige Überprüfung der Konformität mit BAT notwendig	Änderung der Verordnung (BGBl.II Nr. 201/2014)
Abwasseremissionsverordnung Kohleverarbeitung (BGBl. II Nr. 346/1997)	EGW für PAHs	regelmäßige Überprüfung der Konformität mit BAT notwendig	Verordnung wird überarbeitet
Abwasseremissionsverordnung Pflanzenschutzmittel (BGBl. Nr. 668/1996)	EGW für AOX und spezifische POPs	regelmäßige Überprüfung der Konformität mit BAT notwendig	keine Änderungen
Qualitätszielverordnung Oberflächengewässer (BGBl. II Nr. 96/2006)	Umweltqualitätsziel für HCB	Für PAHs wurden 2008 gemeinschaftsweite Qualitätsziele festgelegt.	Änderung der Qualitätszielverordnung (BGBl. II Nr. 461/2010) gemäß der RL 2008/105/EG und 2016 (BGBl. II Nr. 363/2016)
Deponieverordnung (BGBl. Nr.39/2008)	Grenzwerte für PAH-Konzentrationen in Abfällen		Änderung mit BGBl. II Nr. 291/2016
Kompostverordnung[1] (BGBl. II Nr. 292/2001)	Grenzwerte für POP-Konzentrationen in Komposten	regelmäßige Evaluierung der Grenzwerte notwendig	keine Änderung

andere relevante Rechtsvorschriften	**POP-relevante Inhalte**	**vorgeschlagene Maßnahmen im NAP 2012**	**derzeitiger Status**
bereits im Amtsblatt der Europäischen Kommission veröffentlichte BVT Schlussfolgerungen:	EGW für POPs	neue Maßnahme	Umsetzung in nationales Recht (Verordnungen, Bescheid)
Zement, Kalk und Magnesiumoxid	EGW für POPs	neue Maßnahme	umgesetzt in Abfallverbrennungsverordnung (BGBl. II Nr. 135/2013)
Nichteisenmetalle	EGW für POPs	neue Maßnahme	Umsetzung im Luftbereich in Nichteisenmetallverordnung (BGBl. II Nr. 86/2008), im Wasserbereich in AEV Nichteisenmetallverordnung (BGBl. Nr. 889/1995) und/oder Bescheiden bis 30. Juni 2020 notwendig
Eisen und Stahl	EGW für POPs	neue Maßnahme	umgesetzt im Luftbereich mit Änderung der Eisen und Stahlverordnung (BGBl. II Nr. 54/2016), im Wasserbereich mit AEV Eisen-Metallindustrie (BGBl. II Nr. 202/2014)
Klärschlamm- und Kompostverordnungen der Bundesländer	Grenzwerte für POPs	regelmäßige Evaluierung der Grenzwerte notwendig	einige Bundesländer regeln POPs im Klärschlamm
Immissionsschutzgesetz – Luft (IG-L)	§ 21 IG-L: Verordnungsermächtigung	Überprüfung, ob allgemein verbindliche EGW für Krematorien in einer Verordnung gemäß § 21 IG-L notwendig sind	nicht umgesetzt, keine generellen Verpflichtungen für Krematorien
Rechtsakte der Bundesländer betreffend häusliche Verbrennungsanlagen (Kleinfeuerungsanlagen)	PM-Emissionsgrenzwerte für Neuanlagen von Kleinfeuerungsanlagen	Vereinbarung gemäß Art. 15a BVG über das Inverkehrbringen und die Überprüfung von Feuerungsanlagen Zeitplan: ehestmögliche Umsetzung dieser Vereinbarung in das Länderrecht	2011 wurde 15a Vereinbarung von Landeshauptleuten der Bundesländer unterzeichnet. Umgesetzt in einzelnen-Landesgesetzen bzw. -verordnungen (Start 2012)
Bundesluftreinhaltegesetz (BGBl. I Nr. 137/2002 i.d. F. von BGBl. I Nr. 50/2012))	Verbot des Verbrennens biogener Materialien, viele Ausnahmen möglich	Überprüfung der Ausnahmebestimmungen	Integration des Verbots im Bundesluftreinhaltegesetz – BLRG
Genehmigungsverfahren	Pop-relevante Inhalte	Kommentare/konkrete Schritte	laufend
Deponien	Anforderungen an die Brandverhütung	Implementierung wirksamer Brandverhütungsmaßnahmen für Deponien und Abfallzwischenlager	keine neuen Informationen

EGW: Emissionsgrenzwert

BAT: Best Available Technique

Im Bereich Kleinfeuerungsanlagen durchgeführte Maßnahmen

Ökodesign-Anforderungen im Hinblick auf das Inverkehrbringen und die Inbetriebnahme von Einzelraumheizgeräten[5] und Festbrennstoffkesseln[6] treten am 1. Jänner 2020 (2015/1189) bzw. am 1. Jänner 2022 (2015/1185) in Kraft und werden schrittweise die nationalen standardisierten Emissionsanforderungen (Artikel 15a Vereinbarung) außer Kraft setzen.

Allerdings sind in der Österreichischen Umweltzeichen-Richtlinie UZ 37 Holzheizungen[7] neben weiteren umweltfreundlichen Kriterien anspruchsvollere Grenzwerte für PM-Emissionen für Neuanlagen festgelegt. Dieses Umweltzeichen ist für Neuanlagen im Bereich Biomasseverbrennung verbindlich, wenn der Austausch von alten, mit fossilen Brennstoffen betriebenen, Heizsystemen durch Förderprogramme unterstützt wird.

Weitere notwendige Maßnahmen betreffen die Bewusstseinsbildung in Hinblick auf emissionsarme Verbrennung in Kleinfeuerungsanlagen oder die Verwendung von Aschen aus Kleinfeuerungsanlagen für die Düngung.

Die Initiative des Ministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft „Richtig heizen“ wurde 2009 gestartet und ist 2017 noch immer aktuell. Im Rahmen dieser Initiative wurde 2010 eine Broschüre mit dem Titel „Richtig heizen“ herausgegeben. Der Folder informiert über die Auswirkungen von Emissionen aus Holzöfen auf die menschliche Gesundheit und die Umwelt und gibt Hinweise darauf, wie diese Emissionen durch die richtige Bedienungsweise verringert werden können. Die Broschüre wurde über Rauchfangkehrer und Ärzte verteilt.

Zusätzlich wurde auch eine Internetseite eingerichtet (www.richtigheizen.at), die weitere Informationen über die richtige Verwendung von Öfen und über rechtliche Belange bietet. Die Internetseite wurde 2013 mit einem interaktiven Online-Rechner verbessert, der es ermöglicht, den Energiebedarf, PM-Emissionen und den Einsatz an festen Brennstoffen zu berechnen. Anschließend berät der Online-Rechner hinsichtlich möglicher Maßnahmen zur Reduktion des Energieeinsatzes und der Emissionen (Holztrocknung, thermische Isolierung, Austausch des Heizsystems). Informationen zu Ökodesign-Vorschriften und Feinstaub-Filtersystemen für Kleinfeuerungsanlagen werden 2017 ergänzt.

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[5] Verordnung (EU) 2015/1185 der Kommission vom 24. April 2015 zur Durchführung der Richtlinie 2009/125/EG des Europäischen Parlaments und des Rates im Hinblick auf die Festlegung von Anforderungen an die umweltgerechte Gestaltung von Festbrennstoff-Einzelraumheizgeräten

[6] Verordnung (EU) 2015/1189 der Kommission vom 28. April 2015 zur Durchführung der Richtlinie 2009/125/EG des Europäischen Parlaments und des Rates im Hinblick auf die Festlegung von Anforderungen an die umweltgerechte Gestaltung von Festbrennstoffkesseln

[7] Österreichisches Umweltzeichen Richtlinie UZ 37 Holzheizungen, Version 6.0 vom 1. Jänner 2017

Im Bereich Kleinfeuerungsanlagen und Biomasseanlagen vorgeschlagene Maßnahmen

- Effiziente Förderung des Austausches von kohlebefeuerten Öfen bzw. alten Biomasseanlagen mit vermutlich hohen Emissionen durch moderne Biomasseheizsysteme, Fernwärmesysteme oder erneuerbare Energien;
- regelmäßige Überprüfung und Verbesserung der Förderkriterien für Biomasseverbrennungsanlagen (einschließlich derartiger landwirtschaftlicher Anlagen) in Hinblick auf Betriebsbedingungen, Energieeffizienz (einschließlich Fernwärmesysteme), Brennstoffqualität und Emissionsgrenzwerte für Staub;
- Weiterführung der Informationskampagnen (awareness raising), um die Verbrennung von Abfällen in Kleinfeuerungsanlagen zu verhindern;
- Weiterführung der Informationskampagnen (awareness raising) zur Entsorgung von Ruß und Asche aus Kleinfeuerungsanlagen (insbesondere im Haushalt und in der Landwirtschaft);
- Untersuchung des Emissionsverhaltens von Kleinfeuerungsanlagen (insb. Getreideverbrennung).

  → bezüglich POPs noch teilweise nicht bekannt; eine Literaturstudie wird derzeit durchgeführt.

Datenverfügbarkeit bzgl. POP-Freisetzungen in die Umwelt

Für die im Folgenden genannten Quellen existieren bisher nur unzureichend Daten. Um die Relevanz dieser Quellen abschätzen zu können sowie um die österreichischen Quellverzeichnisse zu vervollständigen, sind die unten angeführten Maßnahmen notwendig oder zumindest wünschenswert. Allerdings bleibt die Umsetzung dieser Maßnahmen oft abhängig von der Finanzierbarkeit:

- Verbesserung der Datenqualität in Hinblick auf HCB-, PCB-, PeCB- und, falls durchführbar, PCN-Freisetzungen in die Luft (z. B. durch Planung und Durchführung von Messprogrammen bei prioritären Quellen, wie z. B. häuslichen und industriellen Quellen);
- Überprüfung des PCB-Emissionsfaktors in der Quellkategorie Teil III „thermische Prozesse in der metallurgischen Industrie“ (speziell für den Sektor Sekundärbleierzeugung);
- Einrichtung von Monitoringprogrammen in der Nähe POP-relevanter Quellen: Identifizierung relevanter Standorte für Probenahme- und Messungskampagnen (Winter, Sommer);
- Weiterführung des Monitorings der Umgebungsluft und der Deposition auf POPs;
- Weiterführung der Monitoringprogramme in Nahrungsmitteln (Fleisch, Milch, …);
- Nahrungsmittel- und Futtermittel-Monitoring in der Nachbarschaft von POP-relevanten Emittenten, Identifikation;
- Implementierung eines nationalen Monitoringprogrammes zur Untersuchung der Verteilung der Deposition von POPs;
- Weiterführung der Monitoringprogramme in Böden und Bioindikatoren (Fichtennadeln und/oder Gras) in der Nähe von POP-Quellen;
- Verbesserung der Datenqualität der POP-Freisetzungen aus Deponien und aufgelassenen Industriestandorten sowie kontaminierten Flächen/Altlasten

(z. B. PAH-Anteile im Deponiegas);

- Bestimmung der POP-Konzentrationen in Abfällen aus Kleinfeuerungsanlagen (Haushalt, Versorgungsunternehmen, Landwirtschaft), die mit hoher Wahrscheinlichkeit in die Umwelt gelangen (z. B. Bodenasche und Flugasche);
- Bestimmung der POP-Konzentrationen in Abfällen aus mit fossilen Brennstoffen befeuerten Kesselanlagen (einschließlich Mitverbrennung von Abfällen), die in andere Produktionsprozesse Eingang finden oder mit hoher Wahrscheinlichkeit in die Umwelt gelangen (insb. Flugasche aus Mitverbrennungsanlagen);
- Bestimmung der POP-Konzentrationen in Abfällen aus Biomasseverbrennungsanlagen, die in andere Produktionsprozesse Eingang finden oder mit hoher Wahrscheinlichkeit in die Umwelt gelangen (z. B. Bodenasche);
- Quantifizierung der POP-Emissionen (insb. PCDD/F und PCBs) des Platformer 3 der OMV Raffinerie in Schwechat;
- Emissionsmessungen bei Kraftfahrzeugen und Überprüfung der Emissionsfaktoren, um genauere Trendprognosen zu ermöglichen.

  → Das Handbuch für Emissionsfaktoren des Straßenverkehrs (HBEFA) stellt Emissionsfaktoren für die gängigsten Fahrzeugtypen zur Verfügung (Pkw, leichte und schwere Nutzfahrzeuge, Linien- und Reisebusse sowie Motorräder), differenziert nach Emissionskonzepten sowie nach verschiedenen Verkehrssituationen. HBEFA liefert Emissionsfaktoren für alle reglementierten sowie eine Reihe von nicht-reglementierten Schadstoffen, einschließlich CO_2 und Kraftstoffverbrauch. Die Version HBEFA 3.2 wurde 2014 aktualisiert und ist die neueste verfügbare Version. Alle Emissionsfaktoren wurden überarbeitet. (basierend auf breiterem Set von Emissionsdaten und neuen Maßnahmen, neue Emissionsfaktoren wurden angewandt). Für die Eichung des Modells wurden modale Emissionsmessungen bis Euro 6 verwendet.

Im Bereich Industrieanlagen vorgeschlagene Maßnahmen

- Limitierung von POP-kontaminierten Abfällen/Rückständen in Mitverbrennungsnlagen und Industrieanlagen. Eine repräsentative Probenahme der einzelnen Chargen ist notwendig, bevor diese als Einsatzmaterial verwendet werden.
- Vermeidung/Verbot von hoch kontaminierten Abfällen/Rückständen in Mitverbrennungsanlagen.
- Bevor POP-kontaminierte Abfälle/Rückstände in Industrieanlagen behandelt werden, sind in einem Probebetrieb Messungen der POP-Emissionen durchzuführen.
- Bei Einsatz von POP-haltigen Abfällen/Rückständen ist die regelmäßige/kontinuierliche Messung der POP-Emissionen notwendig. Falls die Zerstörung der POPs in der Industrieanlage nicht gewährleistet werden kann, darf der POP-haltige Abfall/Rückstand nicht als Einsatzmaterial verwendet werden.
- Falls der Prozess, in dem POP-haltige Abfälle/Rückstände eingesetzt werden, geändert wird, sind Versuchsreihen einschließlich dem Monitoring der POP-Emissionen durchzuführen.

Andere vorgeschlagene Maßnahmen

- Sukzessive Reduktion der Dieselfahrzeuge durch verstärkten Einsatz von elektrisch betriebenen Fahrzeugen.

Bodenschutzgesetze der Bundesländer: Burgenländisches Bodenschutzgesetz LGBl. Nr. 87/1990 Niederösterreichisches Bodenschutzgesetz LGBl. Nr. 6160-0 Oberösterreichisches Bodenschutzgesetz LGBl. Nr. 63/1997 Bodenschutzgesetz Salzburg LGBl Nr. 80/2001 Steiermärkisches landwirtschaftliches Bodenschutzgesetz LGBl. Nr. 66/1987		Festlegung von Zielwerten für organische Schadstoffe (einschließlich polybromierte Diphenylether, perfluorierte Tenside und Pestizide) zur Verminderung von Bodenkontaminationen zweckmäßig	AustroPOP-Projekt mit dem Ziel, ein nationales POP-Boden Monitoring System zu implementieren wird diskutiert

1 INTRODUCTION

This report covers the second review of the National Action Plan for POPs which was published in 2008. Article 5 of the Stockholm Convention requires Parties to develop an Action Plan to identify, characterise and address the release of chemicals listed in Annex C. Article 5 further requires a review of the National Action Plan every five years, including the strategies and their success in meeting the relevant obligations.

Currently listed in Annex C are polychlorinated dibenzo(p)dioxins (PCDD), polychlorinated dibenzofurans (PCDF), hexachlorobenzene (HCB), polychlorinated biphenyls (PCB) and pentachlorobenzene (PeCB) when produced unintentionally. Polychlorinated Napthalenes (PCN) have been part of Annex C since the end of 2016.

In line with the European POP-Regulation (850/2004) polyaromatic hydrocarbons (namely the substances benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene) shall be included in the Action Plan as well.

The definition of the term “release” includes emissions of POPs into air, water and soil as well as releases via residues and waste from processes and releases via products.

The Action Plan is part of the Party’s National Implementation Plan specified in Article 7 of the Convention and includes strategies for meeting obligations to reduce or eliminate releases of chemicals listed in Annex C of the Stockholm Convention (including PAH as an additional requirement under the EU POP Regulation), and a schedule for the Action Plan. The Plan identifies priorities for action and includes those source categories that provide the most cost-effective opportunities for release reduction or elimination. It also includes an inventory of the releases of chemicals listed in Annex C.

For the second review of the National Action Plan the inventory (2004, 2009 and 20014) of POP releases has been updated. Based on this inventory instruments and measures aiming at the reduction of POP releases are described. In particular, the effectiveness of national legal regulations is assessed and the report examines whether Best Available Techniques (BAT) in combination with Best Environmental Practices (BEP) have already been applied in the source categories defined by the Stockholm Convention. If applicable, recommendations on how BAT and BEP can be implemented are given. In addition data gaps are identified and proposals for the improvement of data quality elaborated.

The Action Plan will be reviewed and updated on a periodic basis (every 5 years).

1.1 Methodology for Inventories

The inventory is based on activity data which is multiplied with activity specific emission factors. Activity data – units are preferably given in GJ in the case of combustion processes or in Mg in the case of production processes – were taken from the Austrian Energy Balance (UMWELTBUNDESAMT 2015a). Data for this report was taken from the emissions inventory of 2015, which provided data for the years 2004, 2009 and 2014. The emissions inventory underwent changes in 2014, when the new IPCC guidelines (2006) had to be implemented. This led to a new aggregation of and re-allocations in some subsectors. Changes in total emissions are mainly attributed to ameliorations of the energy balance.

Both types of activity data are given in specific formats which are called SNAP[8]- and NFR[9]-Codes. Both formats show relevant differences to the Stockholm Convention with respect to the classification of source categories. Therefore, activity data on individual processes had to be identified and re-classified in order to obtain source specific activity data in line with the requirements of the Stockholm Convention.

In addition to that data from literature and further information from recent studies were used where available (see description of releases from individual source categories).

Emission factors for air emissions were taken from the Austrian Air Emissions Inventory ("Österreichische Luftschadstoffinventur – OLI") which gives a yearly update of emissions of air pollutants, among them PCDD/F (I-TEQ), HCB, PCB and PAH (4 congeneres). Where necessary emission factors have been recalculated to reflect recent developments in data quality (see description of releases from individual source categories).

1.2 Pollutants of concern

1.2.1 Polychlorinated dibenzo(p)dioxins (PCDD) and polychlorinated dibenzofurans (PCDF)

Polychlorinated dibenzo(p)dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) are formed unintentionally in industrial-chemical processes, such as chemical manufacture, and thermal processes, such as waste incineration. PCDD/PCDF are the only POPs whose mechanism of formation has been studied extensively in combustion-related processes and to a lesser extent in non-combustion-related chemical processes; even so, the mechanisms and the exact formation conditions are not fully resolved.

Carbon, oxygen, hydrogen and chlorine, whether in elemental, organic or inorganic form, are needed. At some point in the synthesis process, whether present in a precursor or generated by a chemical reaction, the carbon must assume an aromatic structure.

There are two main pathways by which these compounds can be synthesized: from precursors such as chlorinated phenols or de novo from carbonaceous structures in fly ash, activated carbon, soot or smaller molecule products of incomplete combustion. Under conditions of poor combustion, PCDD/PCDF can be formed in the burning process itself.

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[8] SNAP: Standard Nomenclature of Air Pollutants

[9] NFR: Nomenclature for Reporting

The mechanism associated with this synthesis can be homogeneous (molecules react all in the gas phase or all in the solid phase) or heterogeneous (involving reactions between gas phase molecules and surfaces).

PCDD/PCDF can also be destroyed when incinerated at sufficient temperature with adequate residence time and appropriate mixing of combustion gases and waste or fuel feed. Good combustion practice includes management of the "3 Ts" – time of residence, temperature and turbulence. Use of a fast temperature quench and other known processes are necessary to prevent reformation.

In addition to the primary measures there are a variety of well proven and effective secondary measures to reduce emissions of once formed PCDD/F, including different techniques of adsorption on activated coke or oxidation with the help of a catalyst.

1.2.2 Hexachlorobenzene (HCB)

Hexachlorobenzene (HCB) has been widely employed as a fungicide on seeds, especially against the fungal disease 'bunt' that affects some cereal crops. The marketing and use of hexachlorobenzene as a plant protection product was banned in the European Union in 1988.

As hexachlorobenzene is no longer produced in the EU, the only man-made release of hexachlorobenzene is as unintentionally produced pollutant. HCB can still be found as an impurity in certain active ingredients of some plant protection products and biocides, although in much smaller amounts than there used to be. Further, it is emitted from the same chemical and thermal processes as dioxins and furans and formed via a similar mechanism.

There is far less information on the formation of HCB, especially in combustion processes. Since there are similarities in the structure and occurrence of PCDD/PCDF, PCB and HCB, it is usually assumed that, with the exception of oxygen-containing species, those parameters and factors that favour formation of PCDD/PCDF also generate PCB and HCB.

1.2.3 Polychlorinated biphenyls (PCB)

Polychlorinated biphenyls (PCB) have been widely used as additives in transformer oils, in capacitors, as hydraulic fluids and as softeners in lacquers and plastics.

As PCB is no longer produced in the EU, the only man-made release of PCB is as unintentionally produced pollutant; it is emitted from the same chemical and thermal processes as dioxins and furans and formed via a similar mechanism.

There is far less information on the formation of PCB, especially in combustion processes. Since there are similarities in the structure and occurrence of PCDD/PCDF, PCB and HCB, it is usually assumed that, with the exception of oxygen-containing species, those parameters and factors that favour the formation of PCDD/PCDF also generate PCB and HCB.

1.2.4 Polycyclic aromatic hydrocarbons (PAH)

Polycyclic aromatic hydrocarbons (PAH) are molecules built up of benzene rings. PAHs are a group of approximately 100 compounds. Most PAHs in the environment arise from incomplete combustion of carbon-containing materials like oil, wood, garbage or coal. Fires are able to produce fine PAH particles, which bind to ash particles and are considered long range airpollutants. Thus PAHs have been ubiquitously distributed in the environment for thousands of years.

The four compounds benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene are used as indicators for the purposes of emission inventories.

1.2.5 Pentachlorobenzene (PeCB)

PeCB belongs to a group of chlorobenzenes that are characterized by a benzene ring in which the hydrogen atoms are substituted by one or more chlorines.

PeCB was previously used in PCB products, in dyestuff carriers, as a fungicide, a flame retardant and as a chemical intermediate e.g. for the production of quintozene. PeCB might still be used as an intermediate. PeCB is also produced unintentionally during combustion, as well as during thermal and industrial processes. It is also present as an impurity in products such as solvents or pesticides.

PeCB is persistent in the environment, highly bioaccumulative and has a potential for long-range environmental transport. It is moderately toxic to humans and very toxic to aquatic organisms.

The production of PeCB was phased out in the main producer countries some decades ago as efficient and cost-effective alternatives are available. Applying Best Available Techniques and Best Environmental Practices would significantly reduce the unintentional production of PeCB.

(webpage Stockholm Convention on Persistant Organic Pollutants, http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx)

1.2.6 Polychlorinated Naphthalenes (PCN)

Commercial PCNs are mixtures of up to 75 chlorinated naphthalene congeners plus byproducts and are often described by the total fraction of chlorine. PCNs make effective insulating coatings for electrical wires. Others have been used as wood preservatives, as rubber and plastic additives, for capacitor dielectrics and in lubricants. PCNs started to be produced for high-volume uses around 1910 in both Europe and the United States. To date, intentional production of PCN is assumed to have ended. PCN are unintentionally generated during high-temperature industrial processes in the presence of chlorine.

(webpage Stockholm Convention on Persistant Organic Pollutants, http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx)

2 SOURCE INVENTORY OF POPS RELEASES INTO AIR

In this section two inventories are described: the Austrian air emissions inventory („Österreichische Luftschadstoff-Inventur OLI“) according to UNECE/LRTAP and the inventory developed according to the source categories of Annex C of the Stockholm Convention (including PAH as required by the EU-POP Regulation).

There are distinct methodological differences between these two inventories: The OLI includes a variety of air pollutants, among them PCDD/F (I-TEQ), HCB, PCB and PAH. Source categories are combined in SNAP codes (SNAP: Standard Nomenclature for Air Pollutants) and in NFR codes (NFR: Nomenclature For Reporting).

On the other hand the inventory required by the Stockholm Convention should help to identify major sources of POPs emissions and therefore follows a more source-based approach: Emissions to air (but also emissions to water, soil and releases via residues and waste) should be given for individual processes which have been identified by the relevant Technical Working Group as having the potential for substantial POPs releases.

The National Action Plan according to Article 5 of the Stockholm Convention should also present an inventory of PCN releases. However, due to a general lack of data, this requirement could not be fulfilled.

With respect to emissions into air there are specific differences in the results of the two inventories. These can be explained by the different formats used for activity data and by the incorporation of updated emission factors for the Action Plan’s inventory. Relevant discrepancies are described in detail in the source specific sections.

2.1 Austrian Air emissions Inventory according to UNECE/LRTAP

The Umweltbundesamt, in its capacity as the Environment Agency Austria, has been designated by law as the national entity which is responsible for the preparation of the annual air pollutant inventory. The Environmental Control Act (BGBl. I Nr. (Federal Law Gazette No.) 1998/152 as amended) regulates the responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt. One of these tasks is to provide technical expertise and the data basis for the fulfilment of the emission related reporting obligations under the UNECE LRTAP Convention.

To this end, the Umweltbundesamt prepares and annually updates the Austrian air emissions inventory („Österreichische Luftschadstoff-Inventur OLI“), which covers

- Greenhouse gases (CO_2, N_2O, CH_4, F-gases)
- SO_x, NO_x, NH_3, NMVOC (under the NEC Directive) and CO
- POPs (PAHs, HCB, PCB, PCDD/F)
- Heavy metals (Pb, Cd, Hg)
- Particulate matter (TSP, PM_{10} and $PM_{2.5}$).

For the Umweltbundesamt a national air emission inventory that identifies and quantifies the sources of pollutants in a consistent manner has a high priority. Such an inventory provides a common basis for comparing the relative contributions of different emission sources and hence can be a basis for policies to reduce emissions.

2.1.1 Trends for POPs Emissions into Air

Emissions of PCDD/F decreased between the years 1990–2014 with the biggest drop between the years 1990 and 1994 as a result of legal regulations concerning emission reduction from industry and waste incineration. Emissions of PCDD/F increased in the years 1995 and 1996, and steadily declined afterwards until the year 2001. PCDD/F dropped remarkably between 2001 and 2002 (due to a reduction measure in one sinter plant).

Emissions of PAH decreased steadily from 1990 to 2014 with a significant drop between the years 1990 and 1994.

Emissions of PCB declined significantly from 1990 to 1993, then increased slowly from 1994 to 2014 and at 180 kg per year they are now 7% lower than in 1990, but 11% higher than in 1995. Thermal processes in the metallurgical industry (sinter plants, secondary lead production) contribute – with a lion’s share of 99% - significantly to the total emissions of PCB. The inventory of emissions in the Austrian inventory is based on activity data which is multiplied with an activity specific emission factor. This factor (for PCB) has not changed in the considered years. As activity data (production data) has increased, also the calculated emissions of PCB increased. A review of the emission factors for PCB in the different source categories is necessary.

Emissions of HCB declined from 1990 to 2011, and then increased strongly in the years 2012, 2013 and 2014. This increase is due to an unintentional release of HCB in an Austrian cement installation which was caused by the input of HCB containing waste and incomplete destruction of HCB.

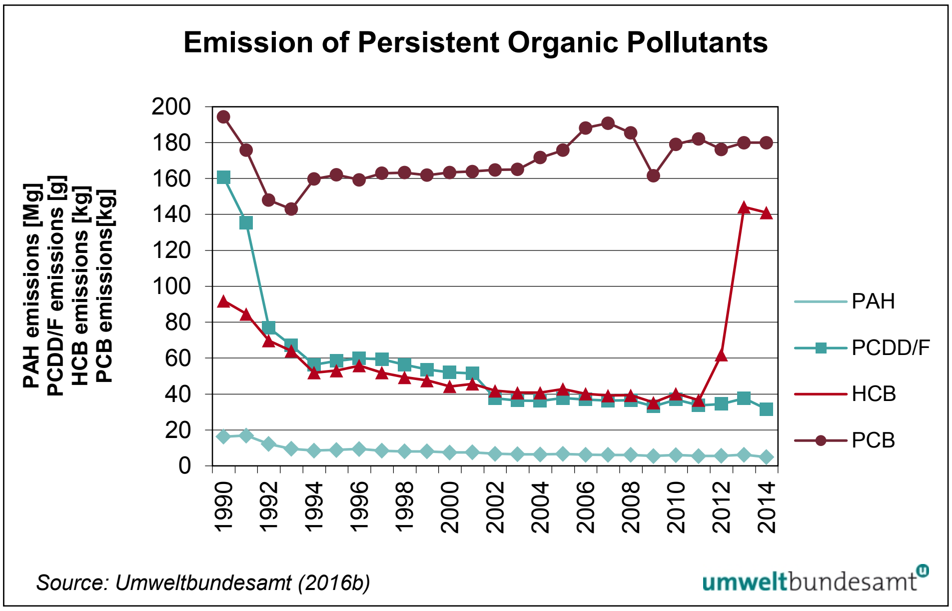
Table 1: Emissions and emission trends for POPs 1990–2014 (UMWELTBUNDESAMT 2016b)

Year	Emission			
	PAH [Mg]	PCDD/F [I-TEQ, g]	HCB [kg]	PCB [kg]
1990	16.27	160.69	91.93	194.23
1991	16.90	135.39	84.62	175.76
1992	12.16	76.81	69.67	147.97
1993	9.49	67.03	64.02	142.96
1994	8.50	56.26	51.93	159.73
1995	8.85	58.48	53.09	161.98
1996	9.40	59.84	55.80	159.26
1997	8.44	59.32	51.91	162.91
1998	8.05	56.33	49.34	163.23
1999	8.03	53.62	47.57	161.86
2000	7.40	52.04	44.28	163.35

Year	**Emission**			
	PAH [Mg]	**PCDD/F [I-TEQ, g]**	**HCB [kg]**	**PCB [kg]**
2001	7.50	51.56	45.65	163.88
2002	6.75	37.60	41.81	164.77
2003	6.48	36.36	40.77	165.08
2004	6.40	36.19	40.77	171.63
2005	6.65	37.77	42.77	175.74
2006	6.23	36.89	40.14	188.13
2007	6.07	36.32	39.11	190.75
2008	6.09	36.54	39.35	185.35
2009	5.48	33.14	35.21	161.43
2010	6.04	36.91	40.25	179.04
2011	5.44	33.69	36.56	182.04
2012	5.58	34.44	61.88	176.17
2013	6.21	37.68	144.20	179.91
2014	4.89	31.57	140.95	179.94
Trend 1990–2014	**-70%**	**-80%**	**+53%**	**-7%**
Trend 1995-2014	**-45%**	**-46%**	**+165%**	**+11%**

Remark: Please note different units used for different groups of pollutants. PeCB and PCN are not covered in the Austrian air emissions inventory.

Figure 1: Emission of Persistent Organic Pollutants 1990–2014: PAH in Mg, PCDD/F in g, HCB in kg and PCB in kg according to UNECE/LRTAP.



Source: Umweltbundesamt (2016b)

Remark: Please note different units used for different groups of pollutants. PeCB and PCN are not covered in the Austrian air emissions inventory. Due to the economic crisis activity data and therefore emissions decreased in 2009.

2.2 Releases of polychlorinated dibenzo(p)dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) – Source categories of the Stockholm Convention

2.2.1 Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge

The following description of this source category is given in the Stockholm Convention's Technical Guidebook, Waste Incinerators (UNEP 2007):

"This section deals only with the dedicated incineration of wastes and not with other situations where waste is thermally treated, for example co-incineration processes such as cement kilns and large combustion plants, which are dealt with in the sections relating to those processes."

2.2.1.1 Emission Factors and Emissions

PCDD/F emissions into air are in the range of 0.0013 to 0.05 ng/Nm^3 (I-TEQ; at 11% oxygen), which is within (or in some cases even below) the ranges associated with Best Available Techniques (0.01–0.1 ng/Nm^3; EUROPEAN COMMISSION 2006a). Most of the measurements are done on a discontinuous basis. However, in some cases PCDD/F-emissions were measured on a semi-continuous basis (i.e. continuous sampling of flue-gas followed by an analysis of the filter cartridge every two weeks).

Municipal Waste

About 1.341 million t municipal waste (mixed municipal waste, bulky waste) were incinerated in municipal waste incineration plants (BMLFUW 2015a).

Hazardous Waste

In 2014, about 1.324 million t of hazardous waste were treated (BMLFUW 2015), 0.227 million t were incinerated in 2014 (assumption Umweltbundesamt 2015).

Sewage sludge

In 2014 an amount of 0.239 million t of sewage sludge was produced in Austria. 1% of this amount was landfilled, 49% was incinerated, 17% was applied on land and 33% was treated in another way. (BMLFUW 2015).

Table 2 lists the PCDD/F-Emissions into air of the source category Waste Incineration for the years 2004, 2009 and 2014. (BMLFUW 2015)

Table 2: PCDD/F-emissions into air from the source category Waste Incineration (UMWELTBUNDESAMT 2007a, own calculation).

	Emissions 2004 (g I-TEQ)	Emissions 2009 (g I-TEQ)	Emissions 2014 (g I-TEQ)
Municipal Solid Waste	0.214	0.210	0.241
Hazardous Waste	0.013	0.017	0.024
Sewage Sludge	0.002	0.002	0.003
Total	**0.230**	**0.229**	**0.267**

2.2.2 Cement kilns firing hazardous waste

The following description of this source category is given in the Stockholm Convention's Technical Guidebook, Cement Kilns (UNEP 2007):

"The following draft guidelines provide guidance on best available techniques and guidance on best environmental practices for cement kilns relevant to Article 5 and Annex C, Part II of the Convention. Waste may be co-processes in cement kilns either als alternative fuel or for destruction purposes. Therefore this section also considers the requirements of Article 6 of the Convention regarding destruction of wastes containing POPs.

Destruction and co-incineration of wastes and hazardous wastes in cement kilns also fall within the scope of this section. It should be kept in mind when reading these guidelines that stringent definitions of the terms "waste" and "hazardous waste" do not currently exist. In the context of this guideline the term "waste" is used independent of its calorific value or its potential to substitute mineral resources."

2.2.2.1 Emission Factors and Emissions

In all Austrian cement plants waste is co-incinerated with an upward trend. Emission factors used in the OLI were assessed using reported emissions from Austrian cement kilns (ENVIRONMENTAL IMPACT STATEMENT WIETERSDORF (2003), ENVIRONMENTAL IMPACT STATEMENT RETZNEI (2004), ENVIRONMENTAL IMPACT STATEMENT LEUBE (2005), KARSTENSEN (2006)).

In 2014 3.14 million t of clinker were produced in nine plants. In total about 493,609 t of waste were co-incinerated in 2014 (VÖZ 2015). Data from single measurements (done in 2014) show emission concentrations between 0.0006–0.058 ng/Nm^3 (I-TEQ); all but one plant are considerably below the BAT ranges of <0.05-0.1 ng PCDD/F I-TEQ/Nm^3 (10 vol-% O_2, dry flue gas, standard state, average over the sampling period 6–8 hours, BMLFUW 2016a). In the Waste Incineration Ordinance (AVV – relevant ordinance for co-incineration of waste in cement plants) the ELV for PCDD/F for cement plants is 0.1 ng/Nm^3. Results from literature show that PCDD/F emissions are not primarily depending on the type of fuel or waste but on the operating conditions and on the prevention of conditions which favour de-novo synthesis.

The next table presents calculated emissions loads from Austrian cement kilns:

Table 3: PCDD/F-emissions from Austrian cement plants (UMWELTBUNDESAMT 2016b).

	Emissions 2004 (g I-TEQ)	Emissions 2009 (g I-TEQ)	Emissions 2014 (g I-TEQ)
Cement kilns (total emissions)	0.119	0.131	0,121

It should be mentioned, that PAH-emissions such as benzene or naphthalene may arise from cement plants. These emissions have so far been reported by a small number of Austrian cement plants. PAHs mainly escape from preheating raw meal and to some extent from the rotary kiln (see PRTR data on the website of the Environment Agency Austria: www.prtr.at).

2.2.3 Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching

The production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching is described in the Stockholm Convention's Technical Guidebook, Production of Pulp (UNEP 2007) as follows:

"The main processes involved in making pulp and paper products are raw material handling and preparation, storage (and preservation for non-woods), wood debarking, chipping and agricultural residue cleaning, deknotting, pulping, pulp processing and bleaching if required and, finally, paper or paperboard manufacturing. Most of the formation of the 2,3,7,8-TCDD and 2,3,7,8-TCDF is generated in the C-stage of bleaching via the reaction of chlorine with precursors of TCDD and TCDF. HCB and PCB are not formed during pulp bleaching".

In the BAT-Conclusions for the production of pulp, paper and board (2014/687/EU) the bleaching of pulp with elemental chlorine or chemicals generating elemental chlorine is not considered as BAT (Best available technique). According to the BAT-Conclusions, state of the art techniques for kraft pulping, sulphite pulping, mechanical and chemimechanical pulping are totally chlorine free bleaching (TCF), modern elemental chlorine free (ECF) bleaching and high consistency (peroxide) bleaching.

2.2.3.1 Emission Factors and Emissions

Emissions into air are released by recovery boilers (incineration of black liquor and fuel oil), fluidised bed reactors (incineration of bark, sludge, coal, fuel oil, biomass and waste), lime kilns (incineration of gas and fuel oil) and other fossil fuel fired incineration plants (UMWELTBUNDESAMT 2007b). Although PCDD/F-emissions are not measured in most of the above mentioned incineration plants (emissions are routinely measured at fluidised bed reactors when waste in co-incinerated) emissions are generally considered to be low (UNEP 2005). Emissions of these incineration plants are reported in section 2.2.8 (fossil fuel-fired utility and industrial boilers).

2.2.4 Thermal processes in the metallurgical industry (secondary copper production; sinter plants in the iron and steel industry; secondary aluminium production; secondary zinc production)

This source category is described in the Stockholm Convention's Technical Guidebook, metallurgical industry (UNEP 2007) as follows:

"Secondary copper smelting involves pyrometallurgical processes dependent on the copper content of the feed material, size distribution and other constituents. Feed sources are copper scrap, sludge, computer scrap, drosses from refineries and semi-finished products. These materials may contain organic materials like coatings or oil, and installations take this into account by using de-oiling and decoating methods or by correct design of the furnace and abatement system."

"Iron sintering plants may be used in the manufacture of iron and steel, often in integrated steel mills. The sintering process is a pretreatment step in the production of iron whereby fine particles of iron ores and, in some plants, secondary iron oxide wastes (collected dusts, mill scale) are agglomerated by combustion."

"Processes used in secondary aluminium smelting are dependent on feed material. Pretreatment, furnace type and fluxes used will vary with each installation. Production processes involve scrap pretreatment and smelting/refining. Pretreatment methods include mechanical, pyrometallurgical and hydrometallurgical cleaning. Smelting is conducted using reverberatory or rotary furnaces. Induction furnaces may also be used to smelt the cleaner aluminium feed materials."

"Secondary zinc smelting involves the processing of zinc scrap from various sources. Feed material includes dusts from copper alloy production and electric arc steel making (both of which have the potential to be contaminated with chemicals listed in Annex C of the Stockholm Convention), residues from steel scrap shredding, and scrap from galvanizing processes. The process method is dependent on zinc purity, form and degree of contamination. Scrap is processed as zinc dust, oxides or slabs. The three general stages of production are pretreatment, melting and refining."

The latter process is not applied in Austria.

2.2.4.1 Emission Factors and Emissions

Secondary copper plant

In Austria only one secondary copper plant is in operation with a production capacity of 92,400 t/a copper anodes, 113,500 t/a copper cathodes and 91,000 t/a of bolts (MONTANWERKE BRIXLEGG 2012).

Emissions are reduced via fabric filter and regenerative afterburner including a catalytical reduction step after the shaft furnace. The general ELV for PCDD/F according to the Ordinance on non ferrous metals and refractory metals (BGBl. II No. 86/2008) is 0.4 ng/Nm^3. According to the BAT-Conclusions for Non Ferrous Metals Industries (EUROPEAN COMMISSION 2016) the emission limit value will have to be changed to 0.1 ng/Nm^3.

There are no dioxin emission reduction measures installed after the converter and the anode furnace.

Sinter Plants

In Austria two sinter plants are in operation with a production capacity of 1.5 million t/a (VA Donawitz) and 2.75 million t/a (VA Linz), respectively. Both plants are equipped with bag filter. For the larger plant the emission limit value is 0.1 ng/Nm^3 PCDD/F (as I-TEQ; ENVIRONMENTAL IMPACT ASSESSMENT 2004), reported emissions are < 0.05 ng/ Nm^3 PCDD/F (BREF review Iron and Steel Production, 2012). The other plant emits less than 0.1 ng/Nm^3 PCDD/F (BREF review Iron and Steel Production, 2012). The review on the BREF Iron and Steel has been published on 28/02/2012 (EUROPEAN COMMISSION 2012). The BAT- associated emission level for PCDD/F in case of the the application of a bag filter is < 0,05 – 0,2 ng I-TEQ/Nm^3. Permit conditions have to be reconsidered within 4 years of publication of decisions on BAT conclusions. With status 06/2016 there is no information available on the permit conditions of the smaller installation.

Secondary aluminium smelting plants

In Austria the following companies are producing secondary aluminium:

- AMAG: 375,900 t/a (AMAG 2014)
- Aluminium Lend GmbH & Co KG (SAG): capacity: 45.000 t/a ; http://www.hrforce.at/hr-infotag2012/vortraege/006-B_Outsourcing_unterjaehrig.pdf;
- Hütte Klein-Reichenbach: capacity: 10.000 t/a.

Different furnaces are used in the secondary aluminium production in Austria like reverberatory furnace, rotary furnace, tilting rotary furnace, induction furnace. Emissions of PCDD/F are reduced via afterburning, dry sorption technique ($NaHCO_3$, coke) or injection of sorbalite (lime and coke). Measured PCDD/F emissions are below <0.1 ng/Nm^3, (UMWELTBUNDESAMT 2010) which is below the emission value associated with Best Available Techniques (≤0.1 ng/Nm^3, EUROPEAN COMMISSION 2016).

Benzo(a)pyrene is limited in the non ferrous metals Ordinance with an emission limit value of 0.05 mg/Nm^3. Measured values (as far as they are available) are far below this limit value.

Emissions

Table 4 gives an overview of calculated emissions from the processes described above:

Table 4: PCDD/F-emissions from thermal processes in the metallurgical industry – Part II (UMWELTBUNDESAMT 2016b).

	Emissions 2004 (g I-TEQ)	Emissions 2009 (g I-TEQ)	Emissions 2014 (g I-TEQ)
Secondary copper production	0.279	0.279	0.279
Sinter plants in the iron and steel industry	3.106	2.538	3.353
Secondary aluminium production	1.309	1.282	1.256
Secondary zinc production	NO	NO	NO
Total	**4.694**	**4.099**	**4.887**

2.2.5 Open burning of waste, including burning of landfill sites

This source category is described in the Stockholm Convention's Technical Guidebook, open burning of waste (UNEP 2007) as follows:

"Open burning covers a wide range of different uncontrolled waste combustion practices, including dump fires, pit burning, fires on plain soil and barrel burning."

2.2.5.1 Emission Factors and Emissions

This source category includes on-field burning of stubble, straw, etc. and open burning of agricultural waste. Releases are taken from the Austrian National Inventory (see Table 5).

Intentional fires like bonfires bear a risk of abuse when used as a method of domestic waste disposal. This issue has been addressed in a single case study showing the effectiveness of current regulation in this field of activity. The situation with unintentional fires is more unclear. Emission factors reported in literature show high uncertainty due to limited sets of data.

In addition releases from accidental burning of landfill sites (esp. landfills for the intermediate storage of waste) should be added here as well as releases during accidental fires of houses and other facilities. In recent years burning of intermediate storage facilities of waste has occurred relatively often. However, due to missing data on the quantities of burnt waste and the great uncertainties associated with the relevant emission factors no quantification of emissions has been done for these types of unwanted emissions.

Nevertheless, it can be assumed that these incidents contribute substantially to the overall emissions of PCDD/F into air: The Dioxin Toolkit (UNEP 2005) gives a default emission factor of 1 mg per tonne of burnt material.

Table 5: PCDD/F-emissions from the source category open burning of waste (UMWELTBUNDESAMT 2016b).

	Emissions 2004 (g I-TEQ)	Emissions 2009 (g I-TEQ)	Emissions 2014 (g I-TEQ)
Open burning of waste*	0.223	0.132	0.069

** without burning of landfill sites and accidental fires*

2.2.6 Thermal processes in the metallurgical industry not mentioned in Part II

This source category is described in the Stockholm Convention's Technical Guidebook, metallurgical industry (UNEP 2007) as follows:

"Secondary lead smelting involves the production of lead and lead alloys, primarily from scrap automobile batteries, and also from other used lead sources (pipe, solder, drosses, lead sheathing). Production processes include scrap pretreatment, smelting and refining. Incomplete combustion; high levels of oils, plastics and other organic materials in feed; and temperatures between 250°C and 500°C may all give rise to chemicals listed in Annex C of the Stockholm Convention."

"Primary aluminium is produced directly from the mined ore, bauxite. The bauxite is refined into alumina through the Bayer process. The alumina is reduced into metallic aluminium by electrolysis through the Hall-Héroult process (either using self-baking anodes – Söderberg anodes – or using prebaked anodes)."

"Magnesium is produced either from raw magnesium chloride with molten salt electrolysis, or magnesium oxide reduction with ferrosilicon or aluminium at high temperatures, as well as through secondary magnesium recovery (for example, from asbestos tailings)."

"Secondary steel is produced through direct smelting of ferrous scrap using electric arc furnaces. The furnace melts and refines a metallic charge of scrap steel to produce carbon, alloy or stainless steels at non integrated steel mills. Ferrous feed materials may include scrap, such as shredded vehicles and metal turnings, or direct reduced iron. In addition scrap may be added to other melting furnaces in the foundry and primary iron and steel sectors.

"Primary base metals smelting involves the extraction and refining of nickel, lead, copper, zinc and cobalt. Generally, primary base metals smelting facilities process ore concentrates. Most primary smelters have the technical capability to supplement primary concentrate feed with secondary materials (e.g. recyclables)."

2.2.6.1 Emission factors and emissions

Secondary lead production

Only one plant in Austria (BMG Metall & Recycling GmbH in Arnoldstein/Kärnten) produces secondary lead from old batteries with a production capacity of 23,000 t/a. (UMWELTERKLÄRUNG 2015). An afterburner has been installed after the furnaces. An emission limit value of 0.4 ng/Nm^3 for PCDD/F exists in the current ordinance (BGBl. II Nr. 86/2008). Measured values are below this ELV.

The ELV will have to be changed due to the revised BAT-AEL of 0.1 ng/Nm^3 for PCDD/F in the European BAT Conclusions. (EUROPEAN COMMISSION 2016) Benzo(a)pyrene is limited by ordinance (BGBl. II No. 86/2008) with an emission limit value of 0.05 mg/Nm^3, a measured value of 0.0064 mg/Nm^3 (UMWELTERKLÄRUNG 2015) is far below the limit value.

Primary aluminium production

Primary aluminium is no longer produced in Austria (1992 – change to secondary aluminium production).

Secondary steel production

Secondary steel (Electric Arc Furnace) is produced in three plants (Böhler Uddeholm, Marienhütte, Breitenfeld). Total production was 664 kt in the year 2013 and 691 kt in the year 2014. www.worldsteel.org.

Emissions

Releases have been taken from the Austrian National Inventory (see Table 6).

Table 6: PCDD/F-emissions from the source category thermal processes in the metallurgical industry – Part III (UMWELTBUNDESAMT 2016b).

	Emissions 2004 (g I-TEQ)	Emissions 2009 (g I-TEQ)	Emissions 2014 (g I-TEQ)
Thermal processes in the metallurgical industry not mentioned in Part II	0.204	0.191	0.213

2.2.7 Residential combustion sources

Residential combustion plants are defined in the Stockholm Convention's Technical Guidebook (UNEP 2007) as follows:

"This section considers the combustion of wood, coal, gas, as well as other organic matter mainly for residential heating and cooking. Combustion takes place in hand-fired stoves or fireplaces or, in the case of larger central heating systems, in automatically fired installations."

Activity data for residential combustion plants can be found within the Austrian National Energy Balance in the NFR-codes (NFR: Nomenclature for Reporting) "Commercial/Institutional" (NFR: 1A4a, SNAP: 0201), "Residential Plants" (NFR: 1A4b1, SNAP: 0202) and "Plants in Agriculture/Forestry" (NFR: 1A4c1, SNAP: 0203). Since these plants are regarded as small scale installations, their emissions are allocated to the source category "Residential combustion sources".

2.2.7.1 Emission factors – NFR-code: "Residential Combustion Sources"

In the next table emission factors of relevant fuels are compiled:

Table 7: PCDD/F emission factors for Residential Plants, Commercial/ Institutional Plants and Plants in Agriculture/ Forestry

EF PCDD/F [µg/GJ]	Umweltbundesamt (2016b)	UNEP Toolkit (UNEP 2013)
1A4a Commercial/Institutional plants (SNAP 020103)		
102A Lignite 104A Lignite briquettes 105A Brown coal 106A Brown coal briquettes 107A Coke	0.24	0.200 (low chlorine) 1.700 (high chlorine)
203B Light fuel oil 203C Medium fuel oil	0.002	0.010 (general)
203D Heavy fuel oil	0.0009	0.010 (general)
204A Heating oil 206A Petroleum	0.0012	0.010 (general)
224A Other Oil Products	0.0017	0.010 (general)
301A Natural gas	0.0016	0.0015 (general)
303A LPG 310A Landfill gas	0.0017	not available
309A Biogas 309B Sewage sludge gas	0.0006	not available
111A Wood (IEF 2004) 111A Wood (IEF 2009) 111A Wood (IEF 2014)	0.2246 0.1948 0.1699	1.500 (contaminated) 0.100 (advanced)
115A Industrial waste	0.3	0.200 (low chlorine) 1.700 (high chlorine)
116A Wood waste (IEF 2004) 116A Wood waste (IEF 2009) 116A Wood waste (IEF 2014)	0.3333 0.43 0.43	1.500 (contaminated) 0.450 (straw) 0.100 (advanced)
1A4c i Plants in Agriculture/Forestry/Fishing (SNAP 020302)		
102A Lignite 104A Lignite briquettes 105A Brown coal 106A Brown coal briquettes 107A Coke	0.24	0.200 (low chlorine) 1.700 (high chlorine)
203B Light fuel oil 204A Heating oil	0.0015	0.010 (general)
301A Natural gas	0.0025	0.0015 (general)
303A LPG	0.0025	not available
111A Wood (IEF 2004) 111A Wood (IEF 2009) 111A Wood (IEF 2014)	0.2878 0.2163 0.1654	1.500 (contaminated) 0.100 (advanced)
116A Wood waste	0.38	1.500 (contaminated) 0.450 (straw) 0.100 (advanced)
1A4b Residential plants: central and apartment heating (SNAP 020202)		
102A Lignite 105A Brown coal 106A Brown coal briquettes 107A Coke	0.38	0.200 (low chlorine) 1.700 (high chlorine)

EF PCDD/F [µg/GJ]	**UMWELTBUNDESAMT (2016b)**	**UNEP Toolkit (UNEP 2013)**
203B Light fuel oil 204A Heating oil	0.0015	0.010 (general)
224A Other Oil Products	0.0017	0.010 (general)
301A Natural gas	0.0025	0.0015 (general)
303A LPG	0.0025	not available
111A Wood: central heating (IEF 2004) 111A Wood: central heating (IEF 2009) 111A Wood: central heating (IEF 2014)	0.2878 0.2163 0.1654	1.500 (contaminated) 0.100 (advanced)
111A Wood: apartment heating	0.38	1.500 (contaminated) 0.100 (advanced)
116A Wood waste: central heating (IEF 2004) 116A Wood waste: central heating (IEF 2009) 116A Wood waste: central heating (IEF 2014)	0.2878 0.2163 0.1654	1.500 (contaminated) 0.450 (straw) 0.100 (advanced)
116A Wood waste: apartment heating	0.38	1.500 (contaminated) 0.450 (straw) 0.100 (advanced)
1A4b Residential plants: stoves[10] (SNAP 020205)		
102A Lignite* 104A Lignite briquettes* 105A Brown coal* 106A Brown coal briquettes* 107A Coke*	0.75	0.200 (low chlorine) 1.700 (high chlorine)
204A Heating oil	0.003	0.010 (general)
301A Natural gas	0.006	0.0015 (general)
111A Wood* 113A Peat* 116A Wood waste*	0.75	1.500 (contaminated) 0.450 (straw) 0.100 (advanced)

** see footnote fur further details*

2.2.7.2 Activity data – NFR-code: "Residential Plants"

In 2014 total energy consumption under the NFR-code "Residential Plants" was 140 PJ. Major fuels were wood with a share of 34.7%, followed by natural gas (29.9%), oil (light and extra light heating oil and liquified petroleum gas) (25.5%) and wood waste (8.2%). Other fuels (0.9%) and coal (0.7%) are of minor importance.

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[10] Referring to UMWELTBUNDESAMT (2002): Coal: 7.74 µg/GJ (stoves, fireplaces). Coke: 1.47 µg/GJ (stoves, fireplaces). Wood, peat & wood waste: 0.32 µg/GJ (stoves, fireplaces).

Table 8: Fuel mix in the NFR-code „Residential Plants“ (Umweltbundesamt 2016a).

Residential Plants	**2004**	**2009**	**2014**
Coal	3.1%	1.5%	0.7%
Oil	36.1%	30.7%	25.5%
Gas	28.5%	28.9%	29.9%
Wood waste	3.6%	5.3%	8.2%
Wood	27.8%	32.4%	34.7%
Others	0.9%	1.2%	0.9%
Sum	**100%**	**100%**	**100%**
Total Energy Consumption	**180 PJ**	**152 PJ**	**140 PJ**

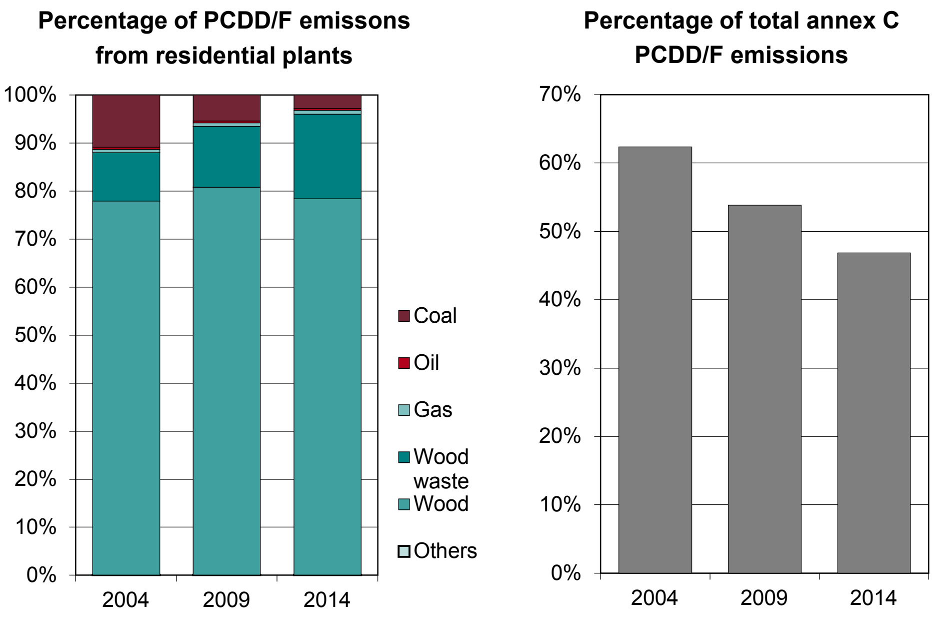
2.2.7.3 Emissions of PCDD/F – NFR-code: “Residential Plants”

Emission factors were taken from the OLI. In the table below emissions of residential plants are listed in relation to the fuel input. The largest part of the emissions stems from the incineration of wood. The incineration of fossil solid fuels (coal, lignite, coke) contributes significantly to the overall emissions from this source category. However, emissions from fossil solid fuels are expected to decrease even further due to a decline in fuel consumption.

Table 9: Emissions of dioxines/furanes from residential plants (Umweltbundesamt 2016b, own calculation)

Residential Plants	**2004 (g I-TEQ)**	**2009 (g I-TEQ)**	**2014 (g I-TEQ)**
Coal	2.40	0.94	0.41
Oil	0.10	0.07	0.05
Gas	0.15	0.13	0.12
Wood waste	2.22	2.21	2.56
Wood	17.24	14.11	11.42
Others	0.01	0.01	0.01
Sum	**22.12**	**17.46**	**14.57**

Figure 2: Percentage of PCDD/F emissions from residential plants by fuel and as share of total annex C PCDD/F emissions 2004, 2009 and 2014.



Percentage of PCDD/F emissons from residential plants

Percentage of total annex C PCDD/F emissions

Source: Umweltbundesamt (2016b)

2.2.7.4 Activity data – NFR-code "Commercial/Institutional" and "Plants in Agriculture/Forestry"

In the year 2014 the total input within these subcategories was 45 PJ. The major fuels were natural gas and other gases (50%), followed by oil (sum of heating oils and LPG: 21%), wood waste (16%) and wood (8.7%). Others (3.8%), solid fossil fuels (total of coke, coal and lignite: 0.3%) and industrial waste (0.2%) were of minor importance. Activity data in this sector suffer from substantial uncertainties which are the result of a lack of qualified data.

Table 10: Share of fuels within the subcategories "Commercial/Institutional" and "Stationary" (UMWELTBUNDESAMT 2016a).

Commercial/Institutional + Plants in Agriculture/Forestry	**2004**	**2009**	**2014**
Coal	1.1%	0.4%	0.3%
Oil	26.8%	28.9%	20.9%
Gas	53.7%	48.5%	50.2%
Wood waste	7.4%	11.8%	15.8%
Industrial waste	0.6%	0.1%	0.2%
Wood	4.6%	6.6%	8.7%
Others (biogas, sewage gas, landfill gas)	5.8%	3.7%	3.8%
Sum	**100%**	**100%**	**100%**
Total Energy Consumption	**81 PJ**	**60 PJ**	**45 PJ**

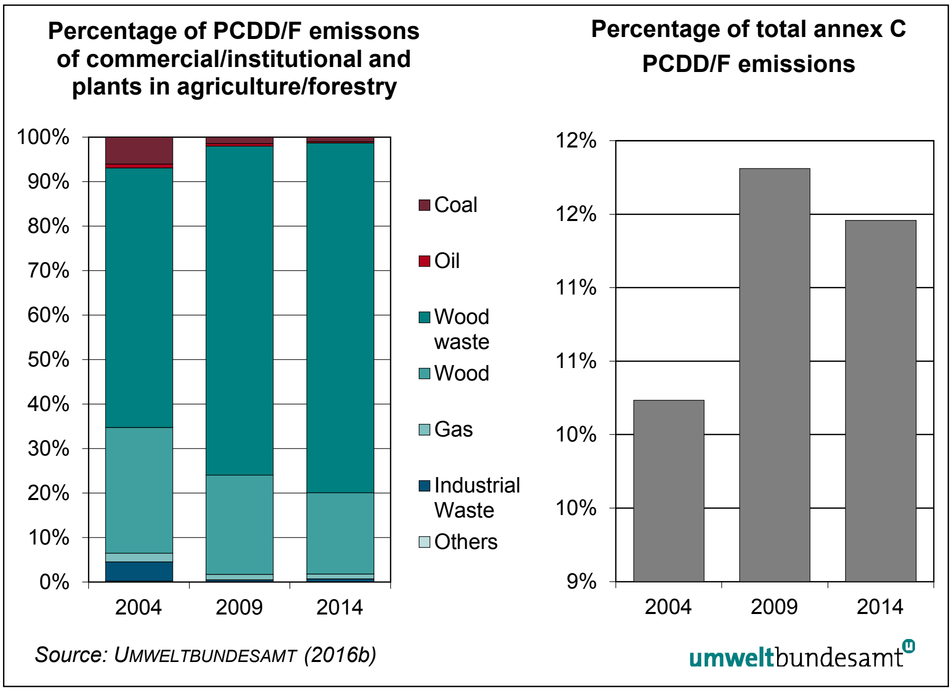
2.2.7.5 Emissions of PCDD/F – NFR-code "Commercial/Institutional" and „Plants in Agriculture/Forestry"

Emission factors were taken from the OLI. Due to the high activity rate of wood waste this type of waste contributes most to the overall emissions.

Table 11: Emissions of Dioxines/Furanes caused by different fuel types (UMWELTBUNDESAMT 2016b, own calculation).

Commercial/Institutional + Plants in Agriculture/Forestry	**2004 (g I-TEQ)**	**2009 (g I-TEQ)**	**2014 (g I-TEQ)**
Coal	0.22	0.05	0.04
Oil	0.03	0.02	0.01
Wood waste	2.12	2.83	2.80
Wood	1.03	0.85	0.65
Gas	0.07	0.05	0.04
Industrial waste	0.16	0.02	0.03
Others	0.01	0.00	0.00
Sum	**3.63**	**3.83**	**3.56**

Figure 3: Percentage of PCDD/F emissions from commercial/institutional and plants in agriculture/forestry by fuel and as share of total annex C PCDD/F emissions 2005, 2009 and 2014.



Source: UMWELTBUNDESAMT (2016b)

2.2.8 Fossil fuel-fired utility and industrial boilers

Fossil fuel-fired utility and industrial boilers are described in the Stockholm Convention's Technical Guidebook, fossil fuel-fired utility and industrial boilers (UNEP 2007) as follows:

"Boilers are facilities designed to burn fuel to heat water or to produce steam. The majority of boilers use fossil fuels to provide the energy source, although boilers can also be designed to burn biomass and wastes. The steam produced from the boiler can be used for electricity production or used in industrial processes; likewise hot water can be used in industrial processing, or for domestic and industrial heating."

2.2.8.1 Emission Factors and Emissions

Emission factors used by the Austrian Air Emissions Inventory are consistent with data from literature (UMWELTBUNDESAMT 2003, EUROPEAN COMMISSION 2003, 2006b). In general emission concentrations of investigated boilers are (far) below 0.1 ng/Nm^3.

Table 12: PCDD/F-emissions from the source category fossil fuel fired utility and industrial boilers (UMWELTBUNDESAMT 2016a).

	Emissions 2004 (g I-TEQ)	**Emissions 2009 (g I-TEQ)**	**Emissions 2014 (g I-TEQ)**
Fossil fuel-fired utility and industrial boilers	0.989	1.079	0.856

2.2.9 Firing installations for wood and other biomass fuels

Firing installations for wood and other biomass fuels are described in the Stockholm Convention's Technical Guidebook, firing installations for wood and other biomass fuels (UNEP 2007) as follows:

"The main purpose of firing installations for wood and other biomass fuels is energy conversion. Large-scale installations for firing wood and other biomass fuels mainly use fluidized bed combustion and grate furnaces. Technologies for small-scale plants include underfeed furnaces and cyclone suspension furnaces. Recovery boilers in the pulp and paper industry apply specific combustion conditions. Technology selection is related to fuel properties and required thermal capacity."

In the present section only large-scale applications in, for example, industry, power generation and district heating are covered.

2.2.9.1 Emission Factors and Emissions

Some emission factors used by the Austrian Air Emissions Inventory have been updated according to available literature (UMWELTBUNDESAMT 2007c). For example emission factors for industrial firing installations have been reduced from 0.08 µg/GJ to 0.03 µg/GJ. Due to the increasing number of commercial biomass firing installations emissions from this source category have risen to to more than 2.5 times in the period from 2004 to 2014.

Table 13: PCDD/F-emissions from the source category firing installations for wood and other biomass fuels (UMWELTBUNDESAMT 2016b).

	Emissions 2004 (g I-TEQ)	Emissions 2009 (g I-TEQ)	Emissions 2014 (g I-TEQ)
Firing installations for wood and other biomass fuels	1.644	3.147	4.192

2.2.10 Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil

This source category is described in the Stockholm Convention's Technical Guidebook, specific chemical production (UNEP 2007) as follows:

"This section focuses on processes for the manufacture of industrial chemicals that could theoretically give rise to persistent organic pollutants (particularly those chemicals listed in Annex C of the Stockholm Convention). Most of the processes described share common steps, including chlorination of organic or inorganic raw materials, purification of the products, separation of product streams (usually by distillation), destruction of high-molecular-weight side products and recycle or sale of hydrogen chloride."

2.2.10.1 Emission Factors and Emissions

No national emission factors are available. It is assumed that – if any – emissions are negligible due to low activity figures.

2.2.11 Crematoria

This source category is described in the Stockholm Convention's Technical Guidebook, crematoria (UNEP 2007) as follows:

"Cremation is the disposal of a cadaver by the process of burning. This can be undertaken in either an uncontrolled, open burning fashion on funeral pyres, or in a controlled fashion within a cremator, installed within a crematorium or crematory. For the purposes of this document, only the cremator installations are discussed with respect to preventing releases of persistent organic pollutants, and not open burning or non combustion alternatives."

2.2.11.1 Emission factors and emissions

In the year 2013 nine of eleven Austrian crematoria were equipped with emission reduction techniques, eight of which with PCDD/F reduction techniques. The emission limit value given in the permits is 0.1 ng/Nm^3 (11% O_2) (communication from operators, permits). There exists no generally binding rule concerning emission reduction for crematoria in Austria.

Due to a general lack of data emission factors from the Austrian Air Emissions Inventory have been used (Table 14).

Table 14: PCDD/F-emissions from the source category crematoria (UMWELTBUNDESAMT 2016b).

	Emissions 2004 (g I-TEQ)	Emissions 2009 (g I-TEQ)	Emissions 2014 (g I-TEQ)
Crematoria	0.154	0.164	0.164

2.2.12 Motor vehicles, particularly those burning leaded gasoline

This source category is described in the Stockholm Convention's Technical Guidebook, motor vehicles (UNEP 2007) as follows:

"The major fuels used in motor vehicle transportation are gasoline and diesel. Liquefied petroleum gas, vegetable oil-based and other biofuels, and alcohol-oil mixtures are gaining importance."

2.2.12.1 Methodology

Activity data for motor vehicles can be found within the Austrian National Energy Balance in the NFR-codes:

Road Transportation (SNAP: 07)

- Passenger cars
- Light duty vehicles <3.5 t
- Heavy duty vehicles >3.5 t and buses (r)
- Mopeds and motorcycles <50 cm^3
- Motorcycles >50 cm^3

Other Mobile Sources and Machinery (SNAP: 08)

- Military
- Railways
- Inland waterways
- Agriculture
- Forestry
- Industry
- Household and gardening

2.2.12.2 Activity data – Road Transportation

In 2014 total energy consumption in the category "Road Transportation" was 324.6 PJ. The major source category with a share of 49.6% was passenger cars, followed by heavy duty vehicles (37%), followed by light duty vehicles, motorcycles and mopeds (13.4%) excluding the relative proportions of liquid biofuels.

Table 15: Fuel Allocation Road Transportation (UMWELTBUNDESAMT 2016a).

Source category	**Activity 2004**		**Activity 2009**		**Activity 2014**	
	(PJ)	**(%)**	**(PJ)**	**(%)**	**(PJ)**	**(%)**
Passenger cars	182.0	57.4	181.0	57.5	162.0	49.9
thereof Gasoline	82.5	26.0	67.6	21.5	59.7	18.4
thereof Diesel	98.6	31.1	101.9	32.4	91.1	28.1
Light duty vehicles <3.5 t (r)	17.1	5.4	18.9	6.0	19.4	6.0
Heavy duty vehicles >3.5 t and buses (r)	118.0	37.2	95.4	30.3	121.5	37.4
Mopeds and Motorcycles <50 cm^3	0.2	0.1	0.3	0.1	0.2	0.1
Motorcycles >50 cm^3	0.0	0.0	0.0	0.0	0.0	0.0
Total	**317.4**	**100**	**314.7**	**100**	**324.6**	**100**
thereof liquid biofuels	*0.0*	*0.0*	*19.2*	*6*	*21.5*	*6.6*

2.2.12.3 Activity data – Other Mobile Sources and Machinery

In 2014 total energy consumption in the category "Other Mobile Sources and Machinery" was 31.3 PJ.

Table 16: Fuel Allocation Other Mobile Sources and Machinery (UMWELTBUNDESAMT 2016a).

Source category	**Activity 2004**		**Activity 2009**		**Activity 2014**	
	(PJ)	**(%)**	**(PJ)**	**(%)**	**(PJ)**	**(%)**
Military	0.6	3	0.6	2	0.7	2
Railways	1.9	8	2.2	7	1.7	5
Inland Waterways	0.2	1	0.2	1	0.2	1
Agriculture	9.6	41	9.8	31	10.0	32
Forestry	1.2	5	1.1	3	1.1	4
Industry	8.0	34	16.1	51	15.8	51
Household and gardening	1.9	8	1.8	6	1.7	6
Total	**23.3**	**100**	**31.6**	**100**	**31.3**	**100**

2.2.12.4 Emission factors – NFR-code: "Road Transportation, Other Mobile Sources and Machinery"

The emission factors used in the Austrian air emission Inventory are also used for the emission projection. These emission factors are based on a study entitled "Österreichische Emissionsinventur für POPs, Forschungsgesellschaft Techn. Umweltschutz GmbH" financed by the Umweltbundesamt and completed in 2001 (HÜBNER 2001).

2.2.12.5 Emissions of dioxins/ – NFR-code "Road Transportation" and "Other Mobile Sources and Machinery"

Table 17: Emissions of dioxins from "Road Transportation" (HÜBNER 2001).

Source category	**Emissions 2004**		**Emissions 2009**		**Emissions 2014**	
	(g)	**(%)**	**(g)**	**(%)**	**(g)**	**(%)**
Passenger cars	0.477	38	0.763	46	0.708	39
thereof Gasoline conventional	0.365	29	0.165	10	0.131	7
thereof Diesel (incl. biofuels)	0.112	9	0.598	36	0.577	31
Light duty vehicles <3.5 t(r)	0.093	7	0.108	7	0.105	6
Heavy duty vehicles >3.5 t and buses (r)	0.673	54	0.775	47	1.013	55
Mopeds and Motorcycles <50 cm^3	0.001	0	0.001	0	0.001	0
Motorcycles >50 cm^3	0.004	0	0.009	1	0.011	1
Total	**1.248**	**100**	**1.656**	**100**	**1.837**	**100**

Table 18: Emissions of dioxins from "Other Mobile sources and Machinery" (HÜBNER 2001).

Source category	**Emission 2004**		**Emission 2009**		**Emission 2014**	
	(g)	**(%)**	**(g)**	**(%)**	**(g)**	**(%)**
Military	0.000	0	0.000	0	0.000	0
Railways	0.013	6	0.019	6	0.016	5
Inland Waterways	0.006	3	0.005	2	0.005	2
International Sea Traffic	0.006	3	0.004	1	0.005	1
Agriculture	0.062	31	0.086	27	0.091	29
Forestry	0.015	7	0.016	5	0.017	5
Industry	0.049	24	0.133	42	0.135	43
Household and gardening	0.052	26	0.049	16	0.048	15
Total	**0.202**	**100**	**0.314**	**100**	**0.316**	**100**

Remark: the strong increase in emissions in all categories is besides the increased traffic volume due to the higher proportion of biodiesel.

2.2.13 Destruction of animal carcasses

This source category is described in the Stockholm Convention's Technical Guidebook, destruction of animal carcasses (UNEP 2007) as follows:

"Destruction of animal carcasses is generally achieved by incineration, rendering or a combination of these two activities. Incineration techniques may include pyrolysis, gasification or other forms of heat treatment, and may involve burning of complete carcasses or parts of carcasses. Rendering covers a range of activities for processing of carcasses to recover materials."

2.2.13.1 Emission Factors and Emissions

No national emission factors are available. It is assumed that emissions, if any, are negligible due to the low activity figures.

2.2.14 Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)

This source category is described in the Stockholm Convention's Technical Guidebook, textile and leather dyeing (UNEP 2007) as follows:

"Woven and knit fabrics cannot be processed into finished goods until the fabrics have passed through several water-intensive wet processing stages (also known as finishing) such as fabric preparation, dyeing, printing and finishing. Natural fibres typically require more processing steps than artificial fibres. Relatively large volumes of wastewater are generated, containing a wide range of contaminants, which must be treated prior to disposal. Significant quantities of energy are used in heating and cooling chemical baths and drying fabrics and yarns."

2.2.14.1 Emission Factors and Emissions

No national emission factors are available. It is assumed that emissions, if any, are negligible due to the low activity figures.

2.2.15 Shredder plants for the treatment of end of life vehicles

This source category is described in the Stockholm Convention's Technical Guidebook, shredder plants (UNEP 2007) as follows:

"Shredder plants for treatment of end-of-life vehicles are listed in Annex C of the Stockholm Convention as a source that has the potential to form and release chemicals listed in Annex C. Shredders are large-scale machines equipped inside with one or more anvils or breaker bars and lined with alloy steel wear plates. An electric motor drives the rotor with the freeswinging alloy steel hammers. Beneath the shredder is a vibratory pan, which receives the shredded material discharged through the grates. Typically a ferrous metal stream is produced, which is relatively clean and consists of small (50 mm) pieces of steel and a "fluff" stream, which contains the fragments of non-ferrous metals and other materials that entered the shredder (also known as fragmentiser).

Very few data on stack emission measurements at shredder plants are available. However, the results of some studies have shown levels of dioxin compounds greater than 0.1 ng I-TEQ/m^3.

At present there is not sufficient evidence that new formation of polychlorinated dibenzo(p)dioxins (PCDD), polychlorinated dibenzofurans (PCDF) or polychlorinated biphenyls (PCB) occurs in the (mechanical) shredding of vehicles, household electrical equipment or other electrical appliances. The data available indicate that the PCDD/PCDF and PCB released from shredderplants are from industrial, intentional production and have been introduced with oils, dielectric fluids, and other materials contained in these vehicles or consumer goods and which are simply set free through this mechanical process."

2.2.15.1 Emission Factors and Emissions

According to BMLFUW 2015a, six shredder plants and four post-shredder plants are in operation in Austria.

No national emission factors are available for this activity.

2.2.16 Smouldering of copper cables

This source category is described in the Stockholm Convention's Technical Guidebook, smouldering of copper cables (UNEP 2007) as follows:

"Smouldering of copper cables involves the open burning of plastic coatings from electrical cable and wiring to recover scrap copper and other constituents of the cables. This process is labour intensive, and is performed by individuals or in small facilities without any abatement measures for air emissions. Smouldering is conducted in burn barrels or on open ground. No means of temperature control or oxygen addition are used to achieve complete combustion of plastic compounds."

2.2.16.1 Emission Factors and Emissions

This process is not applied in Austria.

2.2.17 Waste oil refineries

This source category is described in the Stockholm Convention's Technical Guidebook, waste oil refineries (UNEP 2007) as follows:

"For the purpose of this guidance section, waste oils (or used oils) are defined as any petroleum-based, synthetic, or plant- or animal-based oil that has been used. Waste oils may originate from two large sources: industrial waste oils, and vegetable and animal waste oils. Among the industrial waste oils, three main oil streams can be identified: industrial oil (e.g. hydraulic oil, engine lubricant, cutting oil); garage or workshop oil; and transformer oil.

Waste oils have been found to be contaminated with PCDD, PCDF and PCB. At present there is no available evidence that PCDD/PCDF or PCB are newly formed in waste oil refineries. The data available indicate that the PCDD/PCDF and PCB released from waste oil refineries or waste oil handling and management plants are from industrial, intentional production of PCB or chlorobenzenes that are present in the waste oils either by contamination in the synthesis process (of these chemicals) or have become contaminated during the use phase or earlier recycling processes. In this sense, waste oil refineries represent a distribution source of chemicals listed in Annex C rather than a formation source.

According to available information, waste oil management options include reuse or regeneration; thermal cracking; and incineration or use as fuel. It should be noted that dumping and open burning are also practised in many countries."

2.2.17.1 Emission Factors and Emissions

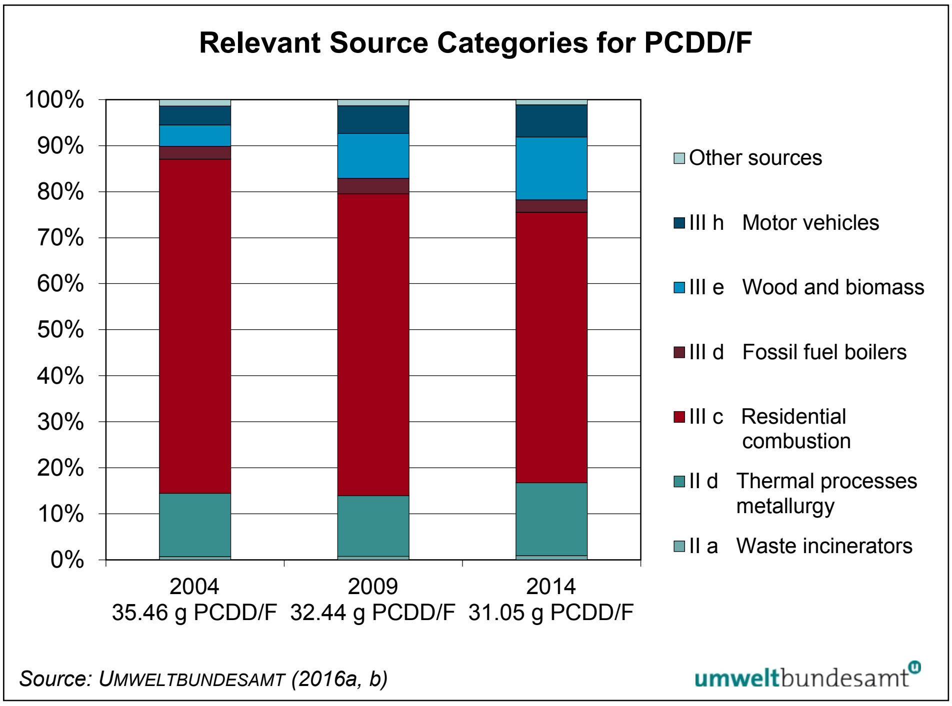
This process is not applied in Austria.

2.2.18 Summary of PCDD/F – Releases to Air from Source Categories of the Stockholm Convention

In the year 2014 a total of 31.05 g PCDD/F (I-TEQ) was emitted in Austria from the source categories according to the Stockholm Convention. In the Austrian Air Emissions Inventory (OLI) PCDD/F emissions into air were calculated to be 31.61 g (I-TEQ, 2009). The difference can be explained by the fact, that the OLI is more comprehensive (i.e. more activities are covered). On the other hand, some emission factors have been updated for this report (see description of source categories).

Only a few source categories contribute significantly to the total emissions of dioxins and furans, the most important being residential combustion sources with a share of 58% and thermal processes in the metallurgical sector with a share of 17%. Other sources are motor vehicles with 7%, biomass combustion (13%) and fossil fuel use in industry (3%) (Table 20, Table 20 and Figure 4).

Figure 4: Relevant source categories for PCDD/F.



Source: UMWELTBUNDESAMT (2016a, b)

Table 19: PCDD/F emissions from Source Categories Part II for 2004, 2009 and 2014 (Umweltbundesamt 2016a, b).

Source Category Part II	**2004 [g I-TEQ]**	**2009 [g I-TEQ]**	**2014 [g I-TEQ]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	0.230	0.229	0.267
Cement kilns firing hazardous waste[1]	0.119	0.131	0.121
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching[2]	IE	IE	IE
The following thermal processes in the metallurgical industry			
(i) Secondary copper production	0.279	0.279	0.279
(ii) Sinter plants in the iron and steel industry	3.106	2.538	3.353
(iii) Secondary aluminium production	1.309	1.282	1.256
(iv) Secondary zinc production	NO	NO	NO
Total (Part II)	**5.043**	**4.459**	**5.275**

[1] *figures represent total emissions from cement kilns*

[2] *only process emissions are covered here; PCDD/F emissions from combustion processes are included in fossil fuel fired utility and industrial boilers and in firing installations for wood and other biomass fuels.*

NO: not occurring

IE: included elsewhere

Table 20: PCDD/F emissions from Source Categories Part III for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part III	**2004 [g I-TEQ]**	**2009 [g I-TEQ]**	**2014 [g I-TEQ]**
Open burning of waste*	0.223	0.132	0.069
Thermal processes in the metallurgical industry not mentioned in Part II	0.204	0.191	0.213
Residential combustion sources	25.748	21.295	18.127
Fossil fuel-fired utility and industrial boilers	0.989	1.079	0.856
Firing installations for wood and other biomass fuels	1.644	3.147	4.192
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA	NA
Crematoria	0.154	0.164	0.164
Motor vehicles, particularly those burning leaded gasoline	1.451	1.972	2.155
Destruction of animal carcasses	NA	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA	NA
Shredder plants for treatment of end of life vehicles	NE	NE	NE
Smouldering of copper cables	NO	NO	NO
Waste oil refineries	NO	NO	NO
Total (Part III)	**30.414**	**27.980**	**25.776**

* *without burning of landfill sites and accidental fires*

NA: not applicable

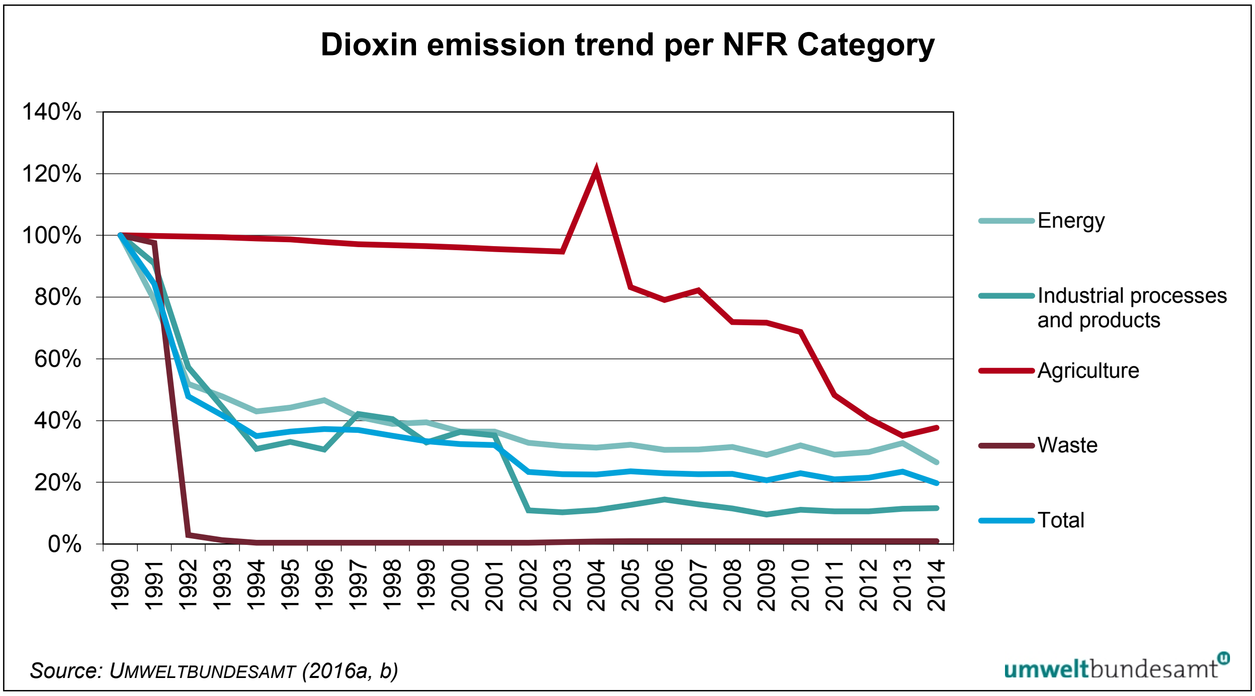
NO: not occurring

NE: not estimated

2.2.19 Austrian Air Emissions Inventory – Polychlorinated dibenzo(p)dioxins (PCDD) and polychlorinated dibenzofurans (PCDF)

In 1990 national total dioxin/furan emissions amounted to about 160 g and in 1995 they amounted to about 60 g; emissions have decreased steadily and by the year 2014 emissions were reduced by about 80% (to 31.6 g in 2014).

In 1990 the main sources for dioxin/furan (as I-TEQ) emissions were the NFR-Sectors Energy (62%; note: the NFR-code Energy includes Energy consumption in industry and energy as well as in the traffic sector) and Industrial Processes and product use (especially iron and steel production) (26%). In 2014 the main sector regarding PCDD/F (as I-TEQ) emissions was Energy with a share of 84% of the National Total.



Source: UMWELTBUNDESAMT (2016a, b)

Figure 5: Dioxin emission trend per NFR Category 1990–2014, base year 1990 = 100%.

2.3 Releases of Hexachlorobenzene (HCB) – Source categories of the Stockholm Convention

2.3.1 Cement kilns

The emissions of HCB from cement kilns were exceptionally high in the year 2014 (107.85 kg HCB) compared to 2004 (0.018 kg HCB) and 2009 (0.020 kg). This is the result of an unintentional release of HCB from one Austrian cement kiln. In order to eliminate large amounts of HCB-contaminated lime sludge from a historic hazardous lime waste site, the lime sludge was used as substitute lime feedstock in a cement kiln. Unintentionally, a part of the contained HCB was not destroyed in the process but emitted to the air instead. The use of the contaminated lime sludge was stopped and prohibited by the competent authority in December 2014 (UMWELTBUNDESAMT 2016c). The total emission of HCB from this cement kiln was estimated by the competent authority (LAND KÄRNTEN 2015) and included in the Austrian Air Emissions Inventory for the respective period.

The HCB emission from the other Austrian cement kilns without the HCB-contaminated feedstock was calculated using emission factors, as for the years 2004 and 2009.

2.3.2 Residential combustion sources

Residential combustion plants are defined in the Stockholm Convention's Technical Guidebook (UNEP 2007) as follows:

"This section considers the combustion of wood, coal and gas, mainly for residential heating and cooking. Combustion takes place in hand-fired stoves or fireplaces or, in the case of larger central heating systems, in automatically fired installations."

Activity data for residential combustion plants can be found within the Austrian National Energy Balance in the NFR-codes (NFR: Nomenclature for Reporting) "Commercial/Institutional" (NFR: 1A4a, SNAP: 0201), "Residential Plants" (NFR: 1A4b1, SNAP: 0202) and "Plants in Agriculture/Forestry" (NFR: 1A4c1, SNAP: 0203). Since these plants are regarded as small scale installations, their emissions are allocated to the source category "Residential combustion sources".

2.3.2.1 Emission factors – NFR-code: "Residential Combustion Sources"

In the next table emission factors of relevant fuels are compiled:

Table 21: HCB emission factors for Residential Plants, Commercial/ Institutional Plants and Plants in Agriculture/ Forestry

EF HCB [µg/GJ]	UMWELTBUNDESAMT (2016b)	UNEP Toolkit (UNEP 2013)
1A4a Commercial/Institutional plants (SNAP 020103)		
102A Lignite 104A Lignite briquettes 107A Coke	180	not available
105A Brown coal	160	not available
106A Brown coal briquettes	190	not available
203B Light fuel oil 203C Medium fuel oil	0.19	not available

EF HCB [µg/GJ]	UMWELTBUNDESAMT (2016b)	UNEP Toolkit (UNEP 2013)
203D Heavy fuel oil	0.12	not available
204A Heating oil 206A Petroleum	0.12	not available
224A Other Oil Products	0.14	not available
301A Natural gas	0.14	not available
303A LPG 310A Landfill gas	0.14	not available
309A Biogas 309B Sewage sludge gas	0.072	not available
111A Wood (IEF 2004) 111A Wood (IEF 2009) 111A Wood (IEF 2014)	193 180 170	not available
115A Industrial waste	250	not available
116A Wood waste (IEF 2004) 116A Wood waste (IEF 2009) 116A Wood waste (IEF 2014)	199 240 240	not available
1A4c i Plants in Agriculture/Forestry/Fishing (SNAP 020302)		
102A Lignite 107A Coke	180	not available
106A Brown coal briquettes	190	
203B Light fuel oil 204A Heating oil	0.15	not available
301A Natural gas	0.25	not available
303A LPG	0.25	not available
111A Wood (IEF 2004) 111A Wood (IEF 2009) 111A Wood (IEF 2014)	475 379 310	not available
116A Wood waste	600	not available
1A4b Residential plants: central and apartment heating (SNAP 020202)		
102A Lignite 104A Lignite briquettes 105A Brown coal 106A Brown coal briquettes 107A Coke	600	not available
203B Light fuel oil 204A Heating oil	0.15	not available
224A Other Oil Products	0.14	not available
301A Natural gas	0.25	not available
303A LPG	0.25	not available
111A Wood: central heating (IEF 2004) 111A Wood: central heating (IEF 2009) 111A Wood: central heating (IEF 2014)	475 379 310	not available
111A Wood: apartment heating	600	not available
116A Wood waste: central heating (IEF 2004) 116A Wood waste: central heating (IEF 2009) 116A Wood waste: central heating (IEF 2014)	475 379 310	not available

EF HCB [µg/GJ]	UMWELTBUNDESAMT (2016b)	UNEP Toolkit (UNEP 2013)
116A Wood waste: apartment heating	600	not available
1A4b Residential plants: stoves (SNAP 020205)		
102A Lignite 104A Lignite briquettes 105A Brown coal 106A Brown coal briquettes 107A Coke	600	not available
204A Heating oil	0.3	not available
301A Natural gas	0.6	not available
111A Wood 113A Peat 116A Wood waste	600	not available

2.3.2.2 Activity data – NFR-code: "Residential Plants"

In 2014 total energy consumption under the NFR-code "Residential Plants" was 140 PJ. Major fuels were wood with a share of 34.7%, followed by natural gas (29.9%), oil (light and extra light heating oil and liquified petroleum gas) (25.5%) and wood waste (8.2%). Other fuels (0.9%) and coal (0.7%) are of minor importance.

Table 22: Fuel mix in the NFR-code „Residential Plants" (UMWELTBUNDESAMT 2016a).

Residential Plants	2004	2009	2014
Coal	3.1%	1.5%	0.7%
Oil	36.1%	30.7%	25.5%
Gas	28.5%	28.9%	29.9%
Wood waste	3.6%	5.3%	8.2%
Wood	27.8%	32.4%	34.7%
Others	0.9%	1.2%	0.9%
Sum	**100%**	**100%**	**100%**
Total Energy Consumption	**180 PJ**	**152 PJ**	**140 PJ**

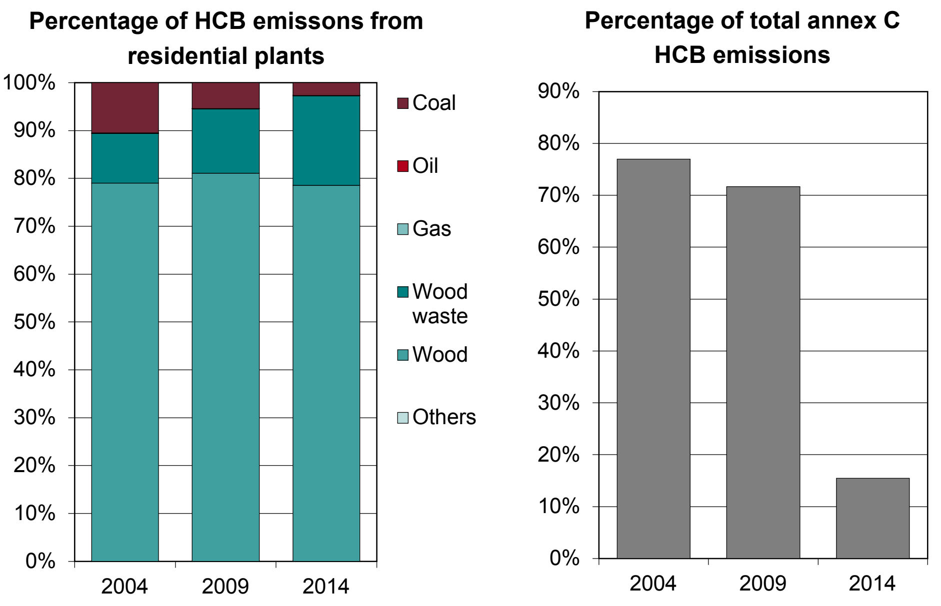
2.3.2.3 Emissions of HCB – NFR-code: "Residential Plants"

Emission factors were taken from the OLI. In the table below emissions of residential plants are listed in relation to the fuel input. The largest part of the emissions stems from the incineration of wood and wood waste. Technology improvement of wood burners and shift to wood pellets (accounted within "wood waste") cause lower emissions in 2014 compared to 2004 and 2009 for total biomass. The incineration of fossil solid fuels (coal, lignite, coke) contributes little to the overall emissions from this source category. However, emissions from fossil solid fuels are expected to decrease even further due to a decline in fuel consumption.

Table 23: Emissions of HCB from residential plants (UMWELTBUNDESAMT 2016b, own calculation)

Residential Plants	**2004 (g HCB)**	**2009 (g HCB)**	**2014 (g HCB)**
Coal	3 295	1 362	580
Oil	10	7.2	5.4
Gas	15	13	12
Wood waste	3 249	3 381	4 070
Wood	24 766	20 442	17 118
Others	3.0	3.1	3.0
Sum	**31 339**	**25 208**	**21 788**

Figure 6: Percentage of HCB emissions from residential plants by fuel and as share of total annex C HCB emissions 2004, 2009 and 2014.



Source: UMWELTBUNDESAMT (2016b)

2.3.2.4 Activity data – NFR-code “Commercial/Institutional” and ”Plants in Agriculture/Forestry“

In the year 2014 the total input within these subcategories was 45 PJ. The major fuels were natural gas and other gases (50%), followed by oil (sum of heating oils and LPG: 21%), wood waste (16%) and wood (8.7%). Others (3.8%), solid fossil fuels (total of coke, coal and lignite: 0.3%) and industrial waste (0.2%) were of minor importance. Activity data in this sector suffer from substantial uncertainties which are the result of a lack of qualified data.

Table 24: Share of fuels within the subcategories “Commercial/Institutional ” and “Stationary” (UMWELTBUNDESAMT 2016a).

Commercial/Institutional + Plants in Agriculture/Forestry	**2004**	**2009**	**2014**
Coal	1.1%	0.4%	0.3%
Oil	26.8%	28.9%	20.9%
Gas	53.7%	48.5%	50.2%
Wood waste	7.4%	11.8%	15.8%

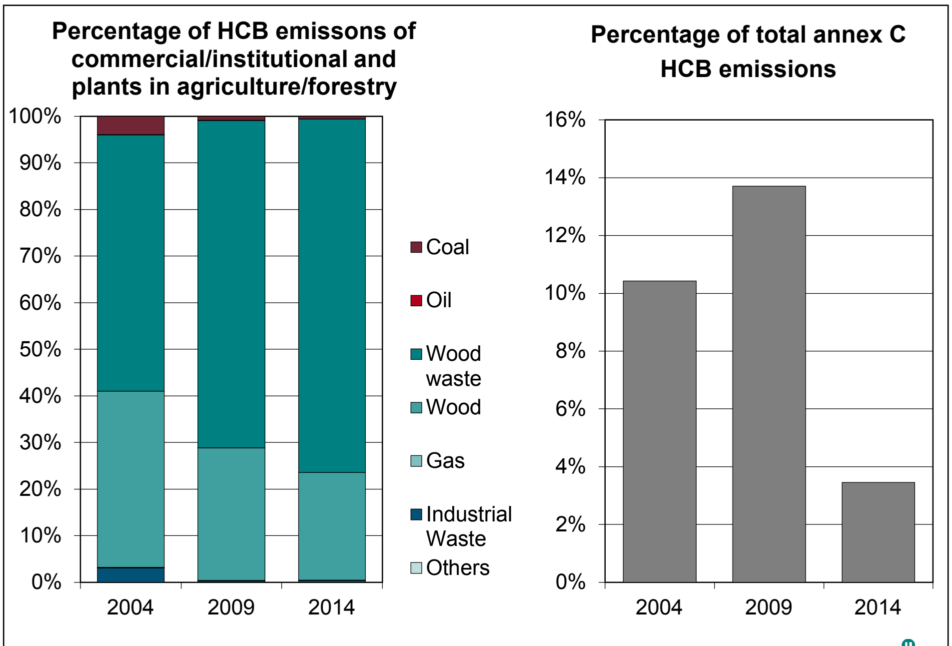
Industrial waste	0.6%	0.1%	0.2%
Wood	4.6%	6.6%	8.7%
Others (biogas, sewage gas, landfill gas)	5.8%	3.7%	3.8%
Sum	**100%**	**100%**	**100%**
Total Energy Consumption	**81 PJ**	**60 PJ**	**45 PJ**

2.3.2.5 Emissions of HCB – NFR-code “Commercial/Institutional” and „Plants in Agriculture/Forestry“

Emission factors were taken from the OLI. Due to the high activity rate of wood waste this type of waste contributes most to the overall emissions.

Table 25: Emissions of HCB caused by different fuel types (UMWELTBUNDESAMT 2016b, own calculation).

Commercial/Institutional + Plants in Agriculture/Forestry	**2004 (g HCB)**	**2009 (g HCB)**	**2014 (g HCB)**
Coal	168	42	27
Oil	2.9	2.2	1.1
Wood waste	2 334	3 387	3 692
Wood	1 604	1 374	1 125
Gas	6.1	4.2	3.2
Industrial waste	131	13	21
Others	0.7	0.3	0.2
Sum	**4 247**	**4 824**	**4 869**



Source: UMWELTBUNDESAMT (2016b)

Figure 7: Percentage of HCB emissions from commercial/institutional and plants in agriculture/forestry by fuel and as share of total annex C HCB emissions 2004, 2009 and 2014.

2.3.3 Motor vehicles, particularly those burning leaded gasoline

2.3.3.1 Activity data – "Road Transportation, Other Mobile Sources and Machinery"

Activity data can be found in chapter 2.2.12.

2.3.3.2 Emission factors– NFR-code: "Road Transportation, Other Mobile Sources and Machinery"

The emission factors used in the Austrian air emission inventory are also used for emission projection. These emission factors are based on the study "Österreichische Emissionsinventur für POPs, Forschungsgesellschaft Techn. Umweltschutz GmbH" (HÜBNER 2001).

2.3.3.3 Emissions HCB – NFR-code "Road Transportation" and "Other Mobile Sources and Machinery"

Table 26: Emissions of HCB from road transport (HÜBNER 2001).

Source category	**Emissions 2004**		**Emissions 2009**		**Emissions 2014**	
	(g)	**(%)**	**(g)**	**(%)**	**(g)**	**(%)**
Passenger cars	95.33	38	152.66	46	141.65	39
thereof Gasoline conventional	72.99	29	33.09	10	26.19	7
thereof Diesel (incl. biofuels)	22.34	9	119.57	36	115.46	31
Light duty vehicles <3.5 t(r)	18.57	7	21.58	7	20.91	6
Heavy duty vehicles >3.5 t and buses (r)	134.70	54	155.00	47	202.52	55
Mopeds and Motorcycles <50 cm^3	0.15	0	0.16	0	0.15	0
Motorcycles >50 cm^3	0.85	0	1.89	1	2.20	1
Total	**249.59**	**100**	**331.29**	**100**	**367.43**	**100**

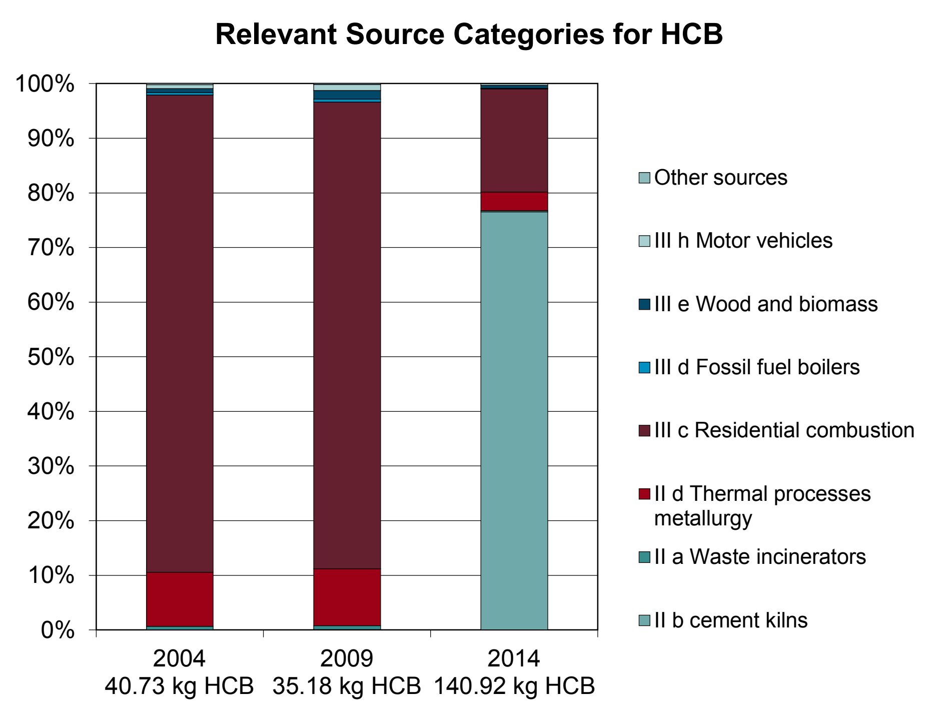
Table 27: Emissions of HCB from other mobile sources and machinery (HÜBNER 2001)

Source category	**Emission 2004**		**Emission 2009**		**Emission 2014**	
	(g)	**(%)**	**(g)**	**(%)**	**(g)**	**(%)**
Military	0.03	0	0.04	0	0.04	0
Railways	2.53	6	3.90	6	3.17	5
Inland Waterways	1.15	3	1.03	2	0.98	2
International Sea Traffic	1.22	3	0.88	1	0.95	1
Agriculture	12.41	31	17.24	27	18.12	29
Forestry	2.94	7	3.26	5	3.34	5
Industry	9.70	24	26.58	42	26.95	43
Household and gardening	10.44	26	9.80	16	9.68	15
Total	**40.42**	**100**	**62.74**	**100**	**63.23**	**100**

Remark: the strong increase in emissions in all categories is besides the increased traffic volume due to the higher proportion of biodiesel.

2.3.4 Summary of Source Categories of the Stockholm Convention: HCB – Releases to Air

In Austria only a few source categories contribute significantly to the total emissions of HCB. In the year 2014, 140.92 kg were emitted in total. Cement kilns sources had the lion’s share (76.5%) while residential combustion sources accounted for 19%. Thermal processes in the metallurgical industries emitted 3.4% of the total emissions. All other sources are well below 1%. The situation is totally different than in the years 2004 and 2009 when the lion’s share of HCB came from residential combustion sources. The increase in 2014 is due to an unintentional release of HCB in an Austrian cement plant.



Source: UMWELTBUNDESAMT (2016a, b)

Figure 8: Relevant source categories for HCB.

Table 28: HCB emissions in Source Category Part II for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part II	**2004 [kg HCB]**	**2009 [kg HCB]**	**2014 [kg HCB]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	0.253	0.262	0.301
Cement kilns firing hazardous waste[1]	0.018	0.020	107.851
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching[2]	IE	IE	IE
The following thermal processes in the metallurgical industry			
(i) Secondary copper production	0.091	0.091	0.091
(ii) Sinter plants in the iron and steel industry	3.261	2.926	4.031
(iii) Secondary aluminium production	0.654	0.641	0.628
(iv) Secondary zinc production	NO	NO	NO
Total (Part II)	**4.277**	**3.939**	**112.902**

[1] *figures represent total emissions from cement kilns*

[2] *only process emissions are covered here; HCB emissions from combustion processes are included in fossil fuel fired utility and industrial boilers and in firing installations for wood and other biomass fuels.*

NO: not occurring

IE: included elsewhere.

Table 29: HCB emissions in Source Category Part III for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part III	**2004 [kg HCB]**	**2009 [kg HCB]**	**2014 [kg HCB]**
Open burning of waste*	0.045	0.026	0.014
Thermal processes in the metallurgical industry not mentioned in Part II	0.016	0.014	0.017
Residential combustion sources	35.586	30.032	26.657
Fossil fuel-fired utility and industrial boilers	0.197	0.195	0.152
Firing installations for wood and other biomass fuels	0.287	0.543	0.715
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA	NA
Crematoria	0.031	0.033	0.033
Motor vehicles, particularly those burning leaded gasoline	0.290	0.394	0.431
Destruction of animal carcasses	NA	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA	NA
Shredder plants for treatment of end of life vehicles	NE	NE	NE
Smouldering of copper cables	NO	NO	NO
Waste oil refineries	NO	NO	NO
Total (Part III)	**36.451**	**31.238**	**28.019**

** without burning of landfill sites and accidental fires*

NA: not applicable

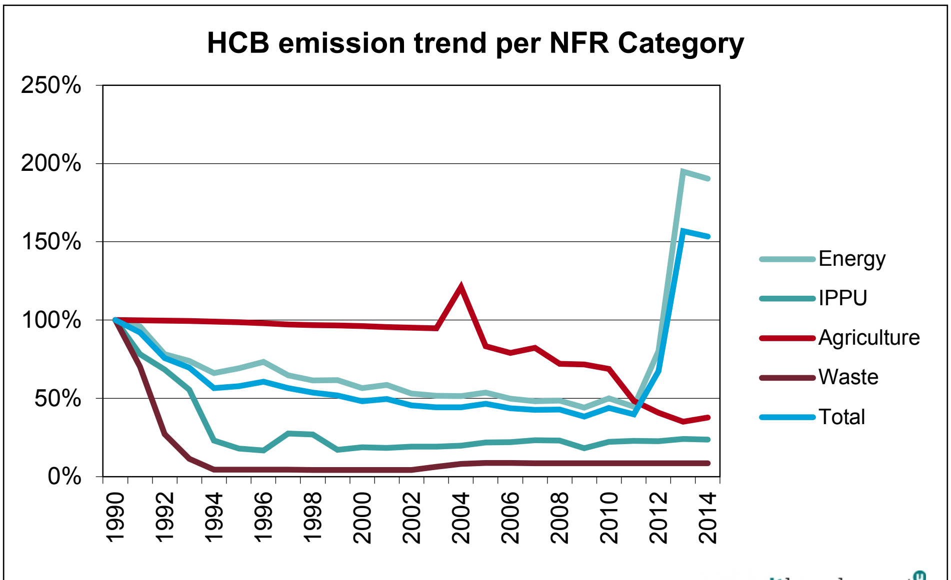
NE: not estimated

NO: not occurring

2.3.5 Austrian Air Emissions Inventory – Hexachlorobenzene (HCB)

In 1990 national total HCB emissions amounted to 92 kg. They decreased to 53 kg in 1995. Emissions have decreased steadily and by the year 2011 emissions were reduced by about 60% (to 36.5 kg in 2011). In the years 2012, 2013 and 2014 HCB emissions strongly increased to 141 kg due to an unintentionally release in an Austrian cement plant. The increase was caused by the input of HCB containing waste and the incomplete destruction of HCB.

In 1990 the two main sources for HCB emissions were the NFR-sectors Energy (78%; note: the NFR-code *Energy* includes Energy consumption in industry and energy as well as in the traffic sector) and Industrial processes and product use (20%). In 2014 the main NFR-sector for HCB emissions was Energy with a share of 96% of the National Total.



Source: UMWELTBUNDESAMT (2016a, b)

Figure 9: HCB emission trend per NFR Category 1990–2014 (base year 1990 = 100%).

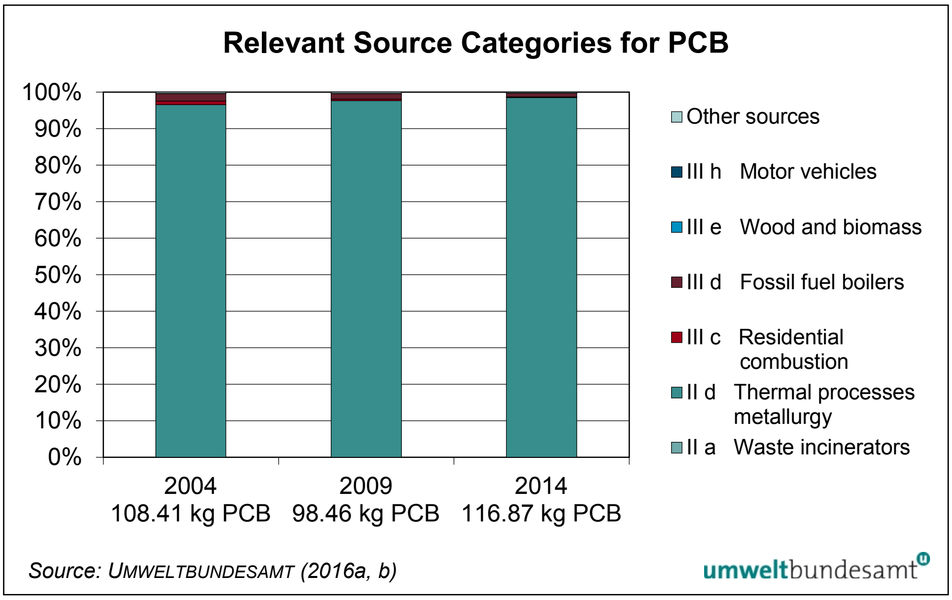
Cement plants are included in NFR-sector Energy. The emissions of HCB were exceptionally high in the year 2014. This is the result of an unintentional release of HCB from one Austrian cement kiln. The increase was caused by the input of HCB containing waste and the incomplete destruction of HCB.

2.4 Releases of polychlorinated biphenyls (PCB) – Source categories of the Stockholm Convention

2.4.1 Summary of Source Categories of the Stockholm Convention: PCB – Releases to Air

In Austria only a few source categories contribute significantly to the total emissions of PCB. In the year 2014, 116.87 kg were emitted in total (Table 31, Table 31 and Figure 10). Thermal processes in the metallurgical industry had the lion's share (99%). All other sources were well below 1%.

Figure 10: Relevant source categories for PCB.



Source: UMWELTBUNDESAMT (2016a, b)

Table 30: PCB emissions from Source Categories Part II for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part II	**2004 [g PCB]**	**2009 [g PCB]**	**2014 [g PCB]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	0.065	0.068	0.053
Cement kilns firing hazardous waste[1]	331.949	353.098	323.780
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching[2]	IE	IE	IE
The following thermal processes in the metallurgical industry			
(i) Secondary copper production	NA	NA	NA
(ii) Sinter plants in the iron and steel industry	26,903.600	23,633.234	33,000.000
(iii) Secondary aluminium production	NA	NA	NA
(iv) Secondary zinc production	NO	NO	NO
Total (Part II)	**27,235.614**	**23,986.401**	**33,323.833**

[1] *figures represent total emissions from cement kilns*

[2] *only process emissions are covered here; PCB emissions from combustion processes are included in fossil fuel fired utility and industrial boilers and in firing installations for wood and other biomass fuels.*

NA: not applicable

NO: not occurring

IE: included elsewhere

Table 31: PCB emissions from Source Categories Part III for 2004, 2009 and 2014 (Umweltbundesamt 2016a, b).

Source Category Part III	**2004 [g PCB]**	**2009 [g PCB]**	**2014 [g PCB]**
Open burning of waste*	NA	NA	NA
Thermal processes in the metallurgical industry not mentioned in Part II	77,779.105	72,499.525	82,162.70
Residential combustion sources	1,091.570	426.201	190.817
Fossil fuel-fired utility and industrial boilers	2,298.303	1,547.341	1,196.029
Firing installations for wood and other biomass fuels	0.128	0.261	0.351
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA	NA
Crematoria	NA	NA	NA
Motor vehicles, particularly those burning leaded gasoline	0.924	0.841	0.508
Destruction of animal carcasses	NA	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA	NA
Shredder plants for treatment of end of life vehicles	NE	NE	NE
Smouldering of copper cables	NO	NO	NO
Waste oil refineries	NO	NO	NO
Total (Part III)	**81,170.031**	**74,474.169**	**83,550.405**

**without burning of landfills sites and accidential fires*

NA: not applicable

NO: not occurring

NE: not estimated

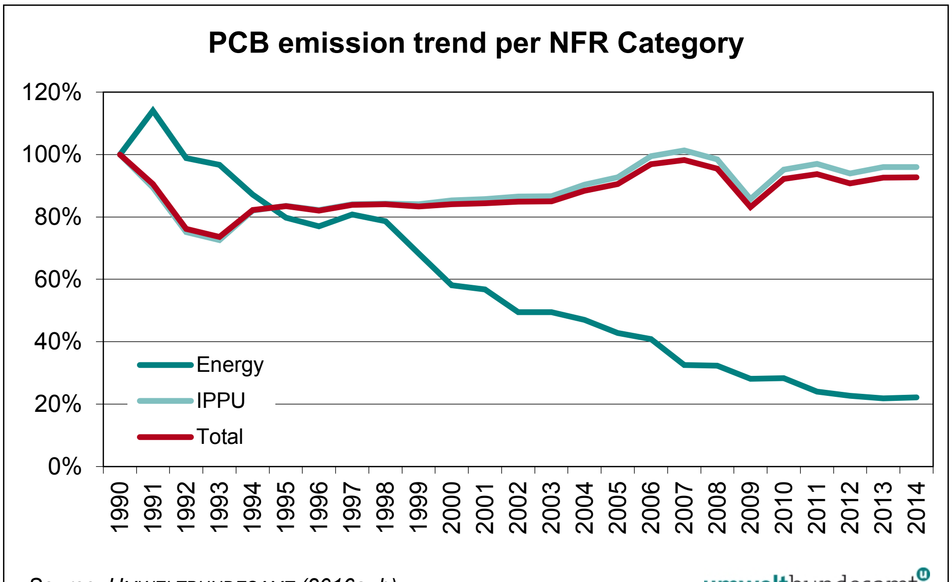
2.4.2 Austrian Air Emissions Inventory – PCB

In 1990 national total PCB emissions amounted to 194 kg. They decreased to 143 kg in 1993. Between 1994 and 2003 emissions of PCB were around 160 kg. Emissions then increased steadily and by the year 2014 PCB emissions amounted to 180 kg (decrease of 7% compared to 1990; increase of 11% compared to 1995).

In 1990 the two sources for PCB emissions were the NFR-sectors Industrial processes and product use (IPPU) (95%) and Energy (5%; note: the NFR-code *Energy* includes Energy consumption in industry and energy as well as in the traffic sector) and. In 2014 the main NFR-sector for PCB emissions was Industrial processes and product use with a share of 99% of the National Total.

The inventory of emissions in the Austrian OLI is based on activity data which is multiplied with an activity specific emission factor. This factor (for PCB) has not changed in the considered years. As activity data (production data) has increased, also the calculated emissions of PCB increased. A review of the emission factors for PCB in the different source categories is necessary.

Figure 11: PCB emission trend per NFR Category 1990–2014 (base year 1990 = 100%). (UMWELTBUNDESAMT 2016 a, b). Due to the economic crisis activity data and therefore emissions decreased significantly in 2009.



Source: UMWELTBUNDESAMT (2016a, b)

2.5 Releases of polycyclic aromatic hydrocarbons (PAH) – Source categories of the Stockholm Convention

2.5.1 Residential combustion sources

Emission factors of the Austrian Air Emissions Inventory have been used for calculating emissions of residential combustion sources. They have been checked and considered appropriate by now.

However, recent study results indicate that these emission factors could be unrealistically low (UMWELTBUNDESAMT 2016e, 2017a). Air quality monitoring results strongly deviate from the dispersion model results of PAH concentrations (OETTL et al. 2017), which were based on emission data calculated with Austrian Emissions Inventory emission factors. On the other hand, recommended Tier 2 standard emission factors of the EMEP/EEA air pollutant emission inventory guidebook 2013 led to considerable higher concentrations than the air quality monitoring results. Good matching results were achieved by technology-specific weighting of EMEP/EEA Tier 2 emission factors with heating technology share of the Austrian Air Emissions Inventory.

In-depth literature survey on PAH emission factors in combination with the devolopment of an advanced modelling approach targeting residential combustion emissions are ongoing and foreseen to be concluded by the end of 2017 both (UMWELTBUNDESAMT 2017b).

2.5.2 Motor vehicles, particularly those burning leaded gasoline

Emission factors used by the Austrian Air Emissions Inventory for calculating emissions have been checked and considered appropriate.

2.5.2.1 Activity data – "Road Transportation, Other Mobile Sources and Machinery"

Activity data can be found in chapter 2.2.12.2 and 2.2.12.3

2.5.2.2 Emission factors– NFR-code: "Road Transportation, Other Mobile Sources and Machinery"

The emission factors used in the Austrian air emission inventory are also used for emission projection. These emission factors are based on the EMEP/EEA air pollutant emission inventory Guidebook (2013).

2.5.2.3 Emissions PAH – NFR-code "Road Transportation" and "Other Mobile Sources and Machinery"

Table 32: Emissions of PAH from Road Transport (EMEP/EEA 2013)

Source category	Emissions 2004		Emissions 2009		Emissions 2014	
	(g)	(%)	(g)	(%)	(g)	(%)
Passenger cars	195.19	52	162.29	51	136.55	42
thereof Gasoline conventional	46.73	12	40.70	13	37.62	11
thereof Diesel (incl. biofuels)	148.46	40	121.59	38	98.93	30
non exhaust	7.16	2	6.93	2	7.41	2
Light duty vehicles <3.5 t(r)	27.52	7	20.95	7	17.48	5
Heavy duty vehicles >3.5 t and buses (r)	143.77	38	124.99	39	164.92	50
Mopeds and Motorcycles <50 cm^3	0.69	0	0.63	0	0.52	0
Motorcycles >50 cm^3	1.41	0	1.66	1	1.98	1
Total	**375.74**	**100**	**317.45**	**100**	**328.85**	**100**

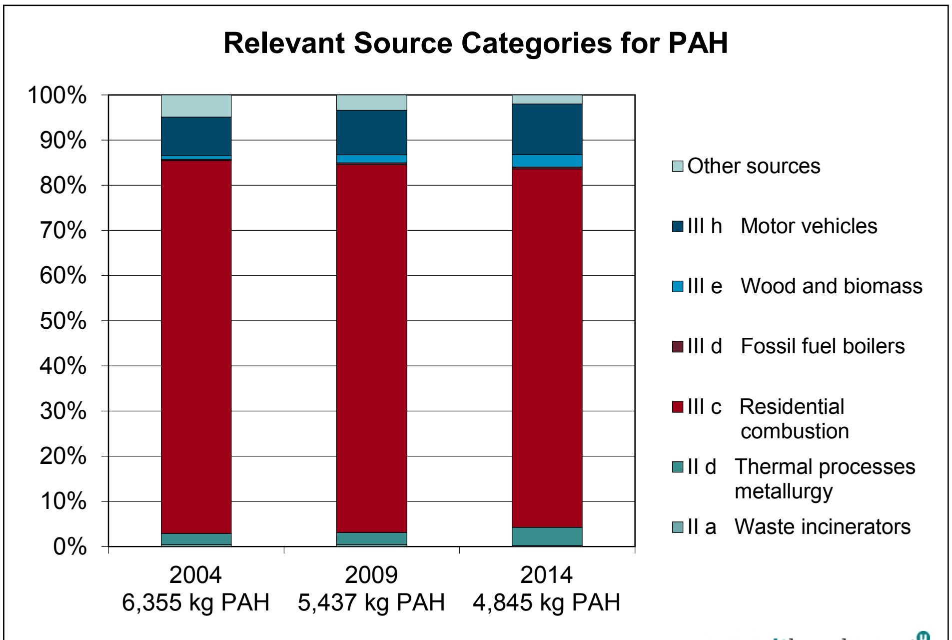
Table 33: Emissions of PAH from Other Mobile Sources and Machinery (EMEP/EEA 2013)

Source category	Emission 2004		Emission 2009		Emission 2014	
	(g)	(%)	(g)	(%)	(g)	(%)
Military	0.17	0	0.17	0	0.17	0
Railways	12.55	7	14.11	6	11.15	5
Inland Waterways	1.21	1	0.90	0	0.90	0
International Sea Traffic	7.07	4	5.14	2	5.50	3
Agriculture	61.31	36	61.64	28	63.29	29
Forestry	10.41	6	9.67	4	9.79	5
Industry	52.67	31	103.50	47	101.80	47
Household and gardening	27.07	16	23.91	11	23.56	11
Total	**172.48**	**100**	**219.04**	**100**	**216.17**	**100**

2.5.3 Summary of Source Categories of the Stockholm Convention: PAHs – Releases to Air

In the year 2014, 4,845 kg PAH were emitted in Austria. PAH emissions are mainly caused by two source categories (Table 35 and Figure 12). Residential combustion sources accounted for 79% and mobile vehicles for 11%. Other notable sources were firing installations for wood and biomass (2.7%) and sinter plants (4%).

Figure 12: Relevant source categories for PAH.



Source: UMWELTBUNDESAMT (2016a, b)

Table 34: PAH emissions in Source Category Part II for 2004, 2009 and 2014 (UMWELTBUNDESAMT 2016a, b).

Source Category Part II	**2004 [kg PAH]**	**2009 [kg PAH]**	**2014 [kg PAH]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	24.066	24.095	9.443
Cement kilns firing hazardous waste[1]	3.332	3.663	3.385
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching[2]	IE	IE	IE
The following thermal processes in the metallurgical industry			
(i) Secondary copper production	NE	NE	NE
(ii) Sinter plants in the iron and steel industry	156.484	140.891	193.647
(iii) Secondary aluminium production	NE	NE	NE
(iv) Secondary zinc production	NO	NO	NO
Total (Part II)	**183.872**	**168.649**	**206.476**

[1] *figures represent total emissions from cement kilns*

[2] *only process emissions are covered here; PAH emissions from combustion processes are included in fossil fuel fired utility and industrial boilers and in firing installations for wood and other biomass fuels.*

NO: not occurring; NE: not estimated; IE: included elsewhere.

Table 35: PAH emissions in Source Category Part III for 2004, 2009 and 2014 (Umweltbundesamt 2016a, b).

Source Category Part III	**2004 [kg PAH]**	**2009 [kg PAH]**	**2014 [kg PAH]**
Open burning of waste*	305.551	178.625	90.885
Thermal processes in the metallurgical industry not mentioned in Part II	2.909	2.763	3.250
Residential combustion sources	5,250.076	4428.292	3,846.067
Fossil fuel-fired utility and industrial boilers	16.925	25.973	20.121
Firing installations for wood and other biomass fuels	46.961	96.496	133.194
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA	NA
Crematoria	0.007	0.008	0.008
Motor vehicles, particularly those burning leaded gasoline	548.220	536.494	545.0025
Destruction of animal carcasses	NA	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA	NA
Shredder plants for treatment of end of life vehicles	NE	NE	NE
Smouldering of copper cables	NO	NO	NO
Waste oil refineries	NO	NO	NO
Total (Part III)	**6,170.651**	**5,268.651**	**4,638.550**

NA: not applicable

NE: not estimated

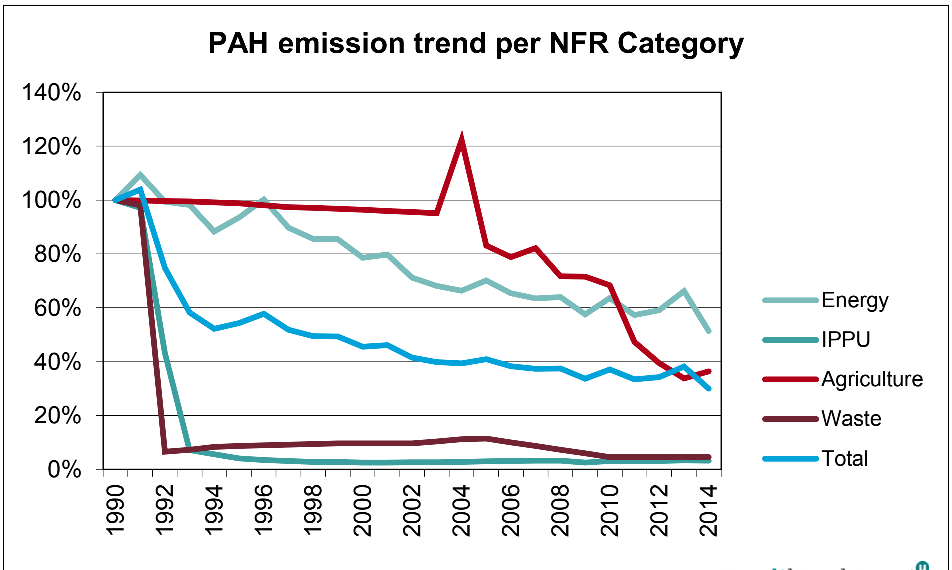
NO: not occurring

2.5.4 Austrian Air Emissions Inventory – Polycyclic Aromatic Hydrocarbons (PAH)

In 1990 national total PAH emissions were 16.27 Mg; they decreased to 8.50 Mg in 1994; emissions have decreased steadily since then and by the year 2014 emissions have gone down by about 70% (to 4.89 Mg in 2014).

In 1990 the main emission sources for PAH emissions were the NFR-sectors Energy (55%; note: the NFR-code *Energy* includes Energy consumption in industry and energy as well as in the traffic sector) and Industrial processes and product use (44%). In 2009 the main NFR-sector regarding PAH emissions was *Energy* with a share of 93% of the national total. From 1990 to 2014 PAH emissions from the sector Industrial processes decreased by 97% due to the shut down of primary aluminium production plants in Austria, a main source for PAH emissions.

Figure 13: PAH emission trend per NFR Category 1990–2004 (base year 1990 = 100%).



Source: UMWELTBUNDESAMT (2016a, b)

2.6 Releases of Pentachlorobenzene (PeCB) – Source categories of the Stockholm Convention

The most relevant source of PeCB emitted to the environment is caused by unintentional production due to different processes (i.e. municipal solid waste incineration, hazardous waste incineration, power production from coal, domestic burning and waste water treatment which leads to the generation of sewage sludge containing PeCB). Table 36 shows which sectors are considered relevant for the emissions of PeCB and which are considered of low relevance due to the low amounts (BIPRO 2011).

Table 36: Overview on sectors and their relevance for PeCB emissions (BIPRO 2011).

Sector	Considered relevant	Not considered relevant
Municipal solid waste incineration (MSWI) including incineration of biomass	x	
Hazardous waste incineration (HWI)	x	
Power production (coal) including power production in iron and steel industry	x	
Domestic burning	x	
Sewage sludge (waste water treatment)	x	
Chemical industry		x
Non-ferrous metal industry (aluminium, secondary copper, magnesium)		x

2.6.1 Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge

Municipal waste

Since PeCB is not commercially used anymore within Europe it can be assumed that municipal solid waste (MSW) is not contaminated with PeCB. But due to the heterogeneous composition of municipal solid waste PeCB can be formed unintentionally when municipal solid waste is burned since PeCB is produced whenever organic compounds are burned or exposed to high energy in the presence of a chlorine source (BIPRO 2011).

There exist only few data on PeCB concentrations in the flue gas of municipal waste incineration facilities. Kato and Urano found, that under normal operating conditions PeCB correlated with PCDD/F within a factor of 3 (KATO & URANO 2001). Both authors derived from emission data on 24 municipal solid waste incinerators in Japan an emission factor for PeCB of 7 mg/t. However, other studies found other factors significantly influencing concentration levels in the flue gas such as combustion conditions and fuel composition. Investigations performed between 1983 and 2001 resulted in emission factors in the range of 3–273 mg/t incinerated waste.

REIMANN et al. (2006) measured a value of 750 ng/m^3 PeCB in the flue gas of a municipal waste incineration plant. This value would correspond to an emission factor of 4 mg/t of incinerated waste.

Given the available data it is suggested that, for the purpose of this emission inventory, an emission factor of **4 mg/t of waste** should be used, independent of the source (i.e. household or industrial waste). This emission factor should also be used for sewage sludge.

In 2014, about 1.341 million t municipal waste (mixed municipal waste, bulky waste) were incinerated in municipal waste incineration plants (BMLFUW 2015a).

Hazardous waste

For hazardous waste it has been reported that an average of 7 mg PeCB is found in flue gas per tonne HW incinerated (KAUNE et al. 1994).

In 2014, about 1.324 million t of hazardous waste were treated (BMLFUW 2015a), 0.227 million t were incinerated in 2014 (assumption Umweltbundesamt 2016).

Sewage sludge

In 2014 an amount of 0.239 million t of sewage sludge was produced in Austria (assumption Umweltbundesamt 2016). 1% of the sewage sludge was landfilled, 49% incinerated, 17% applied on land, 19% treated in another way and 33% stored (BMLFUW 2015a).

Emission into air caused by the incineration of sewage sludge is calculated by using the emission factor for municipal solid waste (4 mg/t of sewage sludge).

Table 37: PeCB emissions into air from the source category waste incineration (Statistik Austria 2015, own calculation, Umweltbundesamt 2016).

	PeCB Emissions [kg] 2009	**PeCB Emissions [kg] 2014**
Municipal Solid Waste	4.69	5.36
Hazardous Waste	1.12	1.59
Sewage Sludge	0.4	0.47
Total	**6.21**	**7.42**

2.6.2 Thermal processes in the metallurgical industry (secondary copper production; sinter plants in the iron steel industry; secondary aluminum production; secondary zinc production)

In iron and steel industries an amount of 1.77 million t of coal was used in 2014 (Statistik Austria 2015).

In the case of coal combustion, the emission factor available in the literature is 2.5 mg/t of coal (Hogendoorn et al 2009).

Table 38: PeCB emissions from the source category thermal processes in the metallurgical industry (Statistik Austria 2015, own calculation).

	Million t coal incinerated	**PeCB emissions [kg]**
2009	1.69	4.2
2014	1,77	4.4

2.6.3 Residential combustion sources

Domestic burning of wood, fossil fuels and mixed wastes is private burning in single stoves or open burning places. Domestic burning is associated with higher levels of air emissions as no flue gas treatment is performed. In addition, process conditions can vary strongly due to specific oven characteristics and the properties of the used fuel. As a consequence, measured contamination and emission data as well as derived emission factors, are highly inhomogeneous within a wide range of possible results. In general it can be assumed that the emissions exceed the discharge via residues by far and that burning of treated wood or co-combustion of waste significantly increases formation and discharge of PeCB (Bipro 2011).

Information about emissions of PeCB from residential combustion is scarce as well. For domestic burning of wood, an emission factor of 1.2 mg/t of wood burned is used (Zimmermann et al.2001).

Residential combustion of coal is not considered relevant in Austria since the amounts are low.

	Incinerated biomass [million t]	PeCB emissions [kg]
2009	4.6	5.5
2014	5.0	6.0

Table 39: PeCB emissions from the source category residential combustion (STATISTIK AUSTRIA 2015, own calculation).

2.6.4 Fossil fuel-fired utility and industrial boilers

In 2014 about 0.95 million t of coal were incinerated in coal fired power plants (STATISTIK AUSTRIA 2015).

In the case of coal combustion, the emission factor which can be found in the literature is 2.5 mg/t of coal (HOGENDOORN et al. 2009).

	Million t coal incinerated	PeCB emissions [kg]
2009	1.2	3.0
2014	0.95	2.4

Table 40: PeCB emissions from the source category fossil fuel-fired utility and industrial boilers (STATISTIK AUSTRIA 2015, own calculation)

2.6.5 Firing installations for wood and other biomass

For biomass incineration, emission data are scarce as well. Zimmermann et al. reported a value of 87 ng/nm^3 (ZIMMERMANN et al. 2001) corresponding to an emission factor of 54 mg/TJ. However, this emission value was obtained under controlled incineration processes in a 1 MW combustion plant to study emission profiles of products of incomplete combustion with shredded waste wood contaminated with plastics and paints as feed materials. Thus this value might not be representative for the incineration of biomass in general.

Table 41: PeCB emissions from the source category firing installations for wood and other biomass (STATISTIK AUSTRIA 2015, own calculation)

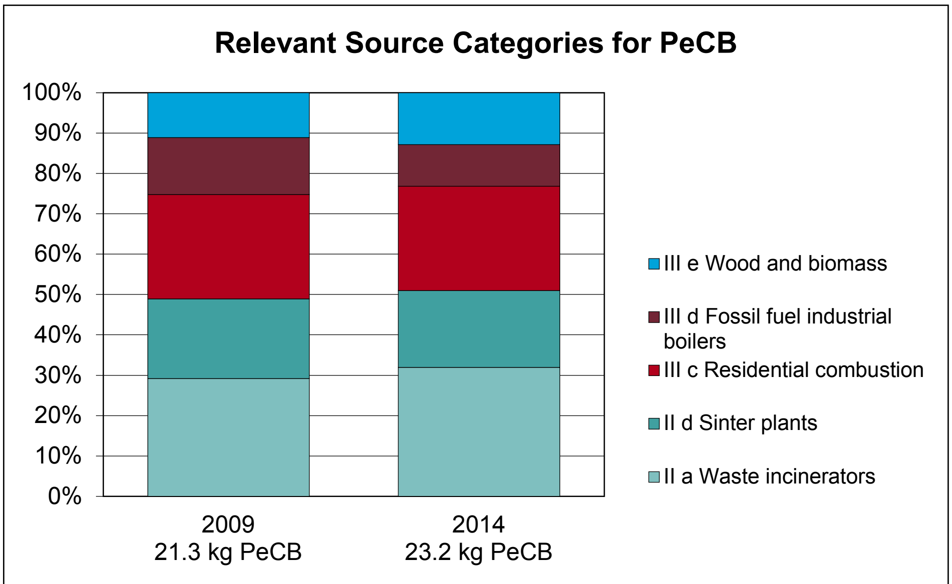
	Incinerated wood [TJ]	PeCB emissions [kg]
2009	43,857	2.37
2014	55,225	2.98

2.6.6 Summary of PeCB – Releases to Air from Source Categories of the Stockholm Convention

In the year 2014, a total of 23.2 kg of PeCB were emitted in Austria from the source categories according to the Stockholm Convention.

PeCB emissions are not available from the Austrian inventory but have been calculated using default emission factors from the literature and the given activity data. Therefore, there are some uncertainties in the calculated PeCB emissions.

Figure 14: Relevant source categories for PeCB for 2009 and 2014 (STATISTIK AUSTRIA 2015, BMLFUW 2015a; own calculation)



Source: STATISTIK AUSTRIA (2015), BMLFUW (2015a); own calculation

Table 42: PeCB emissions from Source Category Part II for 2009 and 2014 (Statistik Austria 2015, BMLFUW 2015a; own calculation).

Source Category Part II	**2009 [kg PeCB]**	**2014 [kg PeCB]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	6.21	7.42
Cement kilns firing hazardous waste	NA	NA
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching	NA	NA
The following thermal processes in the metallurgical industry		
(i) Secondary copper production	NA	NA
(ii) Sinter plants in the iron and steel industry	4.2	4.4
(iii) Secondary aluminium production	NA	NA
(iv) Secondary zinc production	NO	NO
Total (Part II)	**10.41**	**11.82**

NO: not occurring

NA: not applicable.

Table 43: PeCB emissions in Source Category Part III for 2009 and 2014 (Statistik Austria 2015, BMLFUW 2015a, own calculation).

Source Category Part III	**2009 [kg PeCB]**	**2014 [kg PeCB]**
Open burning of waste, including burning of landfill sites	NA	NA
Thermal processes in the metallurgical industry not mentioned in Part II	NA	NA
Residential combustion sources	5.5	6.0
Fossil fuel-fired utility and industrial boilers	3.00	2.4
Firing installations for wood and other biomass fuels	2.37	2.98
Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil	NA	NA
Crematoria	NA	NA
Motor vehicles, particularly those burning leaded gasoline	NA	NA
Destruction of animal carcasses	NA	NA
Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)	NA	NA
Shredder plants for treatment of end of life vehicles	NA	NA
Smouldering of copper cables	NO	NO
Waste oil refineries	NO	NO
Total (Part III)	**10.87**	**11.38**

NA: not applicable.

NO: not occurring

2.7 Releases of polychlorinated Napthalenes (PCN) – Source categories of the Stockholm Convention

Due to the limited availability of qualified data, releases of PCN have not been calculated.

3 SOURCE INVENTORY OF POPS RELEASES INTO WATER

Data on sources for POPs releases into water are held in two registers in Austria:

In principle, point sources and emissions to water for all POPs are included in the European Pollutant Release and Transfer Register – PRTR[11]. In practice, a reporting obligation to PRTR exists (for most industrial sectors) only for facilities exceeding a certain production capacity threshold and for emissions which exceed a pollutant release threshold. For Austria, with its mainly small and medium-sized enterprises and thus lower production capacity thresholds, approx 70 facilities with emissions to water or waste water are listed in the PRTR. None of these facilities have reported emissions to water for the pollutants hexachlorobenzene, pentachlorobenzene and polychlorinated biphenyls. One PRTR-facility reported PCDD/PCDF emissions to water for the years 2010 to 2013. One additional PRTR facility reported PCDD/PCDF emission to water for the year 2013. For PAH only one PRTR facility reported emissions to water for the year 2013. So far, no data on diffuse sources of POPs have been entered in the PRTR.

Additional information on POP releases was gathered as part of a project undertaken to set up the national emissions inventory in 2007/2008[12]. Some 70 substances were analysed at the inlet and outlet of 15 urban waste water treatment plants with different capacity, purification technology and waste water composition. The analytical programme comprised the priority substances and certain other substances listed in the daughter Directive 2008/105/EC[13] of the Water Framework Directive [14] and pollutants of national relevance regulated in the Austrian Ordinance on Quality Standards for Surface Waters[15]. DDT, chlordane, aldrin, dieldrin, endrin, heptachlor, hexachlorobenzene and pentachlorobenzene could not be detected in untreated waste water. With the exception of one facility, PAHs were only detectable in untreated waste water. Only polybrominated diphenylethers were detected in effluents in the sub-ng/l range and hexachlorocyclohexane (lindane) in the ng/l range. The use of lindane has been allowed for some selected minor applications until 1. January 2008.

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[11] 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://prtr.ec.europa.eu/.

[12] Qualitätszielverordnung ChemieOberflächengewässer:Emissionen aus kommunalen Kläranlagen, Endbericht, UMWELTBUNDESAMT 2009.

[13] Directive 2008/105/EC of the European Parliament and of the Councilof 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 andamending Directive 2000/60/EC of the European Parliament and of the Council.

[14] 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.

[15] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt undWasserwirtschaft über die Festlegung des Zielzustandes für Oberflächengewässer (Qualitätszielverordnung Chemie Oberflächengewässer – QZV Chemie OG), BGBl. II Nr. 96/2006 i.d.F. BGBl. II Nr. 461/2010.

In 2009 a national inventory on pollutant emissions to surface waters was established[16]. This national register comprises the emissions of the following point sources: PRTR-facilities, urban waste water treatment plants with a capacity from 2.000 population equivalents upwards, food processing facilities according to annex III of the UWWTD (91/271/EEC) and waste incineration facilities with a capacity of more than 2 tonnes of waste per hour. Priority substances are attributed to industrial activities. There is no release threshold for reporting. The lower release limit is determined by the limit of quantification of the specified analytical method and the waste water discharge. The first reporting cycle (for the data for 2009) covered only basic waste water parameters. Since 2010 discharges have been reported for a number of substances including POPs. The emissions are reported as annual load data.

3.1 Other sources: Contaminated Sites & Persistent Organic Pollutants

The most important problem regarding POPs and especially HCB stems from a contaminated site resulting from the production of chloroalkanes. The production was shut down in 1992. A nearby river has ben affected by the contaminated site via groundwater exchange.

Mitigation measures to reduce the spreading of contaminants are under way since 1995. By 2014, the remediation of a historical landfill had to be stopped as off-site thermal treatment of HCB-contaminated lime sludge from a cement kiln caused unintended releases to air (see 2.3.1). As a new tender for ex-situ treatment of sludges failed, a containment system to minimise pollutant releases from the abandoned landfill is now being installed.

Other most commonly recognised and wide spread contaminated sites problems correlated to persistent organic pollutants in Austria are old gaswork sites and tar manufacturing facilities. Regarding PCDD/F, HCB and PCB, hardly any data on site pollution or wider environmental impacts is available.

Most gasworks in Austria were shut down during the early 1960ies. Due to the usual practices of operation and closure it is in general likely that severe soil and groundwater contamination exists. Persistent organic pollutants of concern stem from tar oil spills and losses. The main components of tar oils are PAH (~ 85%), heterocyclic PAH (N,S,O-PAH 5 to 13%), phenols (1–10%). The fate and transport of those pollutants in the underground environment is governed by their physical-chemical properties and interactions to a specific geological and hydrogeological situation. According to the available literature and experiences in Austria the environmental impacts of sites contaminated with PAH are generally limited. Especially benzo(a)pyrene and also other regulated PAH substances are to be characterised by hardly any significant volatilisation to soil vapour, only a low solution to groundwater but a strong sorption to the solid

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[16] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über ein elektronisches Register zur Erfassung aller wesentlichen Belastungen von Oberflächenwasserkörpern durch Emissionen von Stoffen aus Punktquellen (EmRegV-OW), BGBl. II Nr. 29/2009, (Web based inventory, for the time being only with limited access)

phase. Also because of the high retardation of these higher molecular PAHs, reports on travel distances show that pollutant plumes in groundwater are rather short (<100 m) even after several decades. It can be concluded that underground pollution by PAH causes local impacts to soil and groundwater. Nevertheless, it should be pointed out that, depending on the site-specific situation and whether sensitive land uses are concerned, an analysis of the risks to human health or ecosystems is required.

Remediation and redevelopment of gaswork sites is frequently done as a part of local urban revitalization projects. Such at the largest Austrian gaswork site in Simmering (city of Vienna) projects are under way since the late 20th century. During the period since 2012 a hydraulic barrier system and a water treatment plant were constructed and are effectively limiting groundwater contamination (SCHÖBERL & ROHRHOFER 2015).

Investigations at a coking plant near the Danube proved a major local groundwater damage, which for approximately 70 years caused a continuous PAH-input at the order of 0.2 kg per day. Although the water quality of the Danube always met respective environmental target criteria for PAH, a remediation project to reduce groundwater pollution is under way. To eliminate PAH inputs to the Danube a permeable barrier treating contaminated groundwater was constructed and is functional since January 2015.

Whereas underground pollution by PAH is a well known problem, available information on sites contaminated by PCDD/F, HCB and PCB is scarce. As for the sites recorded in the register of polluted sites (www.umweltbundesamt.at/prtr) the share of such sites can be estimated as being rather low (<5%). Referring to the experiences regarding fate and transport of PAH in the underground environment and given the physical-chemical properties of PCDD/F, HCB or PCB wider environmental impacts seem to be unlikely in general, but may appear in the presence of sensitive land use patterns in the surroundings of a specific site.

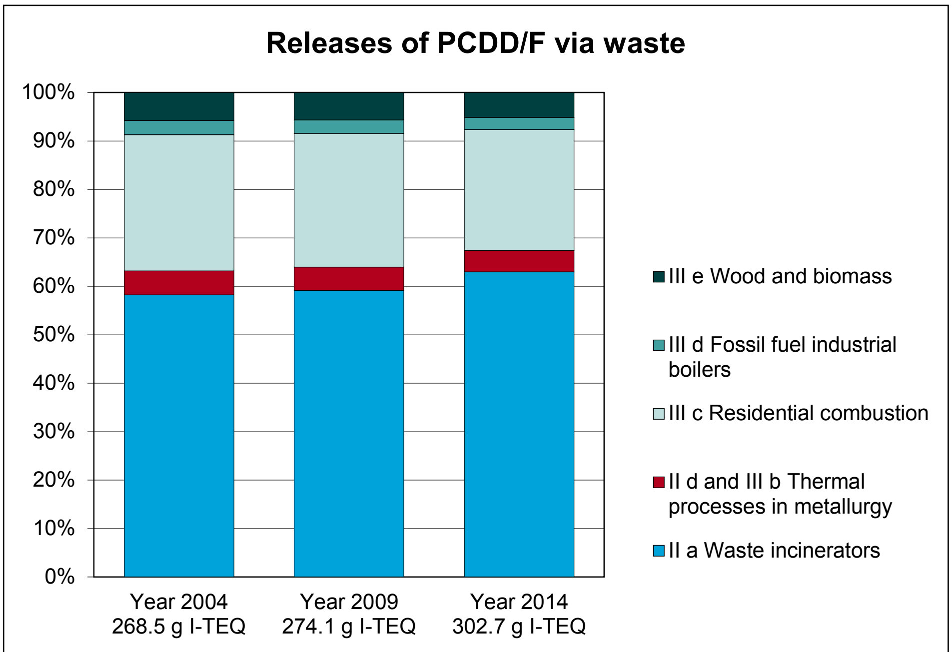
As for old municipal landfill sites, where it is likely that ashes and slags have been disposed of, there are hardly any data on PCDD/F, HCB and PCB. Regarding PAHs, which might be addressed as an ‘indicator’ for POPs, the available data do not show significant loads in percolating water or groundwater. Apart from old landfill sites which were built before 1997, there is no information available on new landfills in compliance with the Landfill Ordinance.

4 SOURCE INVENTORY OF POPS RELEASES VIA WASTE

With regard to waste, an estimation of releases can be established for PCDD/F and PeCB. In the case of the other POPs, qualified data are not available.

4.1 Releases of Polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF)

Figure 15 gives an overview of the contribution of the source categories to PCDD/F emissions via waste. In the year 2014 a total of 302.7 g I-TEQ were emitted, which is approximately ten times as much as the emissions to air (see2.2.18). Solid waste from waste incineration contributes most (63%) to the overall releases. Waste from residential sources also presents a significant release (25%). Other releases come from thermal processes in the metallurgical sector and from fossil fuel and biomass combustion.



Source: own calculation

Figure 15: Releases (though hardly bio-available) of PCDD/F via waste (own calculation).

Note: Total releases may be higher since for many source categories (e.g. the metallurgical sector) which have the potential of POPs releases via waste qualified emission factors are not available.

Table 44: Releases of PCDD/F via waste (own calculation).

Source Category	2004 g I-TEQ	2009 g I-TEQ	2014 g I-TEQ
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	156.37	162.1	190.7
Thermal processes in the metallurgical industry	13.3	13.3	13.3
Residential combustion	75.5	75.5	75.5
Fossil fuel industrial boilers	7.7	7.7	7.7
Wood and biomass	15.6	15.6	15.6
Total	**268.5**	**274.1**	**302.7**

4.1.1 Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge

Table 45 gives an estimation of PCDD/F releases via waste. Concentrations as well as loads are considerably high and follow an upward trend. However, it must be stated that all waste streams resulting from waste incineration are sent to landfills (mass waste, residual waste, underground disposal) and in case provided they are properly designed and operated, these landfills no longer present a risk for the environment.

Table 45: Estimation of PCDD/F releases via waste from waste incineration (municipal waste, hazardous waste; own calculation).

	PCDD/F			
Type of Waste	**Average concentration (µg/kg)**	**Total mass (g/a) 2004**	**Total mass (g/a) 2009**	**Total mass (g/a) 2014**
Bottom Ash	0.046	11.40	15.04	17.59
Fly Ash	2.95	138.29	140.24	165.09
Filtercake	4.0	6.68	6.77	7.96
Total		**156.37**	**162.05**	**190.65**

4.1.2 Secondary aluminium production

Wastes/residues from secondary aluminium production are salt slag, filter dust, furnace linings and drosses/skimmings (UMWELTBUNDESAMT 2000).

The following table gives an overview of wastes/residues arising from secondary aluminum production, as well as their treatment and disposal.

Estimated releases using the reported values of “Stand der Technik in der Sekundäraluminiumerzeugung im Hinblick auf die IPPC-Richtlinie” (UMWELTBUNDESAMT 2000) and the BREF “Non Ferrous Metals Industries” (EUROPEAN COMMISSION 2001) are given in the next table:

Table 46: Estimation of PCDD/F releases via wastes/ residues arising from secondary aluminum production (UMWELTBUNDESAMT 2000).

Waste/Residue	Release (g/a)	Treatment
Filter dust	1.25	Underground disposal, disposal with pre-treatment, partly reconditioned with salt slag, use in steel industry.
Salt slag	0.175	Treatment via dissolution and crystallization technique → reusable substances Al-granulate, mixed salt, non metallic products. Also other treatment techniques are used which are not state of the art.
Furnace lining	No data available	Leaching and landfill, potential for reconditioning with skimmings
Drosses/skimmings	No data available	Recovery

Table 47: Composition of salt slag (UMWELTBUNDESAMT 2000).

Pollutant	Typical value	Range
PCDD/F	5 ng/kg	2–20 ng/kg

Table 48: Composition of filter dust (UMWELTBUNDESAMT 2000, EUROPEAN COMMISSION 2016).

Pollutant	Typical value	Range
PCDD/F	5 µg/kg	3–10 µg/kg

No new values for the years 2009 and 2014 were calculated or estimated.

4.1.3 Secondary copper production

In Austria there is one secondary copper plant in operation which produces 92,400 t/a copper anodes, 113,500 t/a copper cathodes and 91,000 t/a of bolts (MONTANWERKE BRIXLEGG 2012). Wastes/residues from the secondary copper plant are given in the table below. Releases in g/a could not be estimated due to a lack of data.

Table 49: PCDD/F releases via wastes/residues arising from secondary copper production (UMWELTBUNDESAMT 1999b).

Residue	Treatment
Filter dust from the shaft furnace	Exported
Filter dust from the converter	Exported
Filter dust from the anode furnace	Use in shaft furnace
Furnace linings	Use in furnace
Slag from the shaft furnace	Construction material
Slag from the converter	Use in shaft furnace
Slag from the anode furnace	Use in shaft furnace

4.1.4 Secondary lead production

The only secondary lead plant in Austria produces approximately 23,000 t lead/a. Residues/wastes from the secondary lead plant are given below (UMWELTBUNDESAMT 2004). Releases in g/a could not be estimated due to a lack of data.

Table 50: PCDD/F releases via wastes/residues arising from secondary lead production (UMWELTBUNDESAMT 2004).

Residue	Treatment
Filter dust	Reuse in furnace
Furnace linings	Landfill
Slag	Landfill

4.1.5 Thermal processes in the metallurgical industry

PCDD/F releases are summarised below:

Table 51: PCDD/F releases via waste from thermal processes in the metallurgical industry (own calculation).

Residue	Release (g/a)
Sinter plant – residue from flue gas cleaning	n.a.
Electric arc furnace – slag	0.08
Electric arc furnace – residue from flue gas cleaning	9.78
Ferrous metal foundries – residue from flue gas cleaning	1.90
Ferrous metal foundries – sand	0.10
Total	**11.86**

No new values for the year 2014 were calculated or estimated. As regards the sinter plant residues from flue gas cleaning there are no values available.

4.1.6 Residential combustion sources

The Dioxin Toolkit reports concentrations of PCDD/F in the ash of 10 µg/kg ash for clean biomass and 1,000 µg/kg ash for contaminated biomass, respectively. Both values seem to be unreasonably high (UNEP 2005).

Another study (UMWELTBUNDESAMT 2002) gives emission factors based on the fuel input for chimney soot of 5 ng/kg fuel (coal) and 1 ng/kg fuel in the case of biomass combustion. According to this study, releases via bottom ash are below 1 ng/kg combusted fuel (both for biomass and coal).

BIPRO based their calculations on average values of 0.11 µg/kg (ash from wood combustion) and 0.056 µg/kg (ash from coal combustion). As regards chimney soot BIPRO uses values of 6.15 µg/kg (coal) and 3.19 µg/kg (wood) (BIPRO 2005).

In the field tests described in (UMWELTBUNDESAMT 2002) untreated beech wood was used, whereas the value used by (BIPRO 2005) includes all kind of treated and untreated wood.

The ash content of biomass is in the range of 1% (wood) and 5% (bark). Normally, only bottom ash accumulates in residential plants.

Estimated releases based on reported values are given in the next table:

Table 52: Calculation of PCDD/F releases via waste based on available literature (Umweltbundesamt 2002, Bipro 2005, own calculation).

Residue	Release (g/a)	Treatment
Bottom ash from biomass combustion	0.1–6.98[1]	Disposal with MSW; spreading on land
Bottom ash from coal combustion	0.24–0.589[1]	Disposal with MSW; spreading on land
Chimney soot – wood combustion	6.34–60.69[1]	Disposal with MSW; spreading on land; others?
Chimney soot – coal combustion	1.18–7.25[1]	Disposal with MSW; spreading on land; others?

[1] *Higher value more often supported by data from the literature.*

MSW: municipal solid waste

As can be seen from the results given in the table above, the calculation of releases via waste from residential combustion sources is associated with great uncertainties. The reasons for these uncertainties are (among others) a wide variety of types (including some types of waste) and quality of fuels used (e.g. water content, ash content, calorific value, chlorine content), the wide variety of firing systems with different combustion conditions and a wide variety of “local” factors (such as the manual loading of the firing system).

However, these releases are relevant because a certain part of this waste is retransferred to the environment (e.g. when ash is used as “fertiliser” in private gardens).

No new values for the year 2014 were calculated or estimated.

4.1.7 Fossil fuel-fired utility and industrial boilers

Few data are available on POPs concentrations of solid residues/wastes from fossil fuel fired utility and industrial boilers. The Dioxin Toolkit (Unep 2005) gives a value of 14 µg/TJ for the combustion of coal and a value of 15 µg/TJ for biomass combustion. Concentrations in fly ash from coal combustion range from 0.23–8.7 ng/kg and for bottom ash from 0.02–13.5 ng/kg (Unep 2005). For the following calculation concentrations of 5 ng/kg (fly ash) and 10 ng/kg (bottom ash) have been used. The total emission factors for coal and lignite combustion reported by BIPRO do not differentiate between fly ash and bottom ash and result in much higher release estimations (see Table 53).

Table 53: Calculation of PCDD/F releases via ashes from coal combustion based on available literature (Unep 2005, Bipro 2005, own calculation).

Type of Residue/Waste	Release (g/a)	Treatment
Fly ash (coal combustion)	0.70	Use in cement, brick and construction industry
Bottom ash (coal combustion)	0.46	Use in cement, brick and construction industry
All ashes from coal combustion – BIPRO	3.00	Use in cement, brick and construction industry
Ashes from lignite – BIPRO (other data not available)	3.52	Backfilling of coal mine

Total releases are estimated to be in the range of 1.16 g/a (Unep 2005) and 6.62 g/a (Bipro 2005).

No new values for the year 2014 were calculated or estimated.

4.1.8 Firing installations for wood and other biomass fuels

For biomass combustion a wide range of emission factors are reported:

- UNEP (2005): Fly ash: 30–23,300 ng/kg; bottom ash: 30–3,000 ng/kg
- BIPRO (2005): all ashes: 1,135 µg/kg
- UMWELTBUNDESAMT (2002): 0.03 µg/kg (both for fly ash and bottom ash)

The results (using the concentration figures described) are presented in the table below:

Table 54: Calculation of PCDD/F releases via ashes from biomass combustion based on available literature (UNEP 2005, BIPRO 2005, UMWELTBUNDESAMT 2002, own calculation).

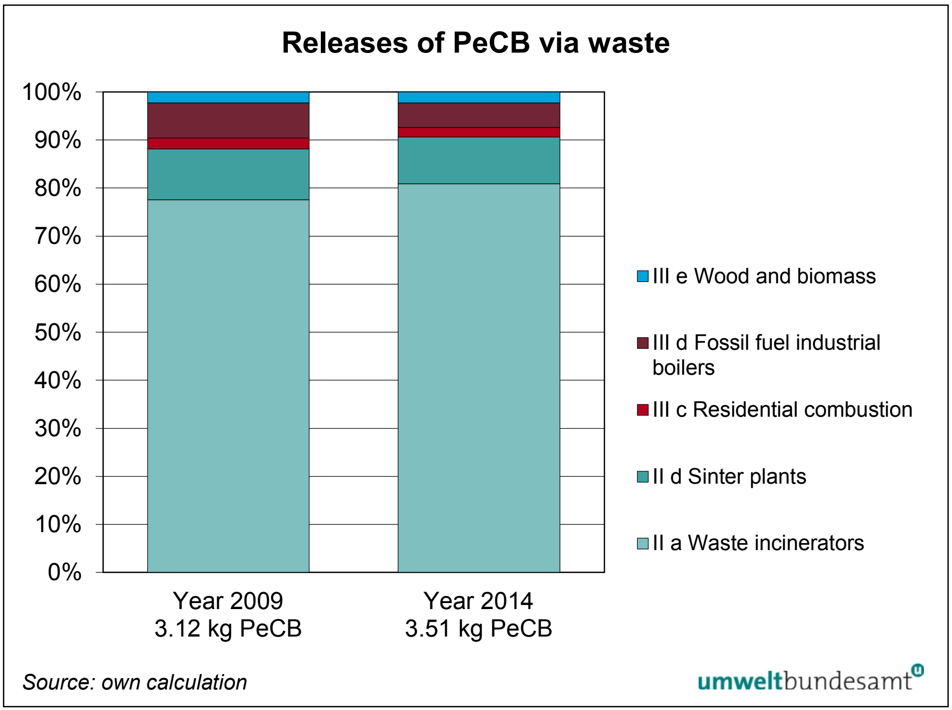
Type of Residue/Waste	Release (g/a)	Treatment
Fly ash (conc: 0.03 µg/kg)	0.67	Landfill
Bottom ash (conc: 0.03 µg/kg)	2.67	Application on land; composting
Ashes from Biomass combustion (conc: 0.11 µg/kg)	12.21	Fly ash: landfilled; bottom ash: use as composting agent

These releases are potentially relevant because some part of bottom ash is used as composting agent and applied on soil.

No new values for the year 2014 were calculated or estimated.

4.2 Releases of Pentachlorobenzene (PeCB)

Table 55 and Figure 16 give an overview of the contribution of the source categories to PeCB emissions to waste. In the year 2014 a total of 3.51 kg PeCB was emitted. Solid waste from waste incineration contributes most (81%) to the overall releases. Other releases come from thermal processes in the metallurgical sector and from fossil fuel and biomass combustion. However, it should be mentioned that the availability of data was scarce.



Source: own calculation

Figure 16: Releases of PeCB via waste (own calculation).

Table 55: Releases of PeCB via waste for 2009 and 2014 (own calculation).

Source Category	**2009 [kg PeCB]**	**2014 [kg PeCB]**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	2.42	2.84
The following thermal processes in the metallurgical industry		
(ii) Sinter plants in the iron and steel industry	0.33	0.34
Residential combustion sources	0.07	0.07
Fossil fuel-fired utility and industrial boilers	0.23	0.18
Firing installations for wood and other biomass fuels	0.07	0.08
Total	**3.12**	**3.51**

4.2.1 Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge

Solid waste from waste incineration contributes most to the overall releases.

Significant amounts of PeCB have been found in fly-ash samples. Korenkova et al. reported that PeCB concentrations in a fly-ash sample taken from an Italian municipal solid waste incinerator amounted to 31 ng/g of fly-ash (IPEN 2008); in Norway fly-ash samples from a municipal solid waste incinerator contained 50 ng/g (VIAU et al. 1984), in the UK 11.5 ng/g (BALAMPANIS et al. 2010), in Sweden 240 ng/g (ÖBERG et al. 2007) and in Germany 39.6 ng/g (SCHREINER et al. 1986). An average contamination factor of 74.4 ng PeCB/g fly ash has been used for the calculation of the mass flows (BIPRO 2011).

Through incineration of municipal waste, residues amounting to 37.75 kg/t are generated. Of these, 22.25 kg/t are fly ash and filter dust and 15.5 kg/t are remaining ACP residues (BIPRO 2011).

As regards the hazardous waste reported PeCB values in fly ash amount to an average of 9.57 ng PeCB/g fly ash (SCHREINER et al. 1986). It has been assumed that the amount of fly ash and filter dust generated is the same as for municipal waste (22.25 kg/t MW incinerated).

In 2014, about 1.341 million t municipal waste (mixed municipal waste, bulky waste) were incinerated in municipal waste incineration plants (BMLFUW 2015a).

In 2014, about 1.324 million t of hazardous waste were treated (BMLFUW 2015a), 0.227 million t were incinerated in 2014 (assumption Umweltbundesamt 2015).

Sewage sludge

As PeCB tends to adsorb on particles, a relevant share of the PeCB content of waste water accumulates in sewage sludge during waste water treatment.

In terms of PeCB contamination data on sewage sludge, a median of 4.85 mg PeCB/t sewage sludge has been used according to a study of Wang et al. for sewage sludge samples analysed in the UK (WANG et al. 1994).

In 2014 an amount of 0.239 million t of sewage sludge was produced in Austria. 1% of this amount was landfilled, 49% was incinerated, 17% was applied on land and 33% was treated in another way. (BMLFUW 2015a)

The following table shows the amounts PeCB in fly ash and filter dust:

Table 56: PeCB-discharge via waste (fly ash and filter dust) for the source category Waste Incineration (BMLFUW 2015a, own calculation).

	Incinerated waste 2014 [Million t]	PeCB Emissions [kg], 2009	PeCB Emissions [kg], 2014
Municipal Solid Waste	1.341	1.94	2.22
Hazardous Waste	0.227	0.03	0.05
Sewage Sludge	0.117	0.45	0.57
Sum		**2.42**	**2.84**

4.2.2 Thermal processes in the metallurgical industry (secondary copper production; sinter plants in the iron steel industry; secondary aluminium production; secondary zinc production)

Compared to incineration and combustion processes, industrial processes, where PeCB can be produced as a by-product are of comparatively low relevance. Nevertheless, it should be mentioned that most industrial processes use incineration or combustion processes, e.g. the industrial production of steel and iron, which according to Eurostat data uses more than 50% of the coal finally consumed within Europe (BIPRO 2011).

In iron and steel mills an amount of 1.77 million t of coal was used in 2014 (STATISTIK AUSTRIA 2015).

Contamination values for fly ashes from coal incineration range from 0.0004 to 7.0 ng/g. The PeCB flow is calculated on the basis of an estimated average of 2.40 ng/g (SCHREINER et al.1986; BIPRO 2011).

The available data and assumptions allow an estimation of PeCB emissions to solid residues (general estimation for ashes: bottom ash, fluidised bed ash, fly ash including FGT residues) resulting from power production from coal. An average of 80 kg ash (no differentiation of ashes) per tonne solid fuel has been taken as the basis for the calculation of the PeCB flow into waste (BIPRO 2011).

Table 57:
PeCB discharge to waste of iron and steel mills (STATISTIK AUSTRIA 2015, own calculation).

	Incinerated coal [Million t]	**PeCB Emissions [kg]**
2009	1.69	0.33
2014	1.77	0.34

4.2.3 Residential combustion sources

For wood, the waste generation factor amounts to 0.017 t ash/t wood and 0.0003 t soot/t wood. A contamination factor of 0.2 ng/g for the resulting ash has been used according to Schreiner et al. (SCHREINER et al. 1986). No information has been available on the PeCB contamination in soot. Since the generation factor of soot for wood is relatively small, it is considered as insignificant (BIPRO 2005).

The available data and assumptions allow an estimation of PeCB discharge to ashes:

Table 58:
PeCB discharge to waste (ash) of residential combustion (STATISTIK AUSTRIA 2015, own calculation).

	Incinerated wood [Million t]	**PeCB emissions [kg]**
2009	4.6	0.07
2014	4.2	0.07

4.2.4 Fossil fuel-fired utility and industrial boilers

The available data and assumptions allow an estimation of PeCB concentrations in solid residues (general estimation for ashes: bottom ash, fluidised bed ash, fly ash including FGT residues) resulting from power production from coal.

An average of 80 kg of ash (no differentiation of ashes) per tone of solid fuel has been taken as the basis for the calculation of the PeCB flow into waste (BIPRO 2011).

Contamination values for fly ashes from coal incineration range from 0.0004 to 7.0 ng/g. The PeCB flow is calculated on the basis of an estimated average of 2.40 ng/g (SCHREINER et al.1986; BIPRO 2011).

In 2014 about 0.9 million t were incinerated in coal fired power plants (STATISTIK AUSTRIA 2015).

Table 59: PeCB discharge to waste of power plants (STATISTIK AUSTRIA 2015, own calculation).

	Incinerated coal [Million t]	PeCB emissions [kg]
2009	1.2	0.23
2014	0.9	0.18

4.2.5 Firing installations for wood and other biomass fuels

For wood, the waste generation factor amounts to 0.017 t ash/t wood and 0.0003 t soot/t wood. A contamination factor of 0.2 ng/g for the resulting ash has been used according to Schreiner et al. (SCHREINER et al. 1986). No information was available on PeCB contamination of soot.

The available data and assumptions allow an estimation of PeCB discharge to ashes.

Table 60: PeCB emissions to ashes from Incinerated wood, source category firing installations for wood and other biomass fuels (STATISTIK AUSTRIA 2015, own calculation).

	Incinerated wood [Million t]	PeCB Emissions [kg]
2009	4.6	0.07
2014	5.0	0.08

5 SOURCE INVENTORY OF POPS RELEASES VIA PRODUCTS

Action on POPs in products is specified in Annex C Part V A (g) of the Convention ("minimization of these chemicals as contaminants in products"). Some data can be found in the literature relating to concentrations of PCDD/F in sold cement and pulp and paper products (KARSTENSEN 2006, UNEP 2013, GRUBER 1996). No data are available on the other POPs described in this report.

However, for most source categories there are no relevant releases via the product.

Table 61: PCDD/F-Releases via the products cement and pulp and paper – calculations were based on data from literature (KARSTENSEN 2006, UNEP 2013, GRUBER 1996).

	Release (g I-TEQ/a)
Cement	4.04
Paper	4.46

Releases via pulp which is not exported are included in the figure for paper.

PCDD/F-releases via cement and pulp and paper products in 2014 were almost the same as in 2009 and 2004 since there were no significant changes in production.

Concentrations of PCDD/F in cement are considered to be low and can be explained by the fact that filter dust from the clinker process (average PCDD/F concentration: 6.7 ng I-TEQ/kg) is added to the product and that secondary raw materials (e.g. fly ash, gypsum from flue gas desulphurisation) are used. Consequently, the cement is contaminated with low concentrations of PCDD/F (average: 0.91 ng I-TEQ/kg cement) (KARSTENSEN 2006).

It should be mentioned that the bio-availability of POPs in cement has been greatly reduced.

Austria participated in the revision of the Dioxin Toolkit (UNEP 2013). UNEP 2013 states under "mineral products": „This section summarises high-temperature processes in the mineral industry. Raw materials or fuels that contain chlorides may potentially cause the formation of PCDD/PCDF at various steps of the processes, e.g., during the cooling phase of the gases or in the heat zone. Due to the long residence time in kilns and the high temperatures needed for the product, emissions of PCDD/PCDF are generally low in these processes."

Cement kilns firing hazardous waste are a source covered in Annex C Part II (b) of the Convention concerning emissions of PCDD/F, HCB, PAH, PCB and PeCB. Therefore the quantification of these POPs in environmental media, as well as in residues and products is desirable.

In pulp and paper production PCDD/F are introduced into the products mainly via bleached (Kraft-)pulp and recycled papers.

In Austria, total pulp production (reference year 2014) amounted to 1,571 kt (2009: 1,514 kt; 2004: 1,509 kt) with bleached pulp having a share of 36%, unbleached pulp 35% and textile pulp 28% (AUSTROPAPIER 2015).

The releases from pulp were calculated was based on emission factors of 0.5 µg/t (bleached Kraft-pulp) and 0.1 µg/t (other pulp) (UNEP 2013). Thus, the total releases via pulp amounted to 0.39 g in the year 2014.

Relevant raw materials for paper production are pulp (both from national production and from imports), wood pulp and recovered paper (both de-inked or not de-inked).

In addition to pulp produced in Austria (see above), imported pulp has to be taken into account: In 2014 about 662,330 t of bleached (Kraft-)pulp were imported. Part of the imported pulp came from countries where chlorine is still used as a bleaching agent. For the calculation of the PCDD/F content it is assumed that the emissions factor is 0.5 µg/t for 10% of the imported pulp, whereas the other imported pulp is less contaminated (0.1 µg/t). This leads to a total of 0.093 g I-TEQ imported via pulp. Input of PCDD/F via wood pulp has been calculated using an emission factor of 0.1 µg/t (UNEP 2013; total input: 0.037 g I-TEQ).

On the other hand, PCDD/F is introduced via recycled paper and more specifically via impurities in used inks. Where de-inking is applied (about 40% of recovered paper is de-inked in Austria), the PCDD/F will be reduced by a factor of 3 (GRUBER 1996). Comparable high concentrations (up to 12 ng/kg) were found in packaging papers and paper board in the early 1990s. In general, there was a sharp decline in average concentrations could be observed between 1989 and 1994 whereas concentrations have been decreasing slowly since 1994 (GRUBER 1996).

Based on that information above and on data given in the Dioxin Toolkit (UNEP 2013), it has been assumed that the PCDD/F concentration in recovered paper is 3 µg/t (without de-inking) and 0.99 µg/t (with de-inking). These assumptions result in an average emission factor of 2.24 µg/t (averaged over paper which undergoes a de-inking step and which does not). Thus the total release of PCDD/F via paper amounts to 4.46 g (reference year: 2014).

Publications in the scientific literature give some indication that waste paper could be contaminated by printing inks containing significant residues of PCDD/F, e.g. through pigments. In 2011 the Environment Agency Austria conducted a survey assessing the PCDD/F contents of cardboard-boxes which are known to be produced from waste paper as the predominant raw material. Comparing the PCDD/F content of brand-new non printed cardboard boxes with used cardboard boxes imprinted to a large extent this limited study did not show any indication of PCDD/F input via printing inks. The cardboard-box samples analysed in this study showed PCDD/F contents in the range of 1.2 to 1.9 ng TEQ/kg (UMWELTBUNDESAMT 2011c).

In 2010 Austropapier, the Association of the Austrian Paper Industry, submitted new data on the PCDD/F content of selected paper products in order to refine calculations based on the emissions factors taken from the Dioxin Toolkit (UNEP 2005). The emission factors derived from the new data indicate a reduction of the overall PCDD/F release via paper products by a factor of three.

A new calculation was performed in 2011:

Table 62: Releases of PCDD/F via products (calculation on the basis of the output of Austropapier and transmitted results of analysis)

Product	Production (t/a)	Emission factor (µg TEQ/t)	Releases (g PCDD/F TEQ/a)	Percentage (%)
Newspaper printing paper	299,205	0.068	0.02	1.2
Printing and writing paper				
● deinked	902,421	0.068	0.06	3.7
● from pulp	1,346,070	0.050	0.07	4.0
Folding box cardboard	487,214	0.723	0.35	21.1
Packaging paper	676,177	1.141	0.77	46.2
Kraft paper				0.0
● with recovered paper	374,855	0.858	0.32	19.3
● only from pulp	250,743	0.050	0.01	0.8
Thin- and special papers				0.0
Sanitary paper	128,660	0.068	0.01	0.5
Others	126,896	0.050	0.01	0.4
Packing and spezial board	13,299	0.858	0.01	0.7
Market pulp exported	95,471	0.070	0.01	0.4
Market pulp (ECF)	313,818	0.090	0.03	1.7
Total	**5,014,829**		**1.67**	**100.0**

6 POLICIES (PROVISIONS) AND MEASURES

This chapter gives an overview of the relevant international, European and national legislation applicable to unintentionally produced POPs. It should be noted that chapter 6 of the National Action Plan 2008 (UMWELTBUNDESAMT 2008b) and chapter 6 of the First Review of the National Action PLAN 2012 (UMWELTBUNDESAMT 2012) already contained comprehensive information on policies and measures. Therefore, this Second Review of the National Action Plan only focuses on new developments or amendments of the relevant policies. For more general information please refer to the National Action Plan 2008 and the First Review of the National Action Plan 2012 (UMWELTBUNDESAMT 2008b, UMWELTBUNDESAMT 2012).

6.1 New developments in International and European Legislation since 2012

6.1.1 Stockholm Convention

The Stockholm Convention on POPs was formally adopted on 22–23 May 2001 and entered into force 17 May 2004. Parties to the convention have agreed to a process by which persistent toxic compounds can be reviewed and added to the convention, if they meet certain criteria for persistence and transboundary threat. The first set of new chemicals to be added to the Convention was agreed at a conference in Geneva on 8 May 2009.

The chemicals targeted by the Stockholm Convention are listed in the annexes of the convention text:

Annex A (elimination):

aldrin, chlordane, chlordecone, dieldrin, endrin, heptachlor, hexabromobiphenyl, hexabromocyclododecane (HBCD), hexabromodiphenyl ether and heptabromodiphenyl ether, hexachlorobenzene (HCB), hexachlorobutadiene, alpha hexachlorocyclohexane, beta hexachlorocyclohexane, lindane, mirex, pentachlorobenzene (PeCB), pentachlorophenol and its salts and esters, polychlorinated biphenyls (PCB), polychlorinated naphthalenes, technical endosulfan and its related isomers, tetrabromodiphenyl ether and pentabromodiphenyl ether, toxaphene.

Annex B (restriction):

DDT, perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluorid.

Annex C (unintentional production):

hexachlorbenzene (HCB), pentachlorobenzene (PeCB), polychlorinated biphenyls (PCB), polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF), polychlorinated naphthalenes (PCN).

Releases of unintentionally produced by-products listed in Annex C (dioxins, furans, PCBs, HCB, PeCB and PCN) are subject to continuous reduction with the objective to achieve ultimate elimination where feasible. The main tool for this is the National Action Plan which should cover the source inventories and release estimates as well as plans for release reductions.

Under the Stockholm Convention on Persistent Organic Pollutants, Parties shall promote in some cases and prescribe in others the use of best available techniques, and promote the application of best environmental practices. In short, each Party shall:

- Develop, within two years of the date of entry into force of the Convention, an action plan (national or regional) where releases of chemicals listed in Annex C of the Convention are identified, characterized and addressed; the plan shall include source inventories and take into consideration the source categories listed in Parts II and III of Annex C (subparagraph (a) of Article 5);
- For new sources:
  - Promote and, in accordance with the schedule in its action plan, require the use of best available techniques within the source categories identified as warranting such action, with particular initial focus on sources categories identified in Part II of Annex C; the requirement to use best available techniques for Part II source categories shall be phased in a soon as practicable, but no later than four years after entry into force of the Convention for the Party (subparagraph (d) of Article 5);
  - Promote, for those categories identified above, the use of best environmental practices (subparagraph (d) of Article 5);
  - Promote in accordance with the action plan, best available techniques and best environmental practices within source categories such as those listed in Part III of Annex C which a Party has not addressed above (subparagraph (e) (ii) of Article 5);
- For existing sources:
  - Promote, in accordance with the action plan the use of best available techniques and best environmental practices for source categories listed in Part II of Annex C and such sources as those in Part III of the Annex (subparagraph (e) (i) of Article 5).

Table 63: Source Categories according to Annex C of the Stockholm Convention on POPs.

Part II: Source categories	**Part III: Source categories**
Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or of sewage sludge	Open burning of waste, including burning of landfill sites
Cement kilns firing hazardous waste	Thermal processes in the metallurgical industry not mentioned in Part II
Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching	Residential combustion sources
The following thermal processes in the metallurgical industry: (i) Secondary copper production; (ii) Sinter plants in the iron and steel industry; (iii) Secondary aluminium production; (iv) Secondary zinc production	Fossil fuel-fired utility and industrial boilers
	Firing installations for wood and other biomass fuels
	Specific chemical production processes releasing unintentionally formed persistent organic pollutants, especially production of chlorophenols and chloranil
	Crematoria
	Motor vehicles, particularly those burning leaded gasoline
	Destruction of animal carcasses
	Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction)
	Shredder plants for the treatment of end of life vehicles
	Smouldering of coppper cables
	Waste Oil Refineries

When applying best available techniques and best environmental practices for the activities listed above, Parties should take into consideration the general guidance on prevention and release reduction measures in Annex C and guidelines on best available techniques and best environmental practices. These Guidelines were finalised by an international Expert Group in November 2006 and were adopted by the Conference of the Parties in May 2007. (UNEP 2007). Currently the Guidelines are under review.

6.1.1.1 EU POP-Regulation

The main legal instrument for implementing the Stockholm Convention and the UNECE Protocol in the EU is the Regulation (EC) No 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants with its amendments 756/2010/EU, 757/2010/EU, 519/2012/EU, 2015/2030/EU and 2016/293/EU.

The Regulation obliges Member States to draw up and maintain comprehensive release inventories for dioxins, furans, HCB, PCBs, PeCB and polyaromatic hydrocarbons (PAH) and to communicate their national action plans on measures to identify, characterise and minimise total releases of these substances to the Commission and to the other Member States. The action plan shall include an evaluation of the efficacy of the laws and policies related to the management of the releases.

The action plan shall also include measures to promote the development of substitute or modified materials, products and processes to prevent the formation and releases of POPs. Producers and holders of waste are obliged to undertake measures to avoid contamination of waste with POP substances. The control measures on waste follow closely those of the Stockholm Convention and provide more details in some aspects.

Amendments of the POP regulation since 2012:

2012, hexachlorbutadiene, polychlorinated napthalines, short chain chlorinated paraffines and endosulfan have been included in the POP regulation (Commission Regulation 519/2012/EU).

In 2015, the POP regulation has been amended, including setting a limit for short chain chlorinated paraffins (SCCPs) (Commission Regulation 2015/2030/EU).

2016, the EU published Regulation 2016/293/EU prohibiting the manufacture, placing on the market and use of hexabromocyclododecane (HBCDD) with certain specific exemptions for the building sector.

For detailed information on the POP Regulation please refer to the National Action Plan 2008 (UMWELTBUNDESAMT 2008b) and the First Review of the National Action Plan (UMWELTBUNDESAMT 2012).

6.1.2 UNECEConvention on Long-range Transboundary Air Pollution (LRTAP)

Since 1979 the Convention on Long-range Transboundary Air Pollution (LRTAP)[17] has addressed some of the major environmental problems of the UNECE region through scientific collaboration and policy negotiation. The Convention has been extended by eight protocols that identify specific measures to be taken by Parties to cut their emissions of air pollutants.

The aim of the Convention is that Parties shall endeavour to limit and, as far as possible, gradually reduce and prevent air pollution including long-range transboundary air pollution. Parties develop policies and strategies to combat the discharge of air pollutants through exchange of information, consultation, research and monitoring.

The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs)

The Executive Body to the UNECE (United Nations Economic Commission for Europe) Convention on Long-Range Transboundary Air Pollution (LRTAP) adopted the Protocol on POPs[18] on 24 June 1998 in Aarhus, Denmark. The Protocol entered into force on 23 October 2003. By May 2012, 31 Parties, including the European Community had ratified the Protocol.

For detailed information on the POP Protocol please refer to the National Action Plan 2008 and the First Review of the National Action Plan 2012 (UMWELTBUNDESAMT 2008b, UMWELTBUNDESAMT 2012).

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[17] http://www.unece.org/env/lrtap/welcome.html

[18] http://www.unece.org/env/lrtap/pops_h1.htm

On 18 December 2009, Parties to the Protocol on POPs adopted decisions 2009/1, 2009/2 and 2009/3 to amend the Protocol to include seven new substances: hexachlorobutadiene, octabromodiphenyl ether, pentachlorobenzene, pentabromodiphenyl ether, perfluorooctane sulfonates, polychlorinated naphthalenes and short-chain chlorinated paraffins. Furthermore, the Parties revised obligations for DDT, heptachlor, hexachlorobenzene and PCBs as well as emission limit values (ELVs) from waste incineration. Parallel to this, with a view to facilitating the Protocol's ratification by countries with economies in transition, the Parties introduced a certain amount of flexibility for these countries regarding the time frames for the application of ELVs and best available technologies (BAT). Finally, the Parties adopted Decision 2009/4 to update guidance on BAT for controlling emissions of POPs in Annex V and turned parts of it into a guidance document (ECE/EB.AIR/2009/14). The amendments to annexes V and VII entered into force for most of the Parties on 13 December 2010. In line with article 14, paragraph 3, the entry into force of the amendments to the text of the Protocol and to its annexes I, II, III, IV, VI and VIII requires ratification of two thirds of the Parties. The amendments according to decisions 2009/1 (amending the text of and annexes I, II, III, IV, VI and VIII) and 2009/2 (amending annexes I and II) require separate ratifications. Those amendments have not yet entered into force.

6.1.3 Industrial Emissions Directive (2010/75/EU)

Directive 2010/75/EU of the European Parliament and the Council on industrial emissions (the Industrial Emissions Directive or IED) is the main EU instrument regulating pollutant emissions from industrial installations. The IED was adopted on 24 November 2010. It is based on a Commission proposal recasting 7 previously existing directives (including the IPPC Directive, the Waste Incineration Directive, the Large Combustion Plants Directive, the VOC Directive and the three TiO_2-Directives). The IED entered into force on 6 January 2011 and had to be transposed by Member States by 7 January 2013.

For detailed information on the IPPC Directive and the original Directives on Waste Incineration and Large Combustion Plants please refer to the National Action Plan 2008 (UMWELTBUNDESAMT 2008b).

The Directive on Industrial Emissions is based on several principles, namely an integrated approach, use of best available techniques, flexibility, inspections and public participation.

The **integrated approach** means that the permits must take into account the whole environmental performance of the plant, covering e.g. emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents, and restoration of the site upon closure. The purpose of the Directive is to ensure a high level of protection of the environment taken as a whole.

The permit conditions including emission limit values must be based on the Best Available Techniques (BAT). In order to define BAT and the BAT-associated environmental performance at EU level, the Commission organises an exchange of information with experts from Member States, industry and environmental organisations. This work is co-ordinated by the European IPPC Bureau of the Institute for Prospective Technology Studies at the EU Joint Research

Centre in Seville (Spain). This process results in BAT Reference Documents (BREFs); the BAT conclusions contained are adopted by the Commission as Implementing Decisions. The IED requires that these BAT conclusions are the reference for setting permit conditions.

It must be noted that the types of installations listed in Annex I of the Industrial Emissions Directive do not directly correspond to the source categories of Annex C of the Stockholm Convention. Annex I of the IED gives a list of major industrial activities which may give cause to general environmental impacts, whereas Annex C of the Stockholm Convention lists source categories which have the potential to release POPs. Therefore the Stockholm Convention is more specific with regard to pollutants, covering also small scale sources (e.g. residential combustion plants, crematoria, open burning).

The BAT Reference Documents (BREFs) and the BAT conclusions give a detailed overview of what represents Best Available Techniques for the sectors in question together with emission and consumption levels.

Table 64: Type of installations listed in Annex I of the IED.

Name of European BREF	**Corresponding Source category of Stockholm Convention (annex C)**	**BAT associated emission level for PCDD/F**	**BAT associated emission level for PAH**
Waste incineration	II a (Waste incinerators, …)	air: 0.01–0.1 ng TEQ/Nm^3 *) (split view 0.01–0.05) water: 0.01–0.1 ng TEQ/l *) (split view <0.01)	
Cement, lime and magnesiumoxide	II b (Cement kilns …)	air: <0.05-0.1 ng/I-TEQ Nm^3	
Non-Ferrous Metals	II d i (Sec. copper prod.) II d iii (Sec. aluminium prod.) II d iv (Sec. zinc prod.) III b (Thermal processes in metallurgy …)	air: ≤ 0.1 ng I-TEQ/Nm^3	air: BaP 0.001-0.01 mg/Nm^3
Iron and Steel	II d ii (Sinter Plants) III b (Thermal processes …)	air: <0.05 – 0.2 ng I-TEQ/Nm^3 (bag-filter); air: <0.2 – 0.4 ng-I-TEQ/Nm^3 (advanced electrostatic precipitator**) air: EAF: <0.1 ng I-TEQ/Nm^3	

** BREF is under review, values will change/might be changed*

*** where bag filters are not applicable*

No specific BREF is available for the source categories III a (Open burning of waste, including burning of landfill sites), III c (Residential combustion sources), III g (Crematoria), III h (Motor vehicles, particularly those burning leaded gasoline), III i (Destruction of animal carcasses), III k (Shredder plants for the treatment of end of life vehicles) and III l (Smouldering of copper cables). For Shredder plants a BREF will have to be written according to Annex I of the new Industrial Emission Directive (2010/75/EU). Shredder plants are included and handled in the review of the BREF waste treatment.

On the other hand the relevant BREFs for the source categories II c (Production of pulp using elemental chlorine or chemicals generating elemental chlorine for bleaching; BREF "Pulp and Paper"), III d (Fossil fuel-fired utility and industrial boilers; BREF LCP), III j (Textile and leather dyeing (with chloranil) and finishing (with alkaline extraction); BREF "Textile Manufacturing") and III m (Waste oil refineries; BREF "Waste Treatment") do not define BAT associated emission levels for PCDD/F or PAH.

Large Combustion Plants

The Large Combustion Plants Directive (LCPD, 2001/80/EC) has been integrated in the Industrial Emissions Directive (2010/75/EC). It does not cover POP emission directly. However, it has some effect on emissions of POPs as it sets definition of emission limit values for dust. Some of these values have been made stricter in the IED.

Waste Incineration Plants

The WID has been integrated in the Industrial Emissions Directive (2010/75/EU). Annex VI of the IED lists special provisions for cement kilns, combustion plants and for industrial sectors co-incinerating waste. In comparison to the Waste Incineration Directive 2000/76/EC some of the POP relevant air emission limit values for dust have been made stricter. The emission limit values for dioxins and furans have remained the same (0.1 ng/Nm^3) as well as the emission limit values for discharges of waste water from the cleaning of exhaust gases.

6.1.4 Medium Combustion Plants Directive MCPD (2015/2193/EU)

The Direcitve on the limitation of emissons of certain pollutant into the air from medium combustrion plants (2015/2193/EU) was adopted on Nov. 5th, 2015. The process of implementation into national law is currently under way by amending the ordinance on combustion plants.

The MCPD does not prescribe emission limit values regarding POPs. However effects may be achieved due to concentration limits for dust into the air.

6.1.5 Water Framework Directive

Article 16 of the Water Framework Directive (2000/60/EC) (WFD) sets out "Strategies against pollution of water". The first step was to establish by way of Decision 2455/2001/EC a first list of priority substances to become Annex X of the WFD. These substances were selected from amongst those presenting a significant risk to or via the aquatic environment, using the approaches outlined in Article 16 of the WFD.

This first list was replaced by Annex II of the Directive on Environmental Quality Standards (Directive 2008/105/EC) (EQSD), also known as the Priority Substances Directive, which set environmental quality standards (EQS) for the substances in surface waters (river, lake, transitional and coastal) and confirmed their designation as priority or priority hazardous substances, the latter being a subset of particular concern.

The list of priority hazardous substances (PHS) includes:

- hexachlorobenzene (PHS)
- polyaromatic hydrocarbons (all PHS) (benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene)
- pentachlorobenzene (PHS)

As required by the WFD and EQSD, the Commission subsequently reviewed the list and in 2013 the WFD and the EQSD were amended by Directive 2013/39/EU. The main features are:

- 12 additional priority substances or groups of substances, 4 of them designated as priority hazardous substances;
- stricter EQS for four existing priority substances and slightly revised EQS for three others;
- the designation of two existing priority substances as priority hazardous substances;
- the introduction of biota standards for several substances;
- provisions to improve the efficiency of monitoring and clarifying reporting requirements with regard to certain substances behaving as ubiquitous persistent, bioaccumulative and toxic (uPBT) substances;
- a provision for a watch-list mechanism designed to allow targeted EU-wide monitoring of substances of possible concern to support the prioritisation process in future reviews of the priority substances list.

The environmental quality standards for hexachlorobenzene, pentachlorobenzen and PAH as defined in Annex I of Directive 2008/105/EC in the version of Directive 2013/39/EU are summarised in the two tables below:

Table 65: Environmental quality standards (EQS) as defined in Annex I of directive 2008/105/EC.

Pollutant	**AA-EQS* Inland surface waters**	**AA-EQS* Other surface waters**	**MAC-EQS** Inland surface waters**	**MAC-EQS** Other surface waters**	**UQN Biota**
Hexachlorobenzene	-	-	0.05 µg/l	0.05 µg/l	10 µg/kg
Pentachlorobenzene	0.007 µg/l	0.007 µg/l	Not applicable	Not applicable	-
Polyaromatic hydrocarbons (PAH)					
Benzo(a)pyrene	0.05 µg/l	0.05 µg/l	0.1 µg/l	0.1 µg/l	5 µg/kg
Benzo(b)fluoranthene Benzo(k)fluoranthene	Σ=0.03 µg/l	Σ=0.03 µg/l	Not applicable	Not applicable	-
Benzo(g,h,i)perylene Indeno(1,2,3-cd)-pyrene	Σ=0.002 µg/l	Σ=0.002 µg/l	Not applicable	Not applicable	-

* *AA-EQS … Annual average value for the EQS*

** *MAC-EQS … maximum allowable concentration*

Table 66: Environmental quality standards (EQS) as proposed in Annex I of directive 2013/39/EU.

Pollutant	AA-EQS* Inland surface waters	AA-EQS* Other surface waters	MAC-EQS** Inland surface waters	MAC-EQS** Other surface waters	UQN Biota
Hexachlorobenzene	-	-	0.05 µg/l	0.05 µg/l	10 µg/kg
Pentachlorobenzene	0.007 µg/l	0.007 µg/l	not applicable	not applicable	-
Polyaromatic hydrocarbons (PAH)					
Benzo(a)pyrene	$1.7*10^{-4}$ µg/l	$1.7*10^{-4}$ µg/l	0.27 µg/l	0.027 µg/l	5 µg/kg
Benzo(b)fluoranthene	-	-	0.017 µg/l	0.017 µg/l	-
Benzo(k)fluoranthene	-	-	0.017 µg/l	0.017 µg/l	-
Benzo(g,h,i)perylene	-	-	$8.2*10^{-3}$	$8.2*10^{-4}$	-
Indeno(1,2,3-cd)-pyrene	-	-	-	-	-

* *AA-EQS … Annual average value for the EQS*

** *MAC-EQS … maximum allowable concentration*

6.1.6 Air Quality Directive

The **Clean Air For Europe (CAFE) Directive** (2008/50/EC) was published in May 2008.

It does not address POPs directly but might be of relevance as it covers pollutants associated with combustion processes.

The **4th Daughter Directive 2004/107/EC** deals with arsenic, nickel, cadmium, mercury and PAHs[19]. It specifies limit or target values together with deadlines for meeting these values. In addition obligations are laid down for monitoring these pollutants in ambient air.

POPs are not addressed directly with the exception of PAH. However, as unintentionally produced POPs are mostly formed during combustion processes and emitted into air either in gaseous form or bound to particles, every measure aiming at the reduction of emissions of particulate matter, metals and CO has the co-benefit of reducing POPs emissions. For benzo(a)pyrene a target value of 1 ng/m³ has been laid down in the 4th Daughter Directive. From 2013 onwards this target value shall not be exceeded. Member States shall take all necessary measures not entailing disproportionate costs to ensure this.

6.1.7 Pollutant Release and Transfer Register (PRTR)

Regulation No. 166/2006/EC of the European Parliament and of the Council of 18 January 2006 provided for the setting up of a Pollutant Release and Transfer Register (PRTR) at European Union (EU) level in the form of a publicly accessible electronic database. This database meets the requirements of the UNECE Protocol on Pollutant Release and Transfer Registers, signed by the Community in May 2003.

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[19] Environmental targets were defined for Ni, As, Cd and benzo(a)pyrene.

The public is able to access this register free of charge on the internet and is able to find information using various search criteria (type of pollutant, geographical location, affected environment, source facility, etc.).

The register contains information on releases of pollutants to air, water and land, as well as transfers of waste and pollutants, where emissions exceed certain threshold values and result from specific activities. The register also covers releases of pollutants from diffuse sources (such as transport). Apart from their releases of pollutants to air, water, land and wastewater destined for treatment in external wastewater treatment plants, industrial facilities subject to the IED regime have to report their transfers of waste if they exceed annual threshold levels as laid down in the Regulation. Reporting obligations include also PeCB (BIPRO 2011).

6.1.8 Waste Framework Directive

At EU level, the basic legislation with respect to waste management is the Waste Framework Directive 2008/98/EC (replacing and repealing the former Waste Framework Directive 2006/12/EC with effect of 12 December 2010).

The Directive contains definitions for waste as well as waste categories and disposal and recovery operations; inter alia it sets criteria for end-of-waste-status of items and introduces “reuse” as favorable option within the waste hierarchy.

Furthermore properties and characteristics rendering waste hazardous as well as specific obligations for hazardous wastes are introduced in the new Waste Framework Directive.

6.1.9 Other relevant EU legislation

The following EU Directives or Regulations are potentially relevant for the control of POPs releases:

- Directive of the European Parliament and of the Council on the Protection of Groundwater against Pollution and Deterioration (2006/118/EG)
- Sewage sludge Directive (86/278/EEC)
- Directives concerning Motor Vehicles
- Directive on Waste Electrical and Electronic Equipment (WEEE) (2012/19/EU)
- Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) (2011/65/EU)
- Directive on the landfill of waste (1999/31/EG)
- Council Regulation (EC) No 1013/2006 on the supervision and control of shipments of waste within, into and out of the Community

For detailed information please refer to the National Action Plan 2008 (UMWELTBUNDESAMT 2008b).

6.2 Developments in National Legislation since 2012

The following legislation has not undergone changes with regard to emissions of POPs. Therefore, for detailed information refer to the National Action Plan 2008 (UMWELTBUNDESAMT 2008b).

- Industrial Code 1994 (GewO 1994), BGBl. No. 1994/194 as amended
- Ordinance on Non Ferrous and Refractory Metals Production (BGBl. II No. 2008/39)

6.2.1 Specific Ordinances

6.2.1.1 Emission Protection Act for Steam Boilers 2013 (Fed. Law Gaz. I No. 127/2013 as amended by BGBl. I No. 81/2015)

The Emission Protection Act applies to steam boilers as well as gasturbines and gas engines with a rated thermal input of > 50 MW. It gives the legal environmental framework for operating such plants in the energy and industry sector and prescribes emission limit values for a variety of pollutants depending on the fuels used for plants with a rated thermal input of > 50 MW. For plants smaller than 50 MW rated thermals input the former Clean Air Ordinance for Steam Boilers, which expired on Dec. 31st 2013, should be used as reference for setting emission limit vales. Emissions of PCDD/F are not regulated directly. However, both documents have some effect on emissions of POPs due to the definition of emission limit values for dust, CO, C_{org} and NOx.

6.2.1.2 Ordinance on Combustion Plants (BGBl. No. II 1997/331 as amended by BGBl. No. II 2011/312)

The Ordinance applies to combustion installations >50 kW in the trade and industrial sector that are not connected to a steam boiler. It describes requirements concerning the monitoring of emissions, operating conditions, inspections of installations and emission limit values for certain pollutants depending on the fuels (such as coal, biomass, oil, and gas) used. Emissions of PCDD/F are not regulated directly. However, the ordinance has some effect on emissions of POPs due to the determinationof emission limit values for dust and CO regarding the combustion of gas, oil and coal. In addition to the mentioned pollutants, there is a limit value for organic carbon which applies to the combustion of biomass.

The amendment in 2011 led to some modifications: The emission limit values for dust became more stringent and the ordinance provides for the first time emission limit values for dust, CO, HC, and NO_x for the combustion of biomass other than wood (such as straw or miscanthus).

6.2.1.3 Ordinance on Iron and Steel Production (BGBl. II No. 54/2016)

This ordinance replaces the former ordinance on Iron and steel production (BGBl. II No. 160/1997 as amended by BGBl. II No. 2007/290. The ordinance covers air emissions from the production of iron and steel in integrated steelworks (without coke oven and sinter plants) and by electric arc furnaces (EAF) and the processing of iron/steel. For PCDD/F the following emission limit values are set:

- installations for the production of iron and steel, where the formation of PCDD/F can be expected, because of the input materials used: 0.1 ng/Nm^3
- installations for the production of steel in electric arc furnaces, induction furnaces and ladle furnaces: 0.1 ng/Nm^3.

6.2.1.4 Ordinance on Sinter Plants (BGBl. II No. 1997/163)

The ordinance covered air emissions from sinter plants. For PCDD/F a limit value (0.4 ng/Nm^3) was set (referred to measured oxygen content), however this limit value was not applicable for installations, which were permitted before 01/2004. The ordinance has been repealed in 2014 (BGBl. II No. 303/2014). For sinter plants the BAT conclusions for iron and steel (EUROPEAN COMMISSION 2012) have to be applied. The BAT-AEL for PCDD/F from sinter plants using fabric filters is <0.005-0.2 ng/Nm^3, for sinter plants using high advanced electrostatic precipitators it is <0.2-0.4 ng/Nm^3.

6.2.1.5 Ordinance on Foundries (BGBl. II No. 264/2014)

The ordinance gives limit values (mass flow and/ or concentration) for dust and organic substances for different furnace types (steel and cast iron, aluminium, lead, other metals, heat treatment). Limit values are also given for these pollutants for activities such as sand regeneration, mould production, cleaning and fettling and core production. Some general limit values are given for special organic substances and heavy metals.There is no general reference oxygen content, in most cases the oxygen content of the exhaust gas is chosen as reference value.

6.2.1.6 Waste Incineration Ordinance (BGBl. II No. 389/2002 as amended BGBl. II No. 476/2010, 135/2013 and BGBl. I No. 127/2013)

The Waste Incineration Ordinance requires waste incineration and co-incineration plants (such as large combustion plants, cement kilns and industrial boilers) to be built and operated according to Best Available Techniques (= State of the Art). It defines among others operational requirements (such as the minimum temperature for combustion and the residence time of flue gas within a given temperature level), requirements for input control of waste, monitoring and reporting obligations and prescribes emission limit values for a variety of pollutants including PCDD/F. In general the ELV for PCDD/F for incineration and co-incineration plants is 0.1 ng/Nm^3 (11% oxygen).

Due to the limitation of emissions of dust, CO and C_{org} (and to a certain extent of NO_x) the Waste Incineration Ordinance also has an indirect influence on the reduction of POP emissions.

Concerning PCDD/F concentrations in wastes from waste incineration or co-incineration plants the Ordinance provides for the environmentally sound disposal where the total content exceeds a limit value of 100 ng/kg PCDD (I-TEQ).

Wastes which are incinerated in co-incineration plants have to reach the limit values specified in Annex 8, for waste oils and solvents the limit value for PCB is 10 mg/kg.

6.2.1.7 Implementation of MCPD

The process of implementation into national law is currently under way by amending the ordinance on combustion plants.

6.2.2 Austrian Water Act and Specific Ordinances

The basic document for water-related legislation is the Water Act 1959 (BGBl. No. 215/1959).

For an overview of the Austrian Water Act and its relevant ordinances please refer to the National Action Plan 2008 (UMWELTBUNDESAMT 2008b).

New developments:

Based on the requirement to define environmental quality standards (EQS) codified in §30(a) of the Austrian Water Act the Ordinance on the determination of the target state for surface waters (BGBl. No. 96/2006) prescribes environmental quality standards for 72 substances and groups of substances. These EQS determine the criteria for the good chemical status of surface waters and the chemical parameters for the good biological status. Also POPs and POP like substances are included, e.g. hexachlorobenzene, DDT, aldrin, dieldrin, endrin, heptachlor, etc. In 2010 the Ordinance was amended and the environmental quality standards according to Directive 2008/105/EC were adopted (BGBl. II No. 461/2010).

In order to continuously assess, to monitor and to adapt monitoring programmes to actual necessities the Ordinance on the monitoring of the status of water bodies (BGBl. II No. 479/2006, amended 2010 by BGBl. II No. 465/2010) (originally issued in 1991) was amended in 2006 and 2010. The aim of the monitoring programme is to assess the status of water bodies. The parameters to be considered by the monitoring programme include all pollutants for which EQS have been defined (e.g. POPs and POP like substances such as HCB, PAH, etc.). Beside surface waters, these pollutants also have to be analysed in lake samples and groundwater samples.

In 2010, the Ordinance on Chemical Quality Targets for Groundwater ("Qualitätszielverordnung Chemie Grundwasser" – Austrian Federal Law Gazette II No 98/2010) replaced the former Ordinance on groundwater threshold values. The Ordinance now fully implements the legal requirements of the new EU Groundwater Daughter Directive (2006/118/EC).

Among other things, it lays down the criteria (groundwater threshold values) and the methodology (compliance regime) for assessing the chemical status of groundwater bodies thus providing a basis for establishing necessary measures.

The ordinance gives individual threshold values for a limited number of POPs only (e.g. sum of PAHs, sum of TRI and PER, Aldrin, Dieldrin etc.) and a general groundwater threshold value for pesticides (0.1 µg/l) and the sum of pesticides (0.5 µg/l).

Furthermore, POPs are also mentioned in Annex 2 which lists those substances where direct input into groundwater has to be prevented according to Article 6.

The Ordinance on the establishment of an electronic register for the collection of relevant discharges from point sources into surface water (BGBl. II Nr. 29/2009) entered into force in 2009. The Ordinance requires industrial dischargers as well as municipal wastewater treatment plants with a capacity of more than 10,000 population equivalents to report emissions of relevant pollutants into register. For example, discharges of Pentachlorobenzene have to be measured and reported. Such discharges are attributed to the following industrial activities (classification according to E-PRTR Regulation Annex I):

- 4d, Chemical installations for the production on an industrial scale of basic plant health products and biocides
- 5a, Installations for the recovery or disposal of hazardous waste
- 5c, Installations for the disposal of non-hazardous waste
- 5d, Landfills
- 5g, independently operated industrial waste-water treatment plants
- 6b, Industrial plants for the production of paper and board and other primary wood products (such as chipboard, fibreboard and plywood)

A first evaluation of data in 2011 showed, that concentrations in industrial effluent discharges aldrin, benzo(a)pyren, polybrominated diphenylether, chlordan, chlordecon, dieldrin, endrine heptachlor and mirex are below the respective limit of detection. For benzo(g,h,i)perylen, dioxine, fluoranthen, hexachlorcyclohexane including lindane, PCB, pentachlorbenzene and toxaphen quantifiable concentrations were found in a number of waste water discharges. A more detailed analysis of these results is not possible for the time being as tools for data retrieval and assessment are still being developed.

For more information on the General Ordinance on Waste Water Emissions (BGBl. No. 186/1996) and on relevant sector specific waste water emission ordinances (e.g. ordinance on waste water emissions from flue gas treatment (BGBl. II No. 271/2003) please refer to the National Action Plan 2008 (UMWELTBUNDESAMT 2008b).

6.2.3 Ordinance on Landfills (BGBl. II No. 39/2008)

(Amended by BGBl. II No. 185/2009, 178/2010, 455/2011 and 104/2014)

According to the Ordinance on landfills only the disposal of waste with the lowest possible reactivity has been permitted since 2004 (or, in exceptional cases, since 1 January 2009). A large part of waste materials, among them municipal solid waste, must therefore undergo thermal and mechanical-biological pretreatment before being landfilled.

The Landfill Ordinance 2008 implements the EU Directive 1999/31/EG and Council Decision 2003/33/EG.

It determines the following classes of landfills:

1. Landfill for excavated soils
2. Landfill for inert waste
3. Landfill for non hazardous waste
    a) Landfill for demolition waste
    b) Landfill for residual materials
    c) Mass waste landfill
4. Landfill for hazardous waste (exclusively underground waste storage)

Annex 1 of the Landfill Ordinance 2008 gives limit values for the acceptance of different waste streams of landfills.The POP relevant limit valuesforthe landfill classes are listed below. PAHs are defined as the sum of 16 substances according to EPA (naphthalene; acenaphthylene; acenaphthene; fluorene; phenanthrene; anthracene; fluoranthene; pyrene; benzo(a)anthracene; chrysene; benzo(b)fluoranthene; benzo(k)fluoranthene; benzo(a)pyrene; dibenzo(a,h)anthraxcene; indeno(1,2,3-c,d)pyrene; benzo(g,h,i)perylene).

Table 67: Landfill classes and limit values according to Annex 1 of the Landfill Ordinance 2008

Landfill class	Pollutants, POP relevant	Limit value [mg/kg dry matter]
Landfill for excavated soils	PAH thereof benzo(a)pyrene	4 0,4
Landfill for inert waste	PAH thereof benzo(a)pyrene	20 2
Landfill for demolition waste	PAH	30
Landfill for residual materials	PAH	300
Landfill for mass waste	PAH	300

For detailed information on the Compost Ordinance (BGBl. II No. 2001/292), on Ordinances on Sewage Sludge and Compost and on the protection of soil of the Federal Provinces please refer to the National Action Plan 2008 (UMWELTBUNDESAMT 2008b).

6.2.4 Ambient Air Quality Act (Immissionschutzgesetz – Luft, IG-L)

The legal regulations for air quality assessment and management in Austria are stipulated in Ambient Air Quality Act (IG-L; BGBl. I No. 115/1997, as amended, implementing the Air Quality Directive, Directive 2008/50/EC on ambient air quality and cleaner air for Europe and the 4th Daughter Directive, Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air) and its ordinances. In the case of exceedances of air quality limit values abatement measures have to be applied. Like the Air Quality Directive and the 4th Daughter Directive, the Ambient Air Quality Act does not cover POPs directly, with the exception of benzo(a)pyrene for which a target value (1 ng/m^3) is given (this target value is a limit value since 2013 in Austria). However, as unintentionally produced POPs are mostly due to combustion processes, this type of POPs is strongly related to gaseous and particle pollutants for which abatement measures have to be applied in case of exceedances. For benzo(a)pyrene obligations for monitoring are laid down in an ordinance related to the IG-L. In 2015 30 sites were operated.

6.2.5 Air quality plans under Air Quality Directive

In case of an exceedance of an air quality limit value or target value, plus any relevant margin of tolerance for one or more pollutants, Member States shall ensure that a plan is prepared or implemented for attaining the limit value within the specific time limit (Air Quality Directive, Article 23 (1)). In case the attainment deadline is already expired, the exceedance period has to be kept as short as possible. Plans have to be sent to the European Commission no later than two years following the year the exceedance has been observed.

Most air quality plans reported so far to the Commission deal with PM_{10} and NO_2, some also with SO_2. In most cases, traffic was identified as the main source for PM_{10} and NO_2 exceedances, followed by industry, commercial and residential sources. The abatement measures foreseen in the plans therefore also deal with these polluters.

6.2.6 Residential Combustion Sources

The responsibility for regulating the operation of residential combustion sources lies with the federal provinces. As a consequence requirements concerning product certificates, emission limit values, monitoring of emissions and inspections slightly vary.

An agreement pursuant to Article 15a of the Federal Constitution Act concerning the placing on the market and the inspection of combustion plants/firing installations was concluded in January 2011.

It establishes uniform minimum requirements for the operation of these types of installations in all provinces and will help to reduce environmental impacts from these sources. The agreement includes requirements concerning

- placing on the market
- type tests, conformity tests and labelling
- emission limit values for dust, NO_x, CO and TOC
- inspection of combustion installations
- efficiency requirements
- requirements on permitted fuels
- refurbishment
- advisory service

Another relevant agreement (agreement pursuant to Article 15a of the Federal Constitution concerning the setting of consolidated quality standards to support the establishment and refurbishment of residential buildings for the purpose of the reduction of greenhouse gases) aims to reduce energy consumption in residential buildings. It is thus intended to reduce fuel consumption and emissions from combustion installations in this source category.

6.2.7 Open burning of biogenic materials

The Federal Act on Air Pollution Prevention (BGBl. I No. 137/2002, as amended BGBl. I No. 50/2012 and 97/2013) imposes a ban on open burning of biomass and other materials. The provincial governor may grant exemptions from this ban in specific cases.

6.3 Other measures

6.3.1 Waste as Alternative Feedstock in Installations for Cement Production

Concerning POP emissions which arise from waste used in cement kilns not as alternative fuel, but as alternative feedstock, the Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management drew up a document concerning the “Technical Basis for the Use of Waste as Alternative Feedstock in Installations for Cement Production” (BMLFUW 2016b). It was compiled with inputs of the competent authorities and the Environment Agency Austria. The document provides recommendations for the permit conditions for the competent authorities, regarding technical conditions for the kiln and prior outgassing experiments with the waste, and includes references to the POP Regulation (EC) No 850/2004. The suggested provisions have similarity to the Swiss Ordinance on the Prevention and Disposal of Waste (VVEA) from 2016 and are along the lines of the Austrian ordinance AVV which regulates the use of waste as alternative fuel.

6.3.2 Paper, paper board and packaging paper

The German Federal Institute for Risk Assessment has published recommendations concerning input, used auxiliary materials, filling agents and additives for paper, paper boards and packaging papers which get in contact with food (BfR-Recommendation No. XXXVI, No. XXXVI/1 and No. XXXVI/2). These recommendations comprise a list of materials which can be used for the described purposes, in line with upper concentration limits for a wide range of chemicals. However, Annex C POPs are not regulated here.

6.3.3 Biomass plants serving the purpose of centralised district heating

Biomass plants serving the purpose of centralised district heating are funded by environmental support schemes when certain requirements with regard to energy efficiency, operating conditions, emissions and reporting of emissions are fulfilled. Plants subject to this funding scheme have to meet ELVs for dust, NO_x, CO and C_{org} depending on their size. However, since most ELVs are the same as prescribed in e.g. the Ordinance on combustion installations any additional effect on reduction of POPs emissions is caused by requirements concerning energy efficiency.

6.4 Overview on Monitoring activities and Surveys on federal level since 2012

6.4.1 Ambient Air Monitoring

As described in chapter 6.2.4 benzo(a)pyrene in PM_{10} is required at 30 monitoring sites at least. At several sites in Upper Austria and Styria and the rural background site Illmitz in addition to benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene and dibenz(a,h)anthracene as well as the deposition of benzo(a)pyrene are monitored. Results of all monitoring activities are published in an annual air quality report (see e.g. UMWELTBUNDESAMT 2016, d). Mobile stations are operated by the government of Styria at varying locations[20]. The target value of the 4th Daughter Directive of 1 ng/m³ for benzo(a)pyrene which 2013 has become a limit value was exceeded in recent years at various locations in valleys and basins south of the main Alpine ridge and in the hilly region south-east of the Alps. The reasons for these exceedances are high emissions from wood burning in domestic combustion, in combination with adverse dispersion conditions in winter due to the topographic and climatic situation (UMWELTBUNDESAMT 2014b, 2016e, 2017a).

B(a)P comprises about 65 to 75% of the total TEF weighted PAH sum.

The few available long-term monitoring series of B(a)P show a slowly decreasing trend with high inter-annual variations. The trend does not correspond to PM_{10} concentrations and to winter temperatures.

Atmospheric dispersion modelling of B(a)P for Styria shows a highly variable concentration pattern with levels above the limit value in many villages and towns (UMWELTBUNDESAMT 2016e). Overall about 700,000 people are living in areas in Styria where the limit value was exceeded in 2015, and about 6,000 in Carinthia.

In 1997 a monitoring programme started with the objective to observe long term trends of PCDD/F and additionally PCB in the air. The monitoring programme comprised eight sampling sites representing urban, rural, industrial and remote locations. (MOCHE & THANNER 2002).

Datasets of 1992/93 compared with those of the monitoring programme showed a slight decrease of PCDD/F in the air during winter, whereas the summer levels are almost equal. The monitoring programme shows that there is still a clear seasonal trend for ambient air concentrations of PCDD/F with a maximum during the winter season. PCDD/F-data compared with ambient temperatures clearly indicates that domestic heating is the major source for increasing dioxin levels in ambient air during winter. Also PCBs show a seasonal trend, but contrary to PCDD/F the PCBs show highest concentrations during the summer season. This observation indicates different sources for PCB in ambient air than for PCDD/F. Since the start of the monitoring programme no significant change, neither increase nor decline of the annual PCDD/F and PCB levels in ambient air could be observed. The last monitoring cycle has been completed in 2010.

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[20] http://www.umwelt.steiermark.at/cms/ziel/19221975/DE/

Since 2005 and with the international project MONARPOP (see 6.4.6) the concentrations of all POPs of the Stockholm Convention and the POPs Protocol and of some emerging POPs in ambient air and deposition at three Alpine summits (in Austria: Sonnblick, in Germany: Zugspitze, in Switzerland: Weißfluhjoch) have been monitored (OFFENTHALER et al. 2008). Air sampling is carried out continuously throughout the year (in subsequent three-months sampling periods) but separately according to source regions of the arriving air masses. Sampling is distributed between separate filters assigned to one of four source regions. Filters are switched according to daily trajectory forecasts.The selected source regions (possibly important for the Alps) are

1. the industrial regions of Germany, Great Britain, Belgium, The Netherlands in the Northwest of the Alps,
2. the industrial region of Czech Republic, Slovakia and Poland in the North East of the Alps,
3. the industrial region of the Po basin in Italy and
4. the remaining source regions.

With its ambient air monitoring activities for POPs at remote sites, MONARPOP has been included in the "Global Monitoring Plan" for the "Effectiveness Evaluation" of the "Stockholm Convention". The results of the air measurements at remote summits were included in the 1st and 2nd Global Monitoring Report under the UN Stockholm Convention (UNEP 2009, 2015).

The detected active air concentrations of POPs at the Alpine summits document well that an air transport of these compounds exists across the Alps – even though it is reduced according to the enhanced deposition of POPs at the peripheral parts. All SOCs (OCPs, PCDD/F, PCB, PBDE, PAH), and even compounds that have been banned in Europe for decades (e.g. DDT) or have not even been used in significant amounts in Central Europe (e.g. mirex), have been detected in air and deposition indicating their steady deposition at the remote summits by atmospheric transport.

Air concentrations at the summits were similar or slightly higher to Arctic values (compiled in UNEP 2009, 2015), but clearly lower than in source regions (UMWELTBUNDESAMT 2015, KIRCHNER et al. 2016). For PCB and DDT the means are higher in the Alps than at sites of the northern latitudes. Air concentrations of OCPs at these summit stations were definitely lower than those from source regions, but higher than in the Arctic region. The PCDD/F air concentrations at the three summits in the European Alps are similar to those of remote sites in the USA as measured by the NDAMN monitoring program and one to two orders of magnitude lower than in conurbations. The PCB concentrations are about one order of magnitude lower than in conurbations. The PCB air concentrations from the western site (Weissfluhjoch, CH) are higher than those of to the most eastern site (Sonnblick, A), a result that is confirmed by the regional distribution of PCB concentrations in the forest soil and needles of the numerous MONARPOP sites.

However, deposition of PCDD/F and PCB at the summits reaches magnitudes as reported for sites close to sources. This result gives evidence for the significant input of POPs in the Alps region. The deposition of compounds gives a better indication for the pollutant input to vegetation and soil, and should deserve more attention than the air concentration.

With very few exceptions (see below) no significant trend in the air concentrations and deposition of POPs could be assessed at the three summits (UMWELTBUNDESAMT 2015, Kirchner et al. 2016). Only some of the studied pesticides showed a significant trend of air concentration decrease at all, one or two of the three sites: Endosulfan at all three sites, heptachlor at Sonnblick, α-HCH at Weissfluhjoch, PeCB and trans-chlordane at Zugspitze (KIRCHNER et al. 2016).

A seasonal trend with higher OCP air concentrations and deposition in summer and lower ones in winter could be detected for some compounds (JAKOBI et al. 2014, KIRCHNER et al. 2016). For PCDD/F and PCB such trend did not occur (UMWELTBUNDESAMT 2015).

For only very few compounds higher POP air concentrations could be detected at the Alpine sites in correlation with the source region of the air masses, namely for air masses originating from the North-East-European source region. However, air masses from this source region are significantly lower (about half as) frequent at the summits than air masses originating from the other studied source regions (UMWELTBUNDESAMT 2015, KIRCHNER et al. 2016). Consequently, air masses from the North-East-European source region are not responsible for higher POP loads in the Alps.

In 2010 to 2013 RECETOX (Masaryk University, Brno) and the Environment Agency Austria carried out the EU-funded MONAIRNET project at 20 sites of the Austrian/Czech border region (http://www.monairnet.eu/index-de.php). The project used the same monitoring methods as in MONARPOP (active and passive air sampling, deposition sampling, needle sampling). The project should allow for a cross border comparison of the POPs load of this region with different emission history. The two rural active air monitoring sites of MONAIRNET (Grünbach in Northern Austria and the EMEP site Košetice in the Czech Republic) showed significant higher air concentrations for PCDD/F, DDX (only Košetice), similar air concentrations for PCB, HCB, lindane, DDX (only Grünbach) and lower air concentrations for PBDE than the average from the three MONARPOP summit sites in the Alps. The southern Czech region showed significant higher air concentrations of DDX (particular the Eastern Czech sites) than the Northern Austrian study region, while the northern Austrian region showed significant higher pentachlorobenzene (particularly in Upper Austria), PCB and lindane air concentrations than the southern Czech study region of MONAIRNET. The results for deposition partly deviate from the results for the air concentration: Deposition of PCB and sum HCH were higher at the southern Czech sites than at the Northern Austrian sites. For PCDD/F the regional differences were also not so clear and depended on the studied medium. Seasonal differences were detected: The highest air concentrations and depositions of most OCPs and of perfluorinated compounds (PFxC) were detected in summer. Regarding deposition, even PCDD/F and PCB showed the higher input in the warmer periods than in winter. Some source regions of the air masses were frequently correlated with higher POPs air concentrations detected at the MONAIRNET sites (near range N region for Grünbach, near range S/SE/SW region and long range NE/E/SE region for Košetice). However, similar to the Alpine sites the source regions with higher concentrations were not the predominant source regions for the arriving air masses (but the long range SW/W/NW region for both sites). Therefore, sources responsible for the POP concentrations of the air masses originating from this most frequent source region may have a higher impact on the POPs load of the studied MONAIRNET sites.

2017 a new project called “PureAlps”[21] has been started. PureAlps is designed to protect the Alps from persistent chemicals which have a potential for accumulation in organisms and which are toxic. It is funded by the Bavarian State Ministry of Environment and Consumer Protection and by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.

This follow up project from MONARPOP uses measurement devices at the highest research sites in Germany (Mount Zugspitze) and Austria (Hoher Sonnblick).

Substances which are focus of PureAlps are:

Mercury, Per- and polyfluorinated chemicals (PFC), brominated flame retardants such as HBCD (Hexabromocyclododecane) and PBDEs (Polybrominated diphenyl ethers). Additionally PureAlps extends the time series for atmospheric concentrations and deposition of dioxins and furans, PCB and organochloro-pesticides (OCP).

6.4.2 Emissions Monitoring

For monitoring measures undertaken in previous years please refer to the National Action Plan 2008 (UMWELTBUNDESAMT 2008b).

6.4.3 Food and feed monitoring

The Austrian Agency for Health and Food Safety, competent authority for food safety and control, carries out a food monitoring programme once a year. Samples are collected from all nine provinces of Austria covering all components of average Austrian diet.

In order to evaluate the contamination levels in various food products on the Austrian market and to assess the dietary exposure of the Austrian population for the first time, a national monitoring programme was conducted from 2005 to 2011. The 235 food products comprised meat, poultry, game and offal, fish and fish products, milk and dairy products, eggs, animal fats and vegetable oils. Lowerbound and upperbound concentrations of PCCD/F and DL-PCBs (in WHO TEQ pg/g fat or fresh weight) were e.g. 0.79-1.16 in meat, poultry, game and offal; 0.96-1.33 in ruminants; 3.86-4.39 in livers from terrestrial animals, 0.49-0.51 in fish and fish products, 0.73-1.20 in milk and 0.81-1.15 in cheese. To estimate the dietary intakes of PCDD/Fs and dl-PCBs, mean concentrations in food were combined with the respective food consumption data from the Austrian food consumption survey. Estimated dietary intakes were expressed as toxic equivalents (WHO-TEQs 1998). The mean intakes for PCDD/Fs and dl-PCBs were estimated as 0.77, 0.75 and 0.61 pg WHO-TEQ/kg bw day for children, women and men, respectively. The main contributors to total intake were milk and dairy products followed by fish and fish products for children and women, and meat, poultry, game and offal for men (65% and 15% for children, 67% and 14% for women, and 63% and 19% for men, respectively). (Rauscher Gabernig et al. 2013).

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[21] https://www.lfu.bayern.de/analytik_stoffe/purealps/english/index.htm

Feed and food monitoring for PCDD/F and dioxinlike-PCBs is an ongoing process undertaken with the aim to comply with obligations arising from EC- and national legislation.

HCB

Within accidentially contaminated area in Austria a total of 771 samples of food originating from the area were analysed for HCB. HCB was frequently quantified in foods of animal origin. Especially in high-fat containing food groups such as fats, oils and butter, meat, processed meat, milk and milk products measurable HCB concentrations were found. The highest content was found in beef with a maximum of 625 µg/kg. But also plants such as pumpkins in the oil-rich pumpkin seeds and various herbs with large leaf surface, e.g. peppermint and thyme, may accumulate HCB. In vegetable oils the highest detected concentration was 111 µg/kg (Mihats et al. 2016).

Other POPs

Dietary exposure to non-dioxin-like PCBs of different population groups in Austria has been assessed (Mithats et al. 2015) as well as to PFOS and PFOA (Mihats et al. 2014).

6.4.4 Water Monitoring

6.4.4.1 Surface water bodies

All large surface water bodies are tested for pollutants – including POPs. Analyses are carried out mostly in water but also biota samples are investigated. The monitoring programmes are constantly updated and focus increasingly on the substances (substances, that describe the ecological and chemical status of the water bodies) listed in the Water Framework Directive and in the respective national implementation (e.g. *Ordinance on the determination of the target state for surface waters, BGBl. II No. 2006/96*). The list of priority substances (Annex X of WFD – chemical status) and the Directive on environmental quality standards (2008/105/EC; 2013/39/EU) include a number of POPs and other chemicals with POP-like properties. POPs and POP-like substances must be taken into consideration in evaluating the chemical and the ecological status of a specific water body.

Monitoring is predominantly based on the *Ordinance on the monitoring of the status of water bodies (BGBl. II No. 2006/479).* In addition to the regular monitoring activities on large surface water bodies, several operative programmes were performed on behalf of the Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management in the course of the analysis of the current status in line with Art. 5 of the WFD. These monitoring programmes are pressure specific and include pollutants such as hexachlorobenzene and PAH, as well as DDT, aldrin, dieldrin endrin, heptachlor and others.

Concentrations of pollutants in surface water bodies – including a number of substances of the Stockholm Convention – are measured in Austria in the context of various obligations and monitoring programmes and are available to the public on the Internet (http://wisa.lebensministerium.at). The monitoring results for PCDD/PCDF, hexachlorobenzene (HCB), polychlorinated biphenyles (PCBs), pentachlorobenzene (PeCB) as well as for polycyclic hydrocarbons (benzo(a)pyren B(a)P, benzo(b)fluoranthen B(b)F, benzo(k)fluoranthen (B(k)F, benzo(g,h,i)perylen (BP), indeno(1,2,3-c,d)pyren IP) are summarized in the following table:

Table 68: Summary of the monitoring results for surface waters for hexachlorobenzene (HCB), PAHs and pentachlorobenzene (PeCB).

	2000			**2003**			**2013**		
	n	n>LOQ	max [µg/l]	n	n>LOQ	max [µg/l]	n	n>LOQ	max [µg/l]
HCB	68	0	-	341	0	-	-	-	-
PeCB	97	0	-	341	0	-	-	-	-
B(a)P	133	4	0.009	356	127	0.019	304	26	0,023
B(b)F	133	5	0.01	356	57	0.019	304	10	0,0083
B(k)F	133	3	0.006	356	14	0.012	304	5	0,0048
BP	133	2	0.005	356	45	0.014	304	22	0,0088
IP	133	1	0.001	356	48	0.016	304	12	0,0098

Additionally to the monitoring in water also biota samples are investigated. Due to the EQS directive (2008/105/EC and 2013/39/EU) defined substances have to be monitored in biota for compliance assessment and for trend analysis. Biota analyses were performed in the years 2008 (BMLFUW 2010), 2010 (BMLFUW 2012) and 2013 (BMLFUW 2015b) considering single fish samples as well as pooled fish samples. These fish investigations include a variety of substances as organochlorine compounds (e.g. HCB, HCH, DDT and others), polybrominated compounds (PBDE), fluorinated compounds (PFOS and PFOA) and others. The results for hexachlorobenzene, pentachlorobenzene as well as for dioxins, furans and dioxin-like PCBs are summarized in the table below

Table 69: HCB, PeCB and PCDD/PCDF and dioxin-like PCBs in fish samples from Austrian rivers.

	2008			**2010**			**2013**		
	n	**n>LOQ**	**max [µg/kg]**	**n**	**n>LOQ**	**max [µg/kg]**	**n**	**n>LOQ**	**max [µg/kg]**
HCB	10	-	6,3	32	28	5,4	42	6	34
PeCB	-	-	-	32	23	3,3	42	31	42
PCDD/PCDF and DL-PCB*	-	-	-	-	-	-	58	58	0,016**

* *including 7 polychlorinated dibenzoparadioxines (PCDD), 10 polychlorinated dibenzofuranes (PCDF) und 12 dioxine-like polychlorinated biphenyles (PCB)*

** *refered to TEQ, toxicity equivalents according to WHO 2005.*

Results of the monitoring programme are published as bi-annual reports. Access to data as well as to the reports is provided via the webpage of the Environment Agency Austria – http://www.umweltbundesamt.at/en/umweltschutz/wasser/.

Furthermore, specific substances are analysed in investigative monitoring programmes (run by i.e. regional authorities) and as part of measuring obligations prescribed by international river basin commissions (e.g. ICPDR, Joint Danube Survey). The measuring programmes are constantly updated and increasingly focused on the priority substances specified in the Water Framework Directive.

6.4.4.2 Municipal Wastewater Treatment Plants

Currently no continuous monitoring of effluents of municipal wastewater treatment plants for POPs or POP like substances is performed and the database on emissions of these substances from wastewater treatment plants is limited. In order to improve the knowledge basis and to generate data on those emissions, a monitoring programme was performed in 2007 and 2008. Besides dioxins and PCBs the relevant POPs hexachlorobenzene, polycyclic aromatic hydrocarbons as well as pentachlorobenzene were investigated. None of these pollutants were detectable in the effluents of municipal wastewater treatment plants (UMWELTBUNDESAMT 2009).

In 2012 a few municipal wastewater treatment plants were investigated for the occurrence of polycyclic aromatic hydrocarbons beside other parameters (e.g. polybrominated diphenyl ethers (PBDE), phthalates, PFOS and PFOA, organotin compounds and others). The results for PAHs are presented in the following table. Both investigated wastewater treatment plants are equipped with tertiary treatment including phosphorus and nitrogen removal (BMLFUW 2014). Benzo(p)pyren as well as benzo(b,k)fluoranthen are not detected in the effluent samples. Benzo(g,h,i)perylen and indeno(1,2,3-cd)pyren are detected in few effluent samples.

Table 70: occurence and maximum concentrations [µg/l] of PAH in the effluents of two municipal wastewater treatment plants.

Pollutant	n [-]	LOQ [µg/l]	n>LOQ [-]	Max [µg/l]
Benzo(a)pyren	6	0,02	0	-
Benzo(b)fluoranthen	6	0,0066	0	-
Benzo(k)fluoranthen	6	0,0066	0	-
Benzo(g,h,i)perylen	6	0,001	1	0,0017
Indeno(1,2,3-c,d)pyren	6	0,001	2	0,0015

6.4.4.3 Discharges from urbanized areas via diffuse pathways

Beside emissions via treated wastewater also discharges via diffuse pathways occur. In urbanised areas discharges from combined sewer overflows, urban runoff from separate sewer systems as well as road runoff are of relevance. In 2012 these diffuse pathways were investigated in a few urban areas for the occurrence of polycyclic aromatic hydrocarbons and other parameters (e.g. polybrominated diphenyl ethers (PBDE), phthalates, PFOS and PFOA, organotin compounds and others). Occurence and concentrations of PAH in these diffuse emission pathways are summarised in Table 71. As in the treated effluent samples also in these wastewaters mainly benzo(g,h,i)perylen and indeno(1,2,3-cd)pyren are found, whereas benzo(p)pyren as well as benzo(b,k)fluoranthen are only scarsely detected.

Table 71: Occurrence and concentrations [µg/l] of benzo(a)pyrene (BaP), benzo(b)fluoranthen (BbF), benzo(k)fluoranthen (BkF), benzo(g,h,i)perylene (BP) and indeno(1,2,3-cd)pyren (IP) in combined sewer overflows (CSO), urban runoff from separate sewer systems and road runoff.

		BaP	**BbF**	**BkF**	**BP**	**IP**
CSO	n	7	7	7	7	7
	n>LOQ	0	0	0	6	6
	max	-	-	-	0,0085	0,0039
Urban runoff from SSS	n	6	6	6	6	6
	n>LOQ	0	0	0	2	1
	max	-	-	-	0,0027	0,0021
Road runoff	n	9	9	9	9	9
	n>LOQ	1	1	1	8	6
	max	0,035	0,034	0,019	0,026	0,021

6.4.4.4 Industrial Dischargers

According to the Austrian Federal Ordinance on the establishment of an emission register industrial dischargers have to measure and report emissions of defined pollutants. The Ordinance entered into force in 2009 and the first measurements were performed in 2010. Since 2010 discharges are reported for a number of substances including POPs. Discharged loads are reported on an annual basis and the calculation of the discharges is based on measured concentrations. For load calculations all measurements below the limit of quantification (LOQ) are set equal to zero. Several facilities reported direct discharges for hexachlorobenzene and pentachlorobenzene to surface waters equal to zero.

Direct discharges to surface waters are reported by several facilities for PCB, PCDD/PCDF and PAH. The reported emissions for the reporting year 2014 are summarized in the table below.

Table 72: direct discharges [kg/a] to surface waters for PCB, PCDD/PCDF and PAH reported for the year 2014.

		2014
PCB	[kg/a]	0,0011
PCDD/F	[kg/a]	0,0063
PAH*	[kg/a]	1,3

* *sum of benzo(a)pyren, benzo(b)fluoranthen, benzo(k)fluoranthen, benzo(g,h,i)perylene and indeno(1,2,3-cd)pyren.*

6.4.4.5 Groundwater

In Austria standardised groundwater quality monitoring, based on legal provisions, was established in 1991. Its aim was to ensure the collection of consistent and reliable data to assess the current status of Austrian groundwaters and detect increasing concentrations at an early stage. This information was also to be used as a basis for designing and implementing measures for the protection of groundwater.

The resulting monitoring programme covers groundwater in porous media and in karst and fractured (fissured) rock systems. In total about 2000 groundwater sites are investigated and monitored. Groundwater areas were delineated as monitoring units and the monitoring was carried out on a quarterly basis (up to four times per year) for the whole of Austria.

To comply with the new requirements of the WFD the Austrian Federal Water Act was amended and provided the basis for a new Ordinance for Water Quality Monitoring (BGBl. No. 479/2006). Consequently the groundwater quality monitoring network in Austria was assessed for compliance with the new requirements and, where necessary, the network was amended accordingly. The most important impact resulted from the introduction of WFD groundwater bodies as groundwater management units.

To comply with the WFD and the Austrian Ordinance on Water Quality groundwater monitoring is carried out according to a six year cycle. The cycle starts with an 'initial investigation' under a surveillance monitoring programme. This includes monitoring of an extensive number of parameters.

The parameters listed in the Ordinance for Water Quality Monitoring which are mandatory to groundwater monitoring, 129 in total, are grouped into two parts:

- part 1: important inorganic parameters with relevance to the environment, e.g. nitrate, nitrite, ammonium, phosphate, boron, alkali metaland alkaline earth metal (e.g. potassium, calcium, magnesium);
- part 2: the metal group (e.g. arsenic, mercury, cadmium) and lightly volatile halogenated hydrocarbons (e.g. tetrachloroethylene) and the broad group of pesticide substances (e.g. triazine, phenoxy alkane carbon acids).

For the following substances of concern PCDD and PCDF, PCBs and PAHs there are no monitoring data available, however there are data on HCB in groundwater available. Most of the values are below the limit of detection and below the limit of quantification. In addition the Monitoring programme includes the following POPs as aldrin, chlordan, DDT, dieldrin, endrin, heptachlor and lindan.

In addition the option for "extra-investigations" exists. This is intended to allow for consideration of chemical parameters not mentioned in the Ordinance on Water Quality Monitoring but identified relevant. Accordingly, within the assessment period 2012-2014 in total about 180 substances/indicators were subject to groundwater monitoring.

Various elements of quality assurance have been integrated in the monitoring programme to ensure confidence in the analytical results. The implementation of the Austrian Water Quality Monitoring System is a shared responsibility between the Federal and Provincial Authorities.

Results of the monitoring programme are published as bi-annual reports. Access to the data as well as to the reports is provided via the webpage of the Environment Agency Austria –
http://www.umweltbundesamt.at/en/umweltschutz/wasser/.

6.4.5 Soil Monitoring

There is no common soil monitoring system on organic substances established in Austria. However, several studies were carried out which aim to determine the contents of selected POPs in soil (according to different land uses).

Currently the Austrian wide project "AustroPOPs" is under discussion between the Federal Ministry of Agriculture, Forestry, Environment and Water Management, the federal provinces and soil institutions (lead: Environment Agency Austria) aiming at implementing a national soil POPs monitoring system to close gaps in collecting, assessing and providing POPs data in Austria. Results of this project would serve NAP and NIP as well as other European and Austrian requirements on soil protection related to POPs issues.

Within the environmental soil surveys of the federal provinces in Austria, some organochlorine pesticides and herbicides were partly analysed in 3 federal provinces (Carinthia, Styria, Upper Austria). These studies were carried out in the 1990ies. Styria was the first federal state in Austria with a soil protecting law. From 1986 to 2006 1000 sites were selected in the frame of the Styrian soil protection programme. A periodic sampling in an interval of 10 years takes place. The following organic chemicals are analysed: HCB, DDT, lindane, PAH, atrazin, simazin, cyanazin, terbutylazin und propazin[22].

Repetitions are also routinely made according to the Soil Protection Law of Upper Austria. Also in the province Tyrol rural sites are routinely analysed for selected POPs (PAH, PCCD/F, PCB, PAH, organochlorine pesticides). The following table depicts mean concentrations of certain POPs (DM) in soil at 0-5 cm depth from selected sites in Tyrol[23].

Table 73: Mean concentrations of certain POPs in soil at 0-5 cm depth from selected sites.

Site	**PCDD/F ng/kg**	**PCDD/F TEQ ng/kg**	**DI PCB ng/kg**	**DI PCB TEQ ng/kg**	**PAH (16 EPA) µg/kg**	**HCB µg/kg**	**PeCB µg/kg**
1/grassland	140	33.12	-	-	416	<0.10	-
2/grassland	82	1.4	0.16	0.3	180	<0.10	<0.10
2/forest	188	4.6	1.03	2.1	400	0.12	0.36
3/grassland	31.8	0.34	0.04	0.17	31	0.04	<0.05
3/forest	27.2	1.04	0.19	0.45	63	0.06	<0.05
4/grassland	32	0.12	0.11	0.1	28	<0.05	0.16
4/forest	18	0.32	0.8	0.7	54	0.12	0.08
5/grassland	129.5	2.0	0.27	0.5	363	<0.1	0.26
5/forest	170.0	2.6	0.36	0.78	618	0.16	0.25

Sources: 1: personal communication, 2: UMWELTBUNDESAMT 2012B; 3: UMWELTBUNDESAMT, 2013, 4: UMWELTBUNDESAMT 2014a; 5: BFW 2015

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[22] http://www.umwelt.steiermark.at/cms/beitrag/10215574/2998692/

[23] https://www.tirol.gv.at/umwelt/boden/

The aim of the programme of the Austrian provinces is also to classify the soils according their quality; quality criteria are also based on the content of selected anorganic and organic pollutants. The influence of industrial emissions is clearly visible; site 1 is strongly influenced by copper smelting, site 2 by molybdenum production, site 3 and site 4 are inner alpine rural sites and site 5 is influenced by accumulation due to the geographical conditions (see Table 72).

Further data are provided by a study on POPs in grassland soils far away from emission sources. At the moment results from 24 grassland sites under extensive use are available (UMWELTBUNDESAMT 2008a and 2010). Soil samples were taken at depths of 0–5 cm and 5–10 cm and the range of analysed parameters covers the following substances or groups of substances: organochlorine compounds (aldrin, cis- and trans-chlordane, dieldrin, endrine, mirexe, heptachlorine, hexachlorobutadien, endosulfan, DDX, α-, β-, γ-, δ-HCH, HCB), polychlorinated biphenyls (PCBs), dioxins, furans and dl-PCBs, polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ether (PBDE), nonylphenol and bisphenol A, nitrophenols, chlorophenols, phthalates, organotin compounds, hydrocarbon index, perfluorinated tensides (PFTs)inorganic pollutants, general soil parameters (pH value, humus content, texture, carbonate content).

Overview of the results for PCBs, doxins and furans and PAHs:

Polychlorinated biphenyls (PCBs): Contents of individual PCB congeners are above the chosen limits of determination for all samples. The range for the total content from the sum of the six congeners according to Ballschmiter is between 0.13 and 3.52 µg/kg DS and all values can therefore be considered background concentrations.

DL-PCBs: Contents of coplanar and mono-ortho-substituted PCBs were detected in most of the soil samples. They are within the range of a few nanograms. What is noticeable is that either low chlorinated PCBs are found together on a few sites, or higher chlorinated PCBs. Total values from the sum of PCBs TE-WHO for the sampled grassland sites are between 0.01 and 0.74 ngTE WHO/kg.

Polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs): Total contents from the sum of PCDD/Fs in grassland samples range between 12.5 and 298 ng/kg DS. In order to take into account the varying toxicity of the congeners, PCDD/F contents are assessed according to international toxicity equivalents (I-TEQs). These are between 0.16 and 9.33 ng I-TEQ/kg DS. The upper values are considered high and need further clarification.

Polycyclic aromatic hydrocarbons (PAHs): Contents of EPA PAHs range between 2.4 and 1818.3 µg/kg DS. On 11 sites, values below 100 µg/kg DS were determined. Although none of the grassland sampling sites used for this study showed PAH contents above international background or intervention values, further clarification appears to be necessary with respect to ΣEPA PAH and BaP contents on three sites. For all other sites, PAH contents can be classified as background values.

The results of this study show that persistent organic pollutants can be detected, occasionally in considerable concentrations (e.g. PCDD/F), even in grassland soils under extensive use. On the one hand the substances concerned are those whose use and production have been banned in many countries for several years or decades (e.g. certain pesticides), and on the other hand these substances are so-called upcoming pollutants (e.g. flame retardants, phthalates, chlorophenols), whose environmental relevance is gaining more and more importance at international level.

The study thus provides an initial overview of the verifiability and magnitudes of the levels of selected organic pollutants. Although a more detailed analysis in the light of a correlation between individual soil parameters, or pollutant groups, has not been possible here, it would be an important next step allowing for a better description of the fate and behaviour of these substances in grassland soils.

In general, the data on organic pollutants in soils are considered incomplete. Only a few pollutant groups such as PAHs, PCBs or PCDD/Fs are well documented in the literature. For many other substances however, hardly any comparable data on background values in soils are available. In other mediums such as sewage sludge, sediments and surface waters, these pollutant groups have already been analysed in several studies.

The next part of the study will include further sampling sites throughout Austria and a focus on flame retardants like PBDEs and PFOS.

6.4.6 Bioindication with tree needles and forest ecosystems

Two major earlier studies (UMWELTBUNDESAMT 1998, 2001) focused on POP concentrations in remote forest ecosystems. The international project “MONARPOP”, (an initiative of ministries and institutes in Austria, Germany, Italy, Slovenia and Switzerland started the project MONARPOP in 2004[24]) investigated POPs in Norway spruce needles and soils of remote forests in alpine regions of Europe (Austria, Germany, Italy, Slovenia, Switzerland) from 2004 to 2007. The studies focused on POP background levels at remote sites. The investigations provide information about the following compounds – formerly or still – intentionally produced POPs (organochloropesticides = OCP, PCB, PBDE, chloroparaffins, PFOS and related compounds) and unintentionally released organic pollutants (PCDD/F, PAH). The MONARPOP project also includes extensive air and deposition monitoring (see chapter 6.4.1). The MONARPOP survey on needle and soil concentrations had been finished by end of December 2007, while air and deposition monitoring is still carried out on a continuous basis.

One of the most significant results of MONARPOP is the clear documentation of the barrier effect of the Alps for the long range transport of POPs. Concentrations were higher in the peripheral parts of the Alps than in the more shielded central parts. The location of the lateral parts with higher concentrations (northern, western, southern and/or eastern parts of the Alps) could vary from compound to compound and between the studied matrices (soil, needles). For some compounds like PCDD/F, sites with higher soil concentrations were located in areas of higher precipitation (OFFENTHALER et al. 2009), while the observed regional concentration gradients for other compounds (e.g. single PBDEs, KNOTH et al. 2008) showed no correlation with precipitation and are likely the result of different

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[24] http://www.monarpop.at; co-founded by the EU INTERREG IIIb “Alpine Space Programme”, the Austrian Ministry for Agriculture, Forestry, Environment and Water Ressources; Bavarian State Ministry of the Environment, Public Health and Consumer Protection; Regional Agency for Environmental Protection of Lombardia; Regional Agency for Environmental Prevention and Protection of Veneto; Swiss Federal Office for the Environment; Swiss Federal Institute for Forest, Snow and Landscape Research; German Helmholtz Research Center for Environmental Health, Munich; German Federal Environment Agency; Environment Agency Austria; Slovenian Forestry Institute

emission gradients in the neighboring regions of the Alps. These findings from the Alps, given their location in the centre of Europe, may give some general indications of similar differences on a larger geographic scale.

A comparison between POPs bound in the forests of the Alps and their emissions in this region supports the assumption that significant contributions to the POPs load in the Alps comes from sources outside the Alps and suggests that the Alps represent a net sink for these compounds (BELIS et al. 2009).

Industrial chemicals like chlorinated paraffins were detected at remote sites of the Alps, in similar concentration ranges as unintentionally emitted SOCs like PAHs (IOZZA et al. 2009).

Selected MONARPOP sites, which were also studied in previous studies, showed significantly lower loads of some compounds in needles and soil than approximately ten years ago.

Along the remote vertical MONARPOP profiles of the northern and central Alps, marked altitudinal increases in soil concentrations of organochlorine pesticides (including those with suspected faraway sources like mirex) have been detected (e.g. up to 10-fold for DDT). The statistical results suggest temperature as the key parameter for this increase, while it has been found that precipitation is not correlated with the observed gradients (KIRCHNER et al. 2009). Other compounds like chlorinated paraffins (IOZZA et al. 2009), PCDD/F and PCB (OFFENTHALER et al. 2009), PBDE (KNOTH et al. 2008) and PAH (BELIS et al. 2007) have not shown a uniform trend along or among these slopes. Other than with pesticides, local sources as well as the impact of meteorological phenomena like temperature inversions are assumed to be responsible for these findings.

Apart from surveys in remote forest ecosystem, POP levels (PAH, PCB, PCDD/F, OCPs) close to local pollution sources were obtained by some bioindication studies in industrial areas or conurbations using Norway spruce needles (e.g. UMWELTBUNDESAMT 2009). The Austrian Umweltbundesamt also has an archive of perennial spruce needle samples from selected industrial neighborhoods.

More recent data has been derived in the frame of the EU-funded MONAIRNET project[25], which is described in more detail in chapter 6.4.1.

Spruce needles were analysed at 4 Austrian sites; dioxinlike PCBs were measured in concentrations at ~ 0.025-0.054 ng/kg dm (TEQ DL-PCBs); PCDD/F:~0.35-3.1 (TEQ PCDD/Fs) and PAHs ~20-31 ng/kg dm (29 congeners).

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[25] http://www.monairnet.eu/index-de.php

7 EVALUATION OF THE EFFICACY OF NATIONAL LAWS AND POLICIES AND STRATEGIES FOR MEETING THE OBLIGATIONS OF THE STOCKHOLM CONVENTION AND THE EU POP-REGULATION

Considering the findings of this report for POPs release inventories, availability of data, measures already implemented or planned, it can be concluded that Austria complies to a great extent with the provisions of the Stockholm Convention and the EU POP Regulation. Nevertheless, as one of the goals of the Convention is the "continuous minimization and, where feasible, ultimate elimination of POPs releases" further efforts are necessary.

PCDD/F and PAH emissions of major (industrial) sources decreased steadily in the years 1990-2014 with a significant drop between the years 1990 and 1994. Emissions of PCB declined significantly from 1990 to 1993, then increased slowly from 1994 to 2014 and, at 180 kg/a, are now 7% lower than in 1990 (but 11% higher than in 1995). Emissions of HCB declined from 1990 to 2011, and then increased strongly in the years 2012, 2013 and 2014. This increase was due to an unintentional release of HCB in an Austrian cement installation which was caused by the input of HCB containing waste and imcomplete destruction of HCB.

If there are changes in the best available techniques allowing for lower or zero emissions from relevant sources, policy makers have to react and to adapt the relevant legal provisions accordingly (e.g. by laying down stricter emission limit values).

The NAPs 2008 and 2012 identify small residential combustion plants as an important target area. In 2014 they still are responsible for 58% of the PCDD/F emissions, 79% of the PAH emissions and 26% of the PeCB emissions into air. All possible measures have to be investigated and explored to reduce POP emissions from these sources.

PCDD/F emissions from biomass combustion have more than doubled from 2004 to 2014 and are responsible for 13% of the overall PCDD/F emissions. PAH emissions from biomass combustion almost tripled from 2004 to 2014, but are still only responsible for 3% of the overall PAH emissions.

It should be mentioned that in order to comply with certain national and international obligations a variety of comprehensive and to some extent cross-sectoral measures and instruments are being developed in Austria. These measures are aimed at the reduction of greenhouse gases, NO_x and (fine) particulate matter. Some of these measures (described e.g. in the Climate Strategy 2007 (FEDERAL MINISTRY OF AGRICULTURE, FORESTRY, ENVIRONMENT AND WATER MANAGEMENT 2007) or in the Programme of the Federal Government (FEDERAL GOVERNMENT 2007)) will lead to an indirect reduction of POPs releases (e.g. by reducing energy consumption or by prescribing stricter air emission limit values for dust), others (such as the increased use of biomass in small scale firing installations) will lead to an increase in POP releases.

Moreover, it is important to gain more in-depth knowledge in fields where reliable data are limited or missing. Specific studies e.g. of POP concentrations in certain wastes as well as further POP related monitoring activities are formulated below.

Evaluation of Measures proposed in NAP 2012 (according to § 20 (2) Chemicals Act 1996)

NAP 2008 and NAP 2012 list a variety of measures which help to lower POP emissions from relevant sources on the one hand, and would improve the availability of data on POPs in the environment on the other hand.

Releases of POPs from source categories

The following table gives an overview of measures proposed in the NAP 2012 and implemented in the period 2012-2016.

National legislation	Contents relating to POPs	Measures proposed in NAP 2012	Current status
Industrial Code 1994 and specific ordinances according to § 82 para 1	ELV for various air pollutants, eg dust, PCDD/F	Continuous evaluation with regard to BAT	Amendment of Iron and Steel Ordinance (Fed. Law Gaz. II No. 54/2016) Repeal of ordinance for Sinter Plants (Fed. Law Gaz. II No. 303/2014) Ordinance on Foundries (Fed. Law Gaz. II No. 264/2014)
Ordinance on combustion plants (Fed. Law Gaz. II No. 331/1997)	ELVs for dust, CO, Corg, NO_x	Adaptation to BAT necessary (stricter ELVs for dust)	The process of implementation of the MCPD into national law is currently (2017) under way by amending the ordinance on combustion plants.
Waste incineration ordinance (Fed. Law Gaz. II No. 2002/389)	ELVs for dust, CO, Corg, NO_x, heavy metals, PCDD/F	stricter ELVs for dust for co-incineration plants	Revised ordinance (Fed. Law Gaz. II No. 135/2013)
Austrian Water Act and specific Ordinances:	ELVs for AOX and POX in the sector specific ordinances		
Ordinance on the limitation of waste water emissions from flue gas treatment (Fed. Law Gaz. II No. 271/2003)	ELVs for PCDD/F	Continuous evaluation with regard to BAT	Amendment (Fed. Law Gaz. II No. 201/2014)
Ordinance on the limitation of waste water emissions from processing of coal (Fed. Law Gaz. II No. 346/1997)	ELVs for PAHs	Continuous evaluation with regard to BAT	Amendment in preparation
Ordinance on the limitation of waste water emissions from the production of plant protecting agents and crop sprayings (Fed. Law Gaz. No. 668/1996)	ELVs for AOX and specific POPs	Continuous evaluation with regard to BAT	None

National legislation	***Contents relating to POPs***	***Measures proposed in NAP 2012***	***Current status***
Ordinance on the determination of the target state for surface waters (Fed. Law Gaz. II No. 96/2006)	*Environmental quality standard for HCB*	*For PAHs community environmental quality standards were determined (in 2008)*	*ordinance was amended in 2010 according to directive 2008/105/EC (Fed. Law Gaz. II No. 461/2010) and in 2016 (Fed. Law Gaz. II No. 363/2016)*
Ordinance on landfills (Fed. Law Gaz. II No. 39/2008)	*Limit values for the content of PAH in wastes*		*Amended with Fed. Law Gaz. II No. 291/2016*
Compost ordinance (Fed. Law Gaz. II No. 292/2001)	*Limit values for the content of POPs in composts*	*Continuous evaluation of the limit values necessary*	*none*
Other relevant legal provisions	***Contents with respect to POPs***	***Measures proposed in NAP 2012***	***Current status***
BAT Conclusions, already published in the Official Journal of the European Commission:	*limit values for POPs*	*new measure*	*implementation in national law (ordinances, permits)*
cement, lime and magnesia	*ELV for POPs*	*new measure*	*Implemented via waste incineration ordinance (Fed. Law Gaz. II No. 135/2013)*
non ferrous metals	*ELV for POPs*	*new measure*	*Implementation for air-emissions in non ferrous metals ordinance (Fed. Law Gaz.II No.86/2008), for water emissions in AEV non ferrous metals (Fed. Law Gaz. II No. 889/1995) and/or in individual permits required by 30 June 2020*
iron and steel	*ELV for POPs*	*new measure*	*implemented for air emissions with amendment to iron and steel ordinance (Fed. Law Gaz. II No. 54/2016) and for water emissions with amendment to AEV iron metal industry (Fed. Law Gaz. II No. 202/2014)*
Ordinances on sewage sludge and compost of the Federal Provinces	*Limit values for POP*	*Continuous evaluation of the limit values necessary*	*some Austrian provinces limit POPs in sewage sludge*
Ambient Air Quality Act (IG-L)	*§ 21 IG-L: Legal basis for an ordinance*	*Evaluation whether generally binding ELVs for crematoria in an ordinance according to § 21 IG-L are necessary*	*Not implemented, no general binding rule for crematoria*
Laws of the Federal Provinces concerning residential combustion sources	*PM emission thresholds for new installation of small scale combustion equipment*	*Agreement pursuant to Art. 15a Federal Constitution Law concerning the placing on the market and the inspection of combustion installations, rapid transposition of the requirements of this agreement into the law of the federal provinces*	*Signed by governors of federal provinces in 2011* *Amended by Federal provinces individually by ordinance or law starting from 2012*
Act on Air Pollution Prevention (Fed. Law Gaz. I No. 137/2002, as amended (Fed. Law Gaz. I No. 50/2012))	*Prohibition of burning of biogenic materials, many exemptions possible*	*Evaluation with respect to the exemptions*	*Prohibition integrated in Act on Air Pollution Prevention*

Other relevant legal provisions	***Contents with respect to POPs***	***Measures proposed in NAP 2012***	***Current status***
Permitting process	*Contents relating to POPs*	*Comments/Specific Steps*	*ongoing*
Landfill sites	*Fire protection requirements*	*Implementation of effective fire protection requirements for landfills and intermediate storage sites for waste*	*No new information*

Implemented measures for residential combustion plants

Standard eco-design emission requirements for the placing on the market and putting into service of solid fuel local space heaters[26] and solid fuel boilers[27] will enter into force on 1 January 2020 (2015/1189) and on 1 January 2022 (2015/1185) and gradually repeal the current national standard emission requirements (Article 15a Agreement).

However, the Austrian Ecolabel N°37 on biomass heating[28] sets more ambitious PM emission thresholds for new installations, as well as defining other environment-friendly criteria. The Ecolabel is a mandatory requirement for new installations with biomass combustion systems, if they are supported by funding programmes promoting the exchange of old fossil-fuel based heating systems.

Another set of measures is concerned with awareness raising to encourage low-emission incineration in wood stoves in households or the use of ashes from these stoves for fertilising purposes.

An initiative of the Federal Ministry of Agriculture and Forestry, Environment and Water Management “Richtig heizen” (“Proper Heating”) was launched in 2009 and is still running in 2017. An important output is a booklet published in 2010 containing information on the effects of emissions from household stoves on human health and the environment as well as tips and advice on how heating with low emissions can be achieved by simple measures (e.g. lighting from above). The booklet has been distributed to the public by doctors and chimney sweepers.

Furthermore, an internet site has been created where the proper use of household wood stoves as well as legal considerations are described. The internet site was further developed in 2013 by adding an interactive online calculator that allows users to calculate their energy demand, PM emissions and solid fuel used for heating. Subsequently, it gives advice on possible measures for reducing energy consumption and emissions (wood drying, thermal insulation, exchange of heating system). Information on Ecodesign provisions and PM filter systems for small scale heating appliances will be added in 2017.

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[26] Commission Regulation (EU) 2015/1185 of 24 April 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for solid fuel local space heaters.

[27] Commission Regulation (EU) 2015/1189 of 28 April 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for solid fuel boilers.

[28] Österreichisches Umweltzeichen Richtlinie UZ 37 Holzheizungen, Version 6.0 vom 1. Jänner 2017

Proposed measures for residential combustion plants and biomass plants

- Effective financial funding for the replacement of coal-fired small scale combustion systems and old (probably high emission) biomass heating systems with modern, low emission biomass heating systems, district heating or renewable energy systems.
- Periodic reviews and improvements of the criteria for the funding of biomass plants (including biomass plants operated in the agricultural sector) with respect to operating conditions, energy efficiency (including district heating systems), quality of fuels and emission limit values for dust .
- Providing further information (awareness raising) conerning the prevention of co-incineration of waste in small scale firing installations.
- Providing further information (awareness raising) concerning the final disposal of ashes/soot from small scale firing installations.
- Emission behaviour of small scale combustion installations (esp. in case of firing cereals): → still partly unknown for POPs, a literature study is currently underway.

Data availability on POP releases into the environment

For the following sources the availability of data is still limited or missing. Therefore, to assess whether releases of POPs are relevant and to improve and complete Austrian inventories on POPs, the following specific steps are desirable/necessary to improve data quality. However, the implementation of these measures often depends on available budget resources.

- Improvement of data quality with respect to releases of HCB, PCB, PeCB and, if feasible, PCN into air (e.g. by planning and carrying out measurement programmes for sources with a high priority, such as residential combustion sources, industrial processes).
- Verification of the emission factor for PCB in the source category Part III “thermal processes in the metallurgical industry” (especially for the sector secondary lead production).
- Establishment of emission monitoring programmes in the neighbourhood of POP relevant emitters: identification of relevant sites for sampling and measurements campaigns (winter/summer).
- Continuation of ambient air and deposition monitoring for POPs
- Continuation of monitoring programmes in food (meat, milk,..).
- Food and Feed Monitoring in the neighbourhood of POP relevant emitters, identification of relevant sites for sampling.
- Implementation of a national monitoring programme to investigate the distribution of deposited POPs.
- Continuation of monitoring programmes in soil and bioindicators (Norway spruce needles and/or grass) close to POP sources.
- Improvement of data quality with respect to releases of POPs from landfills and abandoned industrial sites and known contaminated sites (e.g. PAH content of landfill gases).

- Determination of POP-concentrations in waste streams from small scale combustion installations in the sectors residential combustion, services and agriculture which have a high probability of being released into the environment (e.g. bottom ash and fly ash).
- Determination of POP-concentrations in waste streams from fossil fuel fired utilities and industrial boilers (including co-incineration of waste) which are recovered in other production processes or which have a high probability of being released into the environment (e.g. fly ash from co-incineration plants).
- Determination of POP-concentrations in waste streams from biomass fired combustion installations which are recovered in other production processes or which have a high probability of being released into the environment (e.g. bottom ash).
- Quantification of POPs emissions (esp. PCDD/F and PCB) from Platformer 3 of the OMV refinery in Schwechat.
- Measurement of emissions from motor vehicles and update of emission factors to improve the quality of forecasts.

  → The Handbook on Emission Factors for Road Transport (HBEFA) provides emission factors for all current vehicle categories (PC, LDV, HGV, urban buses, coaches and motor cycles), each divided into different categories, for a wide variety of traffic situations. Emission factors for all regulated and the most important non-regulated pollutants as well as fuel consumption and CO_2 are included. The latest HBEFA version 3.2 was updated in 2014. All emission factors have been recalculated (based on a broader set of emission data, new measurements of motor vehicle emissions; and new emission factor models have been applied). For calibrating the model, a broad set of emission measurements up to Euro 6 has been used.

Proposed measures with regard to industrial plants

- Limitation of POP contaminated waste/residues in co-incineration plants and industrial plants. Representative sampling of individual batches of POP contaminated waste/residues is necessary before using them as input material.
- Avoid/prohibit highly contaminated waste/residues in co-incineration plants.
- Before treating POP contaminated waste/residues in industrial plants, test runs (including monitoring of POP emissions) have to be conducted.
- If POP contaminated waste/residues are used as input materials in industrial plants, regular/continuous monitoring of the emissions of POP emissions is necessary. If a destruction of these POPs cannot be ensured in the industrial plant, the POP residues/waste must not be used as input material.
- If there are any changes in the process involving POP contaminated waste/residues, test runs (including monitoring of the POP emissions) have to be conducted.

Proposed other measures

- Successive reduction of diesel powered vehicles through increased market penetration of electrically vehicles.

Soil Protection Laws of the Federal Provinces: Burgenländisches Bodenschutzgesetz (LGBl. Nr. 87/1990) Niederösterreichisches Bodenschutzgesetz (LGBl. Nr. 6160-0) Oberösterreichisches Bodenschutzgesetz (LGBl. Nr. 63/1997) Bodenschutzgesetz Salzburg (LGBl Nr. 80/2001) Steiermärkisches landwirtschaftliches Bodenschutzgesetz (LGBl. Nr. 66/1987)	Setting of target values for organic pollutants (including polybrominated diphenylethers, perfluorinated tensides and pesticides) with the aim to reduce pollution of soils	AustroPOPs project aiming at implementing a national soil POPs monitoring system is under discusssion

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9 ABBREVIATIONS

AVV	Abfallverbrennungsverordnung (Waste Incineration Ordinance, BGBl. II No. 2002/389, latest amendment by BGBl. I No. 127/2013)
CORINAIR	Core Inventory Air
CORINE	Coordination d´information Environmentale
CRF	Common Reporting Format
DKDB	DampfkesseldatenbankAustrian annual steam boiler inventory
DL-PCB	Dioxinlike polychlorinated biphenyls
DM	Dry Mass
EEA	European Environment Agency
EIONET	European Environment Information and Observation NETwork
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
EPER	European Pollutant Emission Register
GLOBEMI	Globale Modellbildung für Emissions- und Verbrauchsszenarien im Verkehrssektor (Global Modelling for Emission- and Fuel consumption Scenarios of the Transport Sector) see Hausberger 1997
GPG	Good Practice Guidance (of the IPCC)
HCB	Hexachlorobenzene
HM	Heavy Metals
IEA	International Energy Agency
IEF	Implied emission factor
IIR	Informative Inventory Report
IPCC	Intergovernmental Panel on Climate Change
NACE	Nomenclature des activites economiques de la Communaute Europeenne
NEC	National Emissions Ceiling (Directive 2001/81/EC of The European Parliament And Of The Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants – NEC Directive)
NFR	Nomenclature for Reporting (Format of Reporting under the UNECE/CLRTAP Convention)
NIR	National Inventory Report (Submission under the United Nations Framework Convention on Climate Change)
NISA	National Inventory System Austria
OECD	Organisation for Economic Co-operation and Development
OLI	Österreichische Luftschadstoff InventurAustrian Air Emission Inventory
PAH	Polycyclic Aromatic Hydrocarbons

PCDD/F	Polychlorinated Dibenzodioxins and Dibenzofurans
PeCB	Pentachlorobenzene
PM	Particular Matter
POP	Persistent Organic Pollutants
PRTR	Pollution Release and Transfer Register
SNAP	Selected Nomenclature on Air Pollutants
TEQ	Toxicity equivalents according to WHO
UNECE/CLRTAP	United Nations Economic Commission for Europe.Convention on Long-range Transboundary Air Pollution
UNFCCC	United Nations Framework Convention on Climate Change
WFD	Waste Framework Directive 2000/60/EC6

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This report is the second review of the National Action Plan pursuant to Article 5 of the Stockholm Convention on Persistent Organic Pollutants (POPs). Emissions from relevant source categories in different environmental media are updated and compared with data from the National Action Plans of 2008 and 2012. The efficacy of national legal regulations has been assessed again and it has been investigated if Best Available Techniques (BAT) in combination with Best Environmental Practices (BEP) have already been applied. Current recommended procedures are developed in order to reduce emissions of POPs in the future.

In general, the findings of the NAP 2008 and 2012 remain valid for the near future.

Measures to reduce emissions from residential combustion sources should be continued. Monitoring programmes should be carried on. Data availability on POP releases should be improved.

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