Global NIP Update Webinar “Activity Options for Action Plans of Stockholm Conventio NIPs: Unintentional POPs and POP-PFASs”, 20. January 2026, 14:00 -16:30 CET, UTC+1

Action Plan options for reduction and elimination of unintentional POPs (Article 5) and considerations for an integrated approach

Dr. Roland Weber
POPs Environmental Consulting,
73527 Schwäbisch Gmünd, Germany
roland.weber10@web.de
https://www.researchgate.net/profile/Roland-Weber-2

Unintentional POPs in the Stockholm Convention

- Four of the original 12 POPs in the Stockholm Convention are unintentionally produced POPs ('UPOPs'):
  - Polychlorinated dibenzo-p-dioxins (PCDDs)
  - Polychlorinated dibenzofurans (PCDFs)
  - Polychlorinated biphenyls (PCBs; main amount are intentionally produced PCBs!)
  - Hexachlorobenzene (HCB)
- In 2009 pentachlorobenzene (PeCB) was added to Annex A/C.
- In 2015 polychlorinated naphtalenes (PCNs) were added to Annex A/C
- In 2017: HCBD added in Annex C (05/2017).

These UPOPs are commonly formed as by-products in:

- the production of organochlorine chemicals;
- processes where elemental chlorine is present;
- thermal processes in the presence of all forms of chlorine.

Synergies in addressing unintentional POPs

- The reduction of PCDD/Fs from sources reduces at the same time other unintentional POPs (unintentional PCBs, PCNs, PeCB, HCB, and HCBD).
- The reduction of dioxins/UPOPs from **incinerators or metal industries** can at the same time reduce **heavy metals, particulate matter (PM), PAHs, and black carbon** (soot; **SLCP**).
- The reduction and control of **open burning** reduce at the same time particulate matter (PM_{10}; $PM_{2.5}$), PAHs, black carbon + other releases.
- Similarly, reducing indoor cooking over an open fire, optimising stove design and ensuring the use of suitable fuels result in additional reduction of PM, PAHs, and UPOPs.
- For an appropriate risk assessment and cost-benefit analysis, these reductions need also to be considered. In some cases, like the open burning of biomass, which releases high PM, black carbon and PAH, the impact of these “co-pollutants” is more relevant than UPOP emission.
- Black carbon is a short-lived climate pollutant (SLCP), contributes to global warming. Therefore synergies exist between UPOPs reduction and reduction of global warming.

UPOPs as an opportunity for an integrated approach for waste management and BAT/BEP

Especially for low and middle-income countries the action plan for UPOPs is an opportunity for promoting and addressing:

- **General management of waste: The reduction of open burning of waste as major source for unintentional POPs and other pollutants is best addressed with the improvement of general waste management. This at the same time also contributes to the management of the large amount of POPs in plastics.**
- **General reduction of industrial emissions from source categories listed in Annex C Part II an III by BAT and BEP.**

STOCKHOLM CONVENTION

Air emissions of a primary steel plant (non-BAT; EU E-PRTR data) (10-12 Mio t steel/a)

	Release to air/year)
PCDD/PCDF	99.6 g TEQ
PCB	0.13 tonnes
Benzene	237 tonnes
PAH	33.6 tonnes
Lead & compounds	79.2 tonnes
Chromium	3.87 tonnes
Mercury	1.5 tonnes
Cadmium & compounds	0.4 tonnes
Nickel	0.6 tonnes
PM10	5380 tonnes
HCN	3.94 tonnes
SOx	40,800 tonnes
NOx	28,100 tonnes
HF	568 tonnes
Carbon dioxide	11,300,000 tonnes
Carbon monoxide	569,000 tonnes
Ammonia	33.5 tonnes

- UPOPs are only one pollutant class from large thermal emission sources.
- Other categories like heavy metals or PM can be even more relevant from health impacts.
- The pollutants can be addressed in an integrated manner

Article

Taranto's Long Shadow? Cancer Mortality Is Higher for People Living Closer to One of the Most Polluted City of Italy

Roberto Cazzolla Gatti [1,*] and Alena Velichevskaya [2]

https://doi.org/10.3390/su14052662

ELSEVIER

Environment International

Volume 132, November 2019, 105030

Industrial air pollution and mortality in the Taranto area, Southern Italy: A difference-in-differences approach

https://doi.org/10.1016/j.envint.2019.105030

Simona Leogrande [a] ✉, Ester Rita Alessandrini [b] ✉, Massimo Stafoggia [b]

Inside Italy's 'toxic town', where children grow up fearing cancer

https://www.itv.com/news/2026-01-06/inside-italys-toxic-town-where-children-grow-up-fearing-cancer

Amy Lewis

ITV News Reporter

Review Article http://dx.doi.org/10.1155/2013/753719

Environment and Health in Contaminated Sites: The Case of Taranto, Italy

Synergies of addressing unintentional POPs and heavy metals

- **UNEP highlighted that the global exposure risks posed by toxic metals and metalloids** – lead, cadmium, arsenic, and organotins – **remain inadequately addressed**.
- Therefore **UNEP published** in the recent 7th session of the UN Environmental Assembly (12/2025) a "***Report on options to address lead, cadmium, arsenic, and organotins pollution***".
- The smelting industries are significant contributors to environmental contamination, often releasing heavy metals and other pollutants into surrounding environment.
- Measures to reduce dioxins/UPOPs from **incinerators or metal industries** can at the same time reduce **these heavy metals, particulate matter (PM), PAHs, and black carbon (soot; SLCP).**

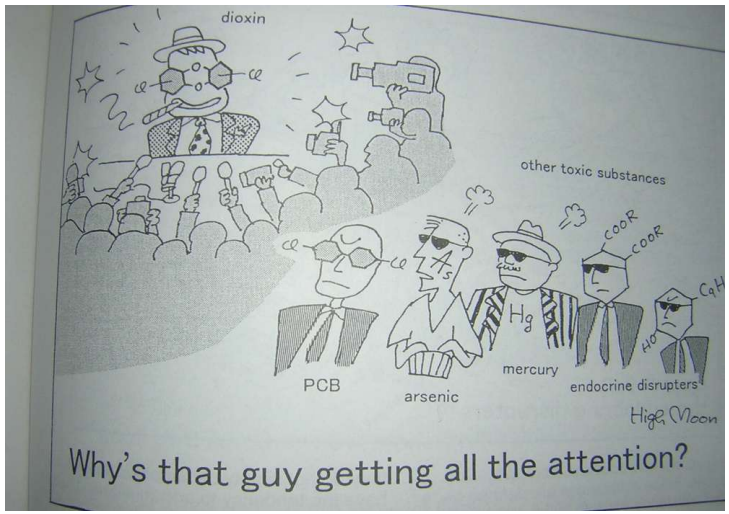
United Nations Environment Assembly
of the United Nations Environment Programme
Seventh session
Nairobi, 8–12 December 2025
Item 5 of the provisional agenda

International environmental policy and governance issues

UNEP/EA.7/INF/10

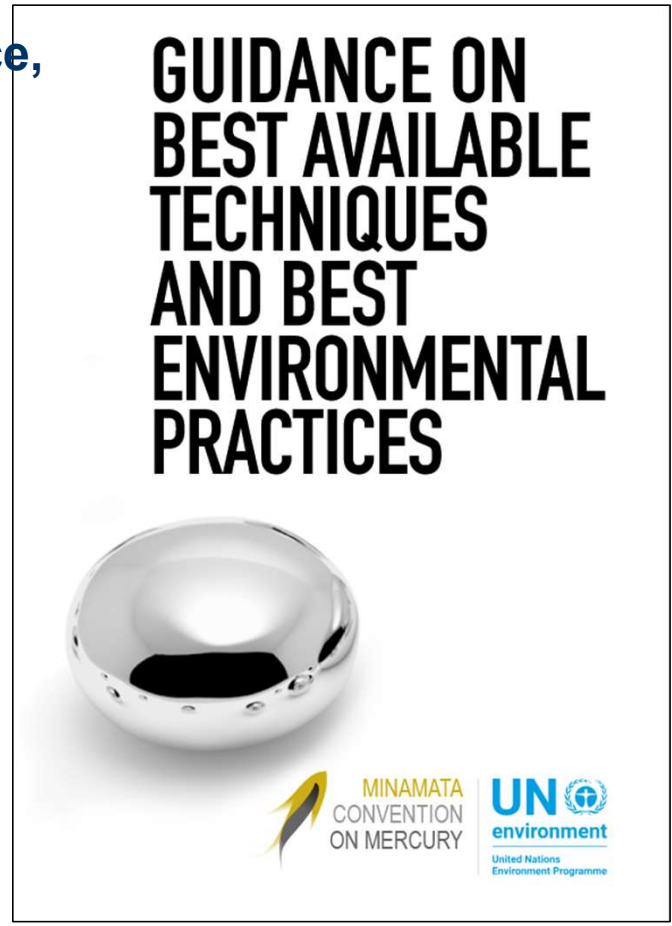
UNEP
United Nations Environment Programme

Information on the implementation of resolution 6/9 on sound management of chemicals and waste to address lead, cadmium, arsenic, and organotins*



Synergies of addressing UPOPs and mercury – thermal sources

- Unintentional POPs and mercury have major common sources which can be inventoried and managed.
- **All thermal sources listed in the Minamata BAT/BEP guidance, are also UPOP sources and are also included in the UPOP BAT/BEP guideline.**
- Major techniques to control UPOP releases (activated carbon, other adsorbents or wet scrubber with removal) also control mercury release.



Stockholm Convention BAT/BEP Guideline:
Guidance principles and cross-cutting considerations

The Stockholm Convention BAT/BEP Guideline stresses in the "general principles and cross-cutting considerations" (Section III.B):

- **Cleaner Production**
- **Integrated Pollution Prevention and Control**
- **Waste hierarchy**
- Sustainable Development and Sustainable Consumption and Production
- Precautionary Approach
- Use of science, technology and indigenous knowledge to inform environmental decisions
- Life Cycle Assessment (including env. inventories and energy)
- Internalising environmental costs and polluter pays principle.

https://chm.pops.int/Implementation/BATandBEP/ReleasesfromunintentionalPOPs/BATandBEPGuidance/tabid/9647/Default.aspx

Integrated Pollution Prevention and Control (IPPC) of the EU and Stockholm Convention BAT/BEP

Integrated Pollution Prevention and Control approach:

Integrated mean „Considering all aspects“:

- All pollutants (Particulate matter, heavy metals, acid gases etc. - PCDD/Fs represent just one parameter)
- Emissions to air, water, soil/land
- Accidents/incidents
- Occupational health aspects and noise
- Energy aspects
- Monitoring of pollutants or operation parameters

➔ **Best Available Techniques Reference Documents (BREFs) for different key industrial sectors**

https://bureau-industrial-transformation.jrc.ec.europa.eu/reference

1. Regulatory framework for PCDD/Fs & other UPOPs (1)

Objective: 1. To establish policy and legal framework for reduction and minimization of unintentional POPs (PCDD/PCDF, PCBs, PCNs, HCB, PeCB, and HCBD).

Recommended activity options:

- Undertake law & policy assessment on PCDD/Fs and other UPOPs - national and international.
- **Amend existing laws, or develop new laws as appropriate**, related to the management of **dioxins/UPOPs** considering Annex C Part V "General guidance on best available techniques and best environmental practices", **possibly within an integrated pollution prevention and control approach**.
- **Development of release limit values or performance standards for UPOPs or surrogate in the frame of general emission limits.**
- **Setting unintentional trace contaminant (UTC) limits for unintentional POPs in chemicals, mixtures and products**.
- **Assess the need and possibly develop standards/limits in major media** considered relevant for the country (e.g. food, feed, soil, product, waste).

Alternative approach of Switzerland: Dioxin control with “Guiding parameters”

Objective: 1. To establish policy and legal framework for reduction and minimization of unintentional POPs (PCDD/PCDF, PCNs, HCB, PCBs and HCBD).

- **Develop release limit values or performance standards for UPOPs or surrogates in the frame of general emission limits.**

Background: Low income countries often do not have the sampling and analytical capacity for PCDD/F.

Switzerland (known as a country with strict environmental guidelines) did not set explicit limits for PCDD/F emission until 2008. **Alternative dioxin control policy:** Dioxin emission were minimized by setting stringent limits for dust emission and heavy metals as well as standards for combustion quality:

- CO: 50 mg/m^3,
- TOC (20 mg/m^3),
- NOx (80 mg/m^3), and
- Dust emission (10 mg/m^3) and heavy metals.
- Temperature of dust filter normally below 170°C to avoid PCDD/F formation & increase adsorption.

A simple but effective strategy for PCDD/F emission control for incinerators and a wide range of thermal industrial facilities ! (often not <0.1 ng TEQ/m^3 but normally <1ng TEQ/m^3)

1. Regulatory framework for PCDD/Fs & other UPOPs (2)

Objective: 1. To establish policy and legal framework for reduction and minimization of unintentional POPs (PCDD/PCDF, PCBs, PCNs, HCB, PeCB, and HCBD).

Recommended activity options: Set unintentional trace contaminant (UTC) limit values for unintentional POPs in chemicals, mixtures and products.

The European POP Directive sets **UTC limits and low POP content limits (LPCL). UTC limits for PCBs are in a draft legislation which will enter into force and could be considered:**

- **A UTC limit value of 0.2 mg/kg will be set for the ΣPCB in substances, mixtures &articles.**
- **PCB are unintentionally present in pigments/dyes >0.2 mg/kg**, a **specific UTC limit of PCB in mixtures and articles containing organic pigments or dyes of 25 mg/kg upon entry into force of this Regulation and 10 mg/kg 3 years later**.

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=intcom:Ares%282025%291300377

- **A UTC limit value of 10 mg/kg was set for the HCB in substances, mixtures & articles.**

https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=PI_COM:C(2022)6122

1. Regulatory framework for PCDD/Fs & other UPOPs (3)

Objective: 1. To establish policy and legal framework for reduction and minimization of unintentional POPs (PCDD/PCDF, PCBs, PCNs, HCB, PeCB, and HCBD).

Recommended activity options are: Set unintentional trace contaminant (UTC) limit values for unintentional POPs in chemicals, mixtures and products: PCDD/Fs.

Background: The Basel Convention low POP content limits of 1,000, 5,000 or 15,000 ng TEQ/kg for PCDD/Fs is too high for a UTC limit in products. Some countries set regulatory limits for products with PCDD/F release risk to protect human health & the environment.

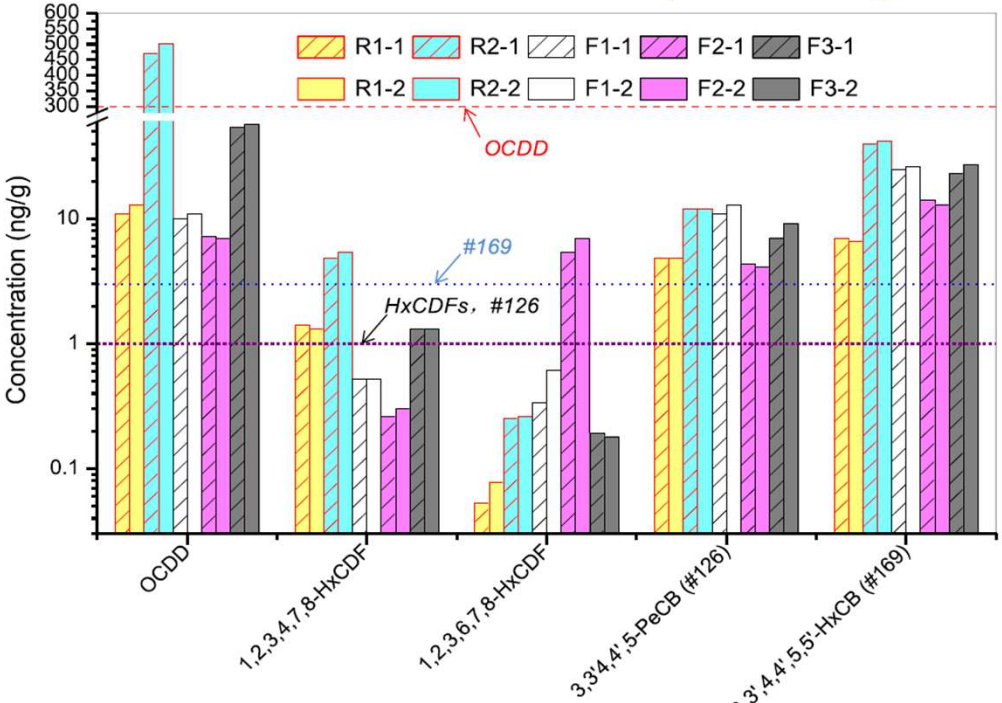
- **After German authorities discovered that levels of 5 ng TEQ/kg (and even lower) in soil can result in PCDD/Fs in eggs above EU regulatory limit**, the **updated German fertilizer regulation contains stringent UTC limits of 8 ng TEQ/kg and 30 ng TEQ/kg. Please note: the regulatory limits for food, feed, products need to correspond.**
  (Deutsche Düngeverordnung (DüV) https://www.gesetze-im-internet.de/d_v_2017/BJNR130510017.html)
- **Certain pesticides can contain high levels of PCDD/PCDF** if not controlled in production. Japan set regulatory limit for PCDD/PCDF and dioxin-like PCBs in pesticides requiring contamination levels below **100 ng TEQ/kg for each 2,3,7,8-substituted PCDD/PCDF congener and dioxin-like PCB** (Japanese Government 2002).

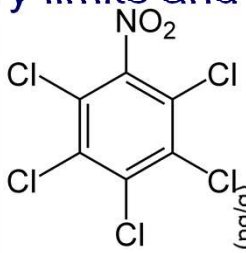
1. Regulatory framework for PCDD/Fs & other UPOPs (3)

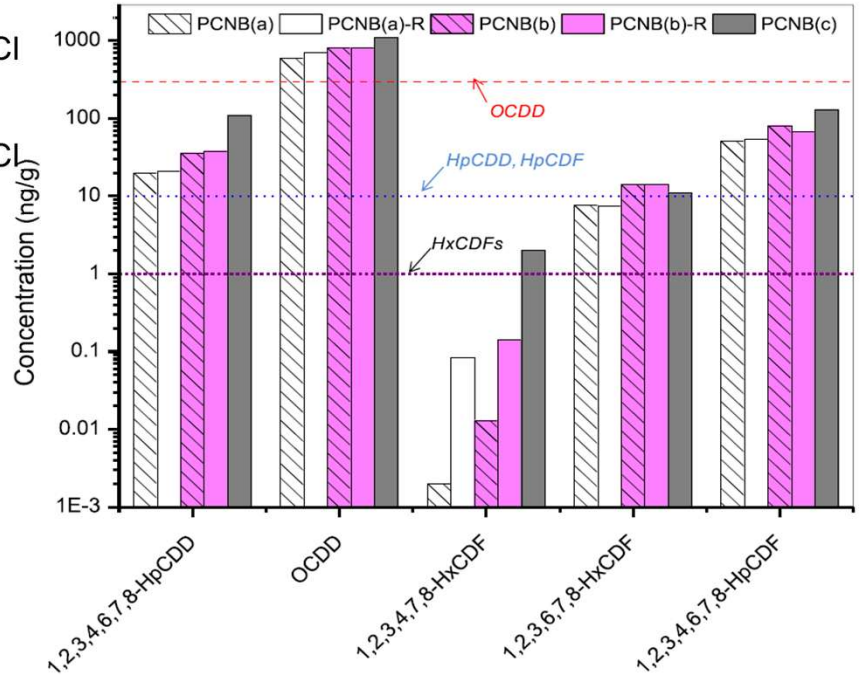
Objective: 1. To establish policy and legal framework for reduction and minimization of unintentional POPs (PCDD/PCDF, PCBs, PCNs, HCB, PeCB, and HCBD).

Recommended activity options are: Set unintentional trace contaminant (UTC) limit values for unintentional POPs in chemicals, mixtures and products.

For all analysed 5 quintozene formulations from China and Australia, some PCDD/F congeners and dl-PCBs were above the Japanese regulatory limits and the use of quintozene was stopped.







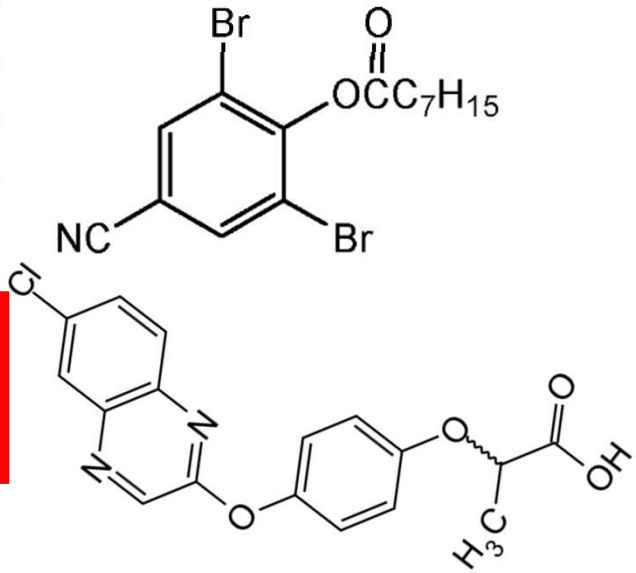
Huang et al. (2015) Environ. Sci. & Pollut. Res.. 22(19), 14462-14470.

Holt et al. (2010) ES&T. 44(14), 5409-5415

1. Regulatory framework for PCDD/Fs & other UPOPs (3)

The US FDA screened some pesticides for their PCDD/F content and dioxin-like toxicity and found some high dioxin-like toxicity in aromatic pesticides containing bromine and heteroaromatic pesticides not detected by the analysis of PCDD/F (Huwe et al. 2003).

Pesticide	Collection Year	Active Ingredients	CALUX TEQ (n=3)	HRGC-MS TEQ
2,4-D Amine	1993	2,4-D dimethylamine, 46.9%	26.2 ± 0.5	8.7
See 2,4-D	1993	2,4-D isooctylester, 61.7%	1637 ± 212	731
2,4-D LV4	1993	2,4-D isooctylester, 66.2%	3392 ± 257	2627
2.4-D LV6	1993	2,4-D isooctylester, 88.8%	1882 ± 311	1379
Weedone LV4	1998	2,4-D isooctylester, 67.2%	45.7 ± 4.1	27.7
Tiller	1998	MCPA-2EH ester, 32.1% 2,4-D isooctylester, 10.4% Fenoxaprop-p-ethyl, 4.4%	34.2 ± 4.1	19.8
Bronate	1998	Bromoxynil octanoic acid ester, 31.7% MCPA isooctyl ester, 34%	800 ± 180	0.3
Assure II	1998	Quizalofop-p-ethyl, 10.3%	1668 ± 419	4.1



Huwe et al. (2003) Organohalogen Compounds 60, 227-230.
https://dioxin20xx.org/wp-content/uploads/pdfs/2003/03-58.pdf

What is the appropriate regulatory approach to regulate these dioxin-like substances?

1. Regulatory framework for PCDD/Fs & other UPOPs (3)
Control & limit the PCDD/F and dl-PCB content in fertilizers/biosolids

Fertilizer (including biosolids or ashes from biomass) can be a dioxin/POP source for agriculture.

- Germany developed regulatory limits for fertilizers (DüMV 2019) including limits for PCDD/Fs & dl-PCBs.
- Also the EU Joint Research Center developed a proposal for a fertilizer regulation in the EU.

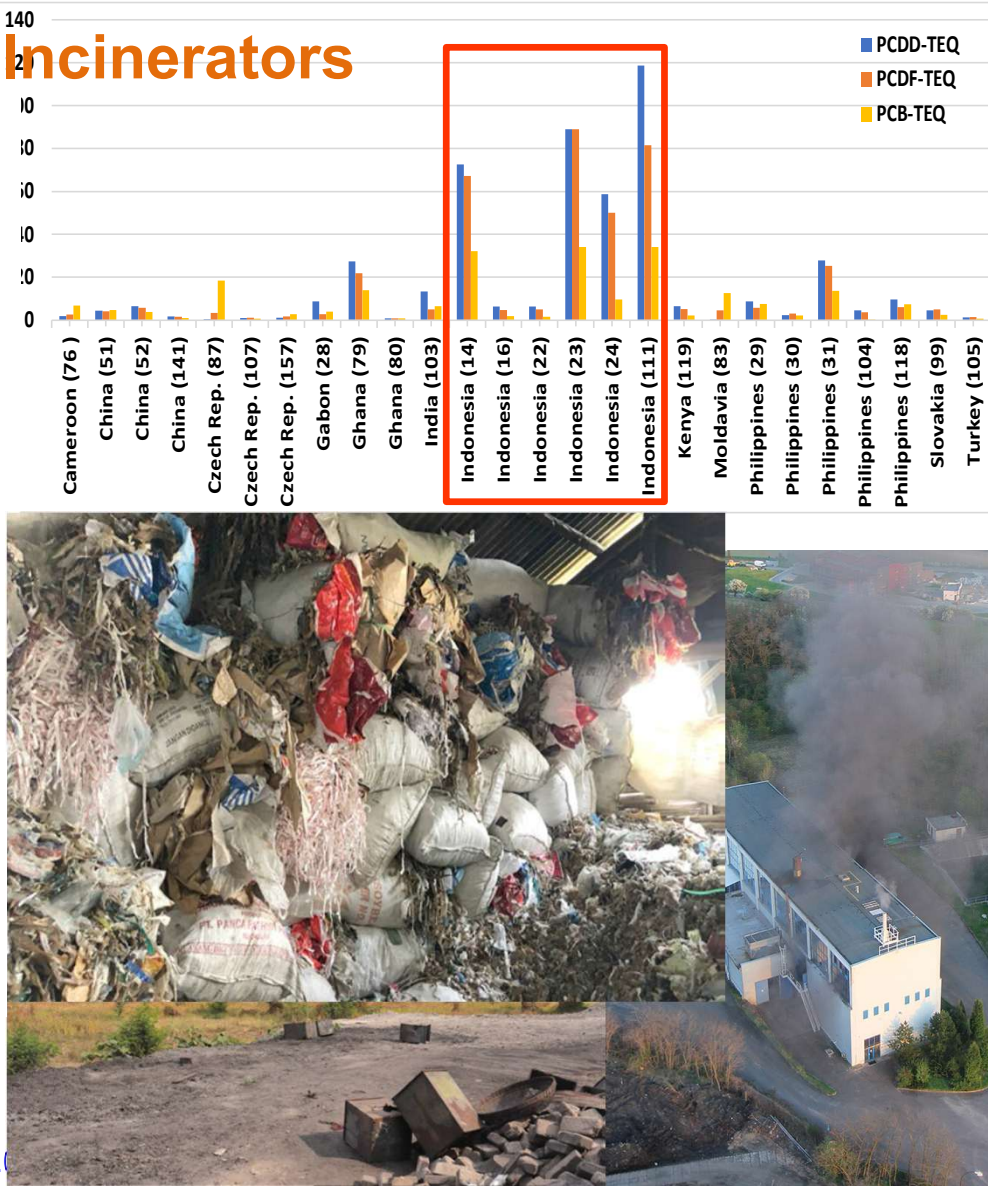
Regulation	Pollutant	Limit value	Application/remark
Germany	a) PCDD/Fs + dl-PCB	**30 ng TEQ/kg**	All with exemption of b)
Germany	b) PCDD/Fs + dl-PCB	**8 ng TEQ/kg**	b) pasture land and production of feed & farmland without plowing
EU (2019)	PCDD/Fs	***20 ng TEQ/kg***	Fertilizer to land (JRC proposal)
Basel „low POP content“	PCDD/Fs	**1,000, 5,000 or 15,000 ng TEQ/kg**	Misleading for further use; flaws in derivation (Swedisch EPA 2011)!

- A **“Basel low POP content” of 15,000 ng TEQ/kg can mislead authorities in managing ashes/waste.**
- **And the limit has been derived with wrong assumptions** (Swedish EPA 2011; Weber et al. 2019; Lopes and Proença 2020; Wu et al. 2020).

EU (2019) JRC report EU fertilizer; ISBN 978-92-76-09888-1, doi:10.2760/186684, JRC117856
Swedish EPA (2011). *Low POP Content Limit of PCDD/F in Waste*. Report 6418; ISBN 978-91-620-6418. Lopes H, Proença S (2020) Appl. Sci. 2020, 10, 4951 https://doi.org/10.3390/app10144951; Wu et al. Emerg. Contam. 6, 235-249. https://doi.org/10.1016/j.emcon.2020.07.001; Weber et al. (2019) Environ Pollut. 249, 703-715. DüMV (2019) Düngemittelverordnung vom 5. Dezember 2012 (BGBl. I S. 2482), d

IPEN Global Egg Study – Waste Incinerators

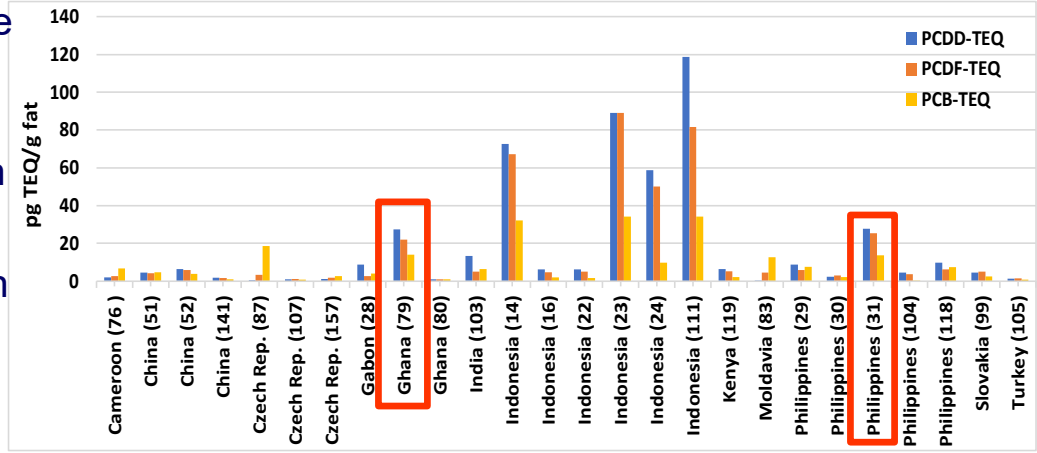
- **24 of 26 egg samples (92.3%) around waste incinerators** in 12 countries (Cameroon, China (3), Czech Republic (3), Gabon, Ghana (3), India, Indonesia (6), Kenya, Moldova, Philippines (5), Slovakia, and Turkey) exceeded the EU limit for PCDD/Fs and dl-PCBs with a mean of **43.1 pg** TEQ/g fat.
- Eggs in Tropodo/Indonesia where **plastic wastes** were used as **fuel for tofu boilers had 234 and 172 pg TEQ/g fat**. And **two chicken flocks in Java, around lime kilns burning plastic waste as a fuel had 212 and 119 pg TEQ/g fat**.
- **This highlights that co-incineration of plastic waste in non-BAT facilities results in** environmental contamination **and human exposure risk via chicken/eggs.**
- The free-range chickens at both locations had access to ashes stored openly next to the kilns or used for paving sidewalks. The ashes contained PCDD/Fs at levels of 120 – 1300 ng TEQ/kg. **These ashes were 10 to 100 times below Basel provisional low POP content of 15,000 ng TEQ/kg**.



Petrlik et al. (2022) Emerging Contaminants https://doi.org/10.1016/j.emcon.2022.

IPEN Global Egg Study – Waste Incinerators

- Two other highly PCDD/F contaminated pooled egg sample **(66.8 TEQ/g fat)** were collected near a **hospital waste incinerator in Aguado, Philippines** which has been operated for more than 20 years with medical waste known to contain a high share of PVC.
- Similarly, high levels (63.1 pg TEQ/g fat) were also found in pooled eggs of a flock near a batch type hospital waste incinerator in Ghana. **The mixed bottom and fly ashes with a level of 551 ng TEQ/kg** PCDD/Fs were dumped close to the incinerator where chickens also had access (Petrlik et al. 2022).
- Ash with 500 ng TEQ/kg is **30 times below the current provisional low POP limit of the Basel Convention of 15,000 ng TEQ/kg. However eggs from chickens are 15 times above regulatory limit.**



Petrlik et al. (2022) Emerging Contaminants https://doi.org/10.1016/j.emcon.2022.05.001

2. Updating the inventories for PCDD/Fs and other UPOPs

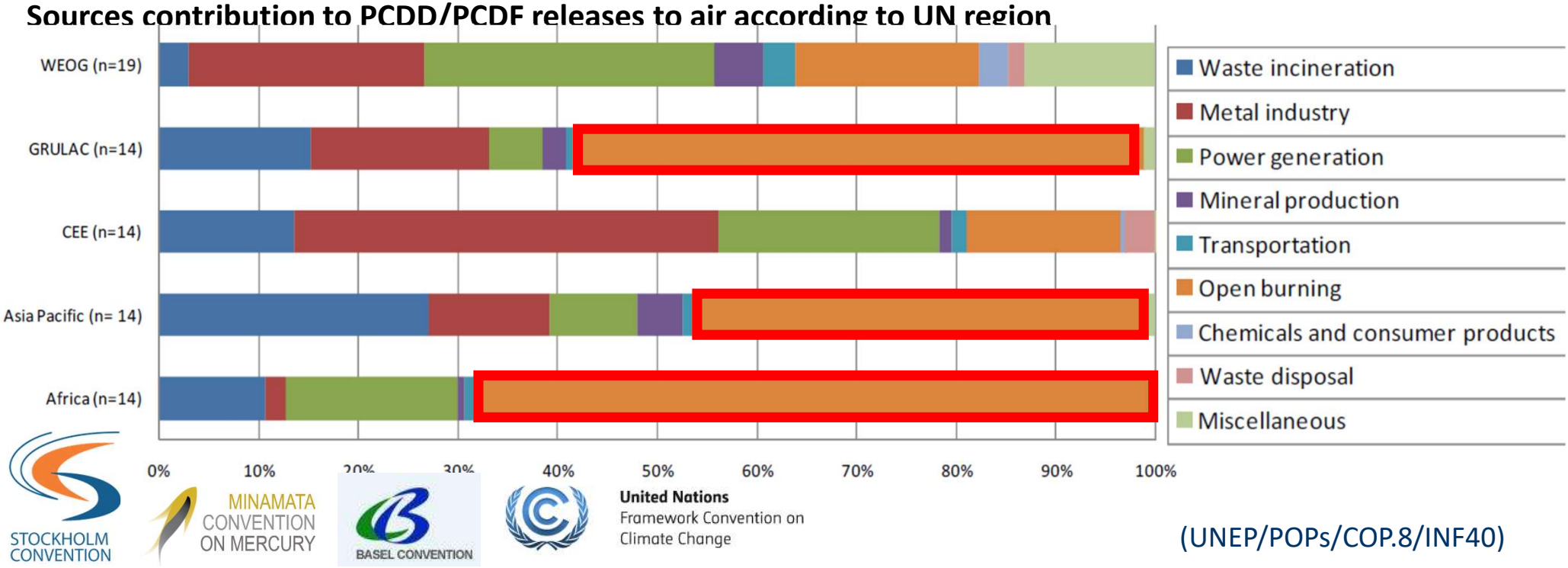
Objective: Updated sources inventories for PCDD/Fs and other listed UPOPs and data appropriately managed and harmonized with other release inventories.

Recommended activity options:

- Regularly update of the UPOP inventory (every 5 years along with review of strategies and reporting)
- Incorporate new listed UPOPs, where appropriate (for most sources, PCDD/Fs are sufficient).
- Quantify other co-pollutants, where appropriate (e.g. PM, heavy metals, PAHs, carbon black).
- Development of a mechanism ensuring appropriate storage and management of data.
- Development of an **integrated database of pollutant releases (e.g. UPOPs, mercury, GHG).**
- Evaluate the option of developing a **Pollution Release and Transfer Register** (PRTR) (see UNITAR activities https://unitar.org/sustainable-development-goals/planet/our-portfolio/pollutant-release-and-transfer-registers; and presentation Katka Šebková RECETOX https://www.youtube.com/watch?v=GUFAP_XyhFs&t=3450s)

Open waste burning as major source of UPOPs require action

- **Open waste burning is the major contributor to PCDD/PCDF global air releases and is the top source of UPOP release in Africa, Asia Pacific** & GRULAC, **followed by waste incineration**, the metallurgical industry, and heat and power generation.
- Open burning and industrial emissions results also in air pollution by small particles ($PM_{2/10}$), heavy metals, PAHs and black carbon (a SLCP).



STOCKHOLM CONVENTION

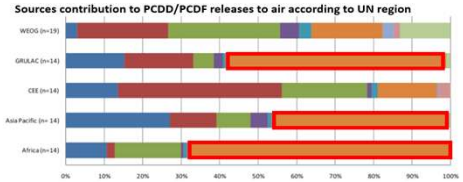
MINAMATA CONVENTION ON MERCURY

BASEL CONVENTION

United Nations Framework Convention on Climate Change

(UNEP/POPs/COP.8/INF40)

3. Reduction of UPOPs by integrated waste management and the waste hierarchy



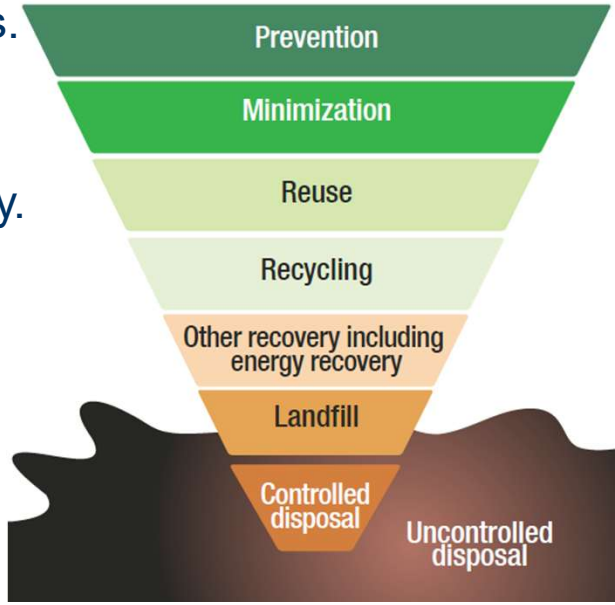
Open waste burning is a major source of UPOP release in most low/middle income countries

Objective: Reduced UPOP releases from open burning of wastes (private & landfill) **and biomass by improvement of waste management (waste hierarchy; circular economy)**.

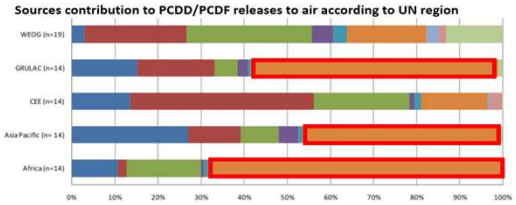
Recommended activity options:

- **Update** the **national waste management plan/strategy** including promotion of the **waste hierarchy and circular economy (Integrating UPOPs/POPs with national waste management strategy)**.

- **Development of a waste catalogue** and related management options.
- **Implementation of sound management of waste considering the waste hierarchy, with an increased focus on prevention, reuse, recycling and recovery in order to move** towards a circular economy.
- **Evaluation of co-incineration capacity** (in particular cement kiln) in the **country or region** and establish co-incineration for waste which cannot be recycled (considering waste hierarchy).
- Thermal recovery of high calorific waste which can not be reused or recycled.



3a. Reduction of UPOPs by control and reduction of open burning at landfills/dumps and backyards



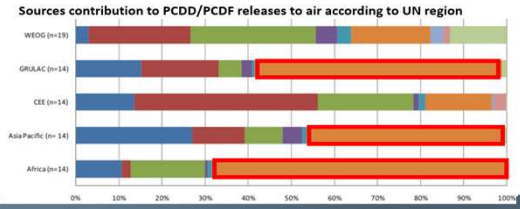
Objective: Reduced UPOPs releases from open burning of wastes (backyard burning and landfill fires).

Background: In recent years **major landfill fires occurred (e.g. Chile, Mauritius, Myanmar, Serbia)** and were main UPOP sources. **Avoidance of such fires need to be a key activity.**

Recommended activity options:

- Assessment of available guidelines for the closure of dump sites; adaptation to national situation
- Closure of dump sites and prevention of illegal dumping of waste (fines).
- Awareness program for landfill operators on the impacts of open waste burning, as well as an educational program on fire control.
- Awareness program and fines for open waste burning.
- Construction of engineered landfills for remaining waste disposal.

3a. Reduction of UPOPs by control and reduction of open burning at landfills/dumps and backyards



Objective: Reduced UPOPs releases from open burning of wastes (backyard burning and landfill fires).

Recommended activity options:

- **Assessment of available guideline for closure of dump sites and adopt to national situation.**
- **Closure of dump sites and stop illegal dumping of wastes (fines).**

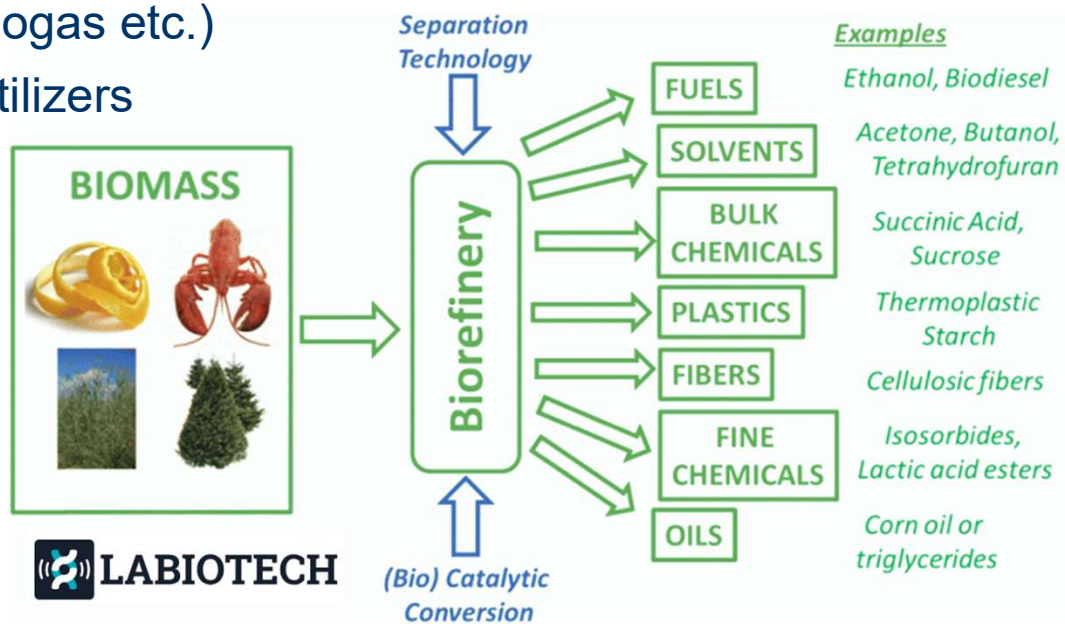
International Solid Waste Association **(ISWA)** task force: https://www.iswa.org/closing-the-worlds-biggest-dumpsites-task-force/?v=3a52f3c22ed6

UNEP/IGES https://www.unep.org/ietc/resources/toolkits-manuals-and-guides/guidelines-safe-closure-and-rehabilitation-municipal-solid

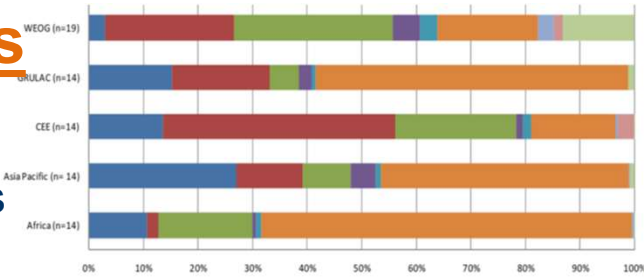
3b. Reduction of UPOPs by control and reduction of open burning of biomass and landfilling of organics

Objective: Reduced releases from open biomass burning by improved national biomass management (biomass strategy; circular economy).

- Assess and develop approaches for reducing open biomass burning.
- **Development of a national strategy for biomass use within the national WM strategy.**
- Promote and implement the strategy by using biomass including agriculture residues - **options**:
  - For energy production (biomass boilers, biogas etc.)
  - For production of compost and organic fertilizers
  - Consider and implement bio-refinery concept as appropriate (sustainable and green chemistry)

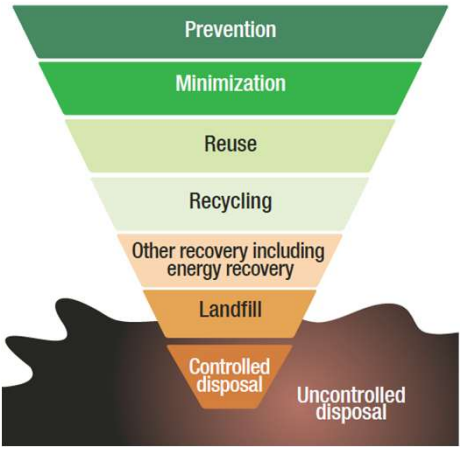


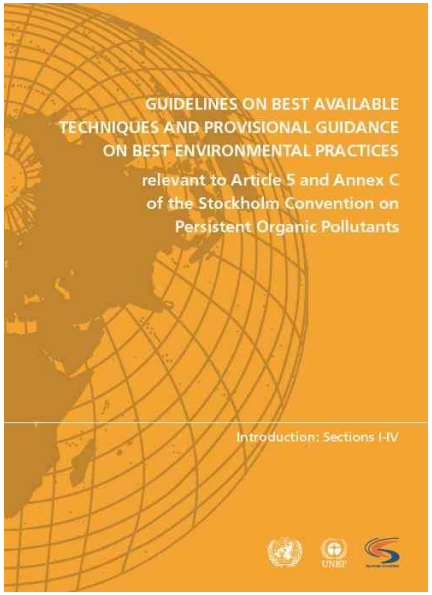
4. Reduction of UPOPs release **from incinerators** (Annex C Part II Sources)

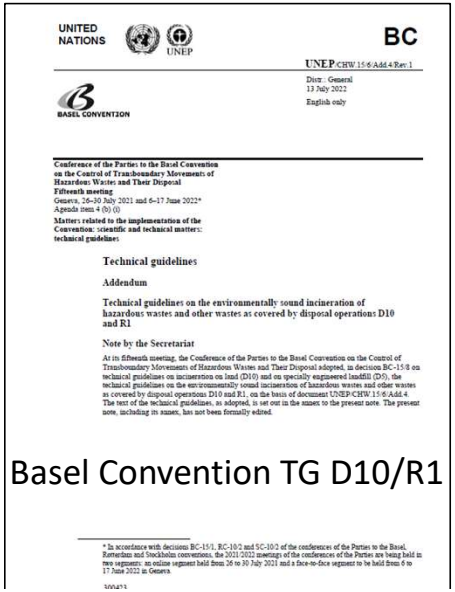


Objective: To **reduce and minimize release** of dioxins & other UPOPs from **waste incinerators** and improve medical waste management.

- **Assessment of the reduction potential of total amount of waste incinerated towards a more circular economy (but avoiding recycling of chemicals of concern).**
- **Assess available BAT guidance documents and adjust to national circumstances.**
- **Implement BEP and where required BAT in existing waste incinerators, including medical and require BAT for new incinerators** (considering integrated pollution prevention & control).






UNITED NATIONS UNEP BC

UNEP/CHW.15/6/Add.4/Rev.1

Distr.: General
13 July 2022
English only

BASEL CONVENTION

Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
Fifteenth meeting
Geneva, 26–30 July 2021 and 6–17 June 2022*
Agenda item 4 (b) (i)
Matters related to the implementation of the Convention: scientific and technical matters: technical guidelines

Technical guidelines

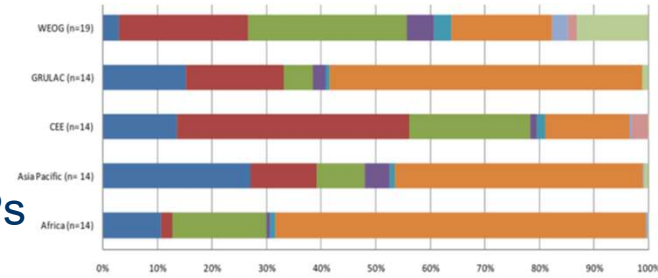
Addendum

Technical guidelines on the environmentally sound incineration of hazardous wastes and other wastes as covered by disposal operations D10 and R1

Note by the Secretariat

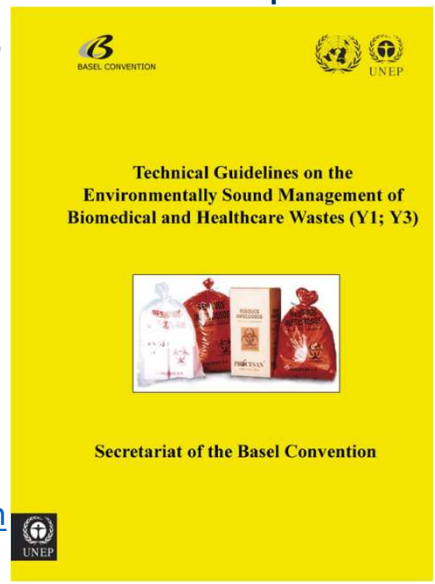
Basel Convention TG D10/R1

4. Reduction of UPOPs release from incinerators (Annex C Part II Sources)



Objective: To reduce and minimize release of dioxins and other UPOPs from waste incinerators **and improve medical waste management.**

- **Assessment of technologies to treat medical waste and selection and implementation of sound treatment methods, including non-combustion technologies.**
- **Develop national guidelines for sound management of medical waste** (considering WHO *"Safe management of wastes from health-care activities*" & Basel Conv. TG)
- **Strengthen institution and human resource capabilities** to implement environmentally sound medical waste management.



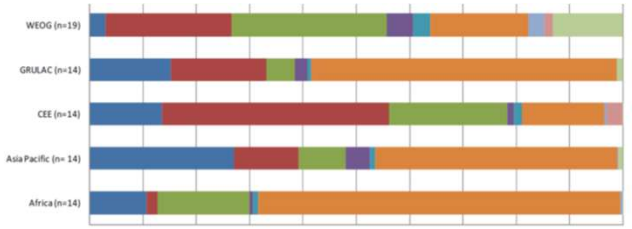
https://www.who.int/publications/i/item/9789241548564

STOCKHOLM CONVENTION

BASEL CONVENTION

https://www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/TechnicalGuidelines/tabid/8025/Default.aspx

5. Reduction of UPOPs release **from metal industries** (Annex C Part II and III sources)



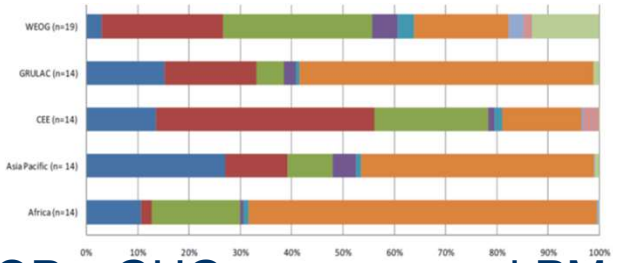
Background: Metal industries are **major emitters** of PCDD/F but also **key** for **circular economy**.

Objective: Adoption of BAT/BEP and Integrated Pollution Prevention and Control, as appropriate, in the ferrous and non-ferrous (secondary) metal production to reduce and minimize release of PCDD/Fs, UPOPs and other priority pollutants.

- **Assessment of metal recovery rates and losses as well as gaps for circular economy.**
- Develop or promote institutions that have the technical capacity to support the implementation of metal (& other resource) recovery and BAT/BEP.
- **Implement BAT for new Annex II sources** (secondary alumina, copper and zinc as well as sinter plants).
- **Promote the use of BAT and BEP** (i) **For existing sources**, within the source categories listed in Part II of Annex C and Part III of that Annex.

Annex C (vi) “New source” means any source of which the construction substantial modification is commenced at least one year after the date of: a) Entry into force of this Convention for the Party concerned; or

6. Reduction and elimination of UPOPs release from power plants (Annex C Part III sources)



Background: Combustion for energy production is a source of UPOPs, GHG, mercury and PM.

Objective: Adoption of BAT/BEP and, as appropriate, Integrated Pollution Prevention and Control (IPPC) for fossil fuel-fired boilers, firing installations for wood/biomass and residential combustion and switch to alternative and renewable energy sources.

- **Promote the use of BAT and BEP** for fossil fuel-fired utility and industrial boilers as well as firing installations for wood and other biomass fuels
- **Substitute fossil fuel power plans with renewables**. (synergy with GHG reduction UN)

The Renewable Energy Transition in Africa

Powering Access, Resilience and Prosperity

https://www.giz.de/en/downloads/Study_Renewable%20Energy%20Transition%20Africa-EN.pdf

KFW giz IRENA

STOCKHOLM CONVENTION

MINAMATA CONVENTION ON MERCURY

United Nations Framework Convention on Climate Change

7. Reduction of UPOPs from indoor cooking & heating with biomass

Background: Indoor heating & cooking with coal, charcoal and wood (Annex C Part III source) result in of indoor air contamination with health effects that contribute heavily to the global burden of disease **(about 3.7 million premature deaths from indoor air pollution**)! Also "*The State of Access to Modern Energy Cooking Services*" report (WB 2020) finds that **4 billion people** around the world **still lack access** to **clean**, **efficient**, **convenient, safe, reliable, and affordable cooking energy**.

Objective: To improve stove performance, phase out open fires, and support alternatives to wood & charcoal for household cooking.

- **Promotion of improved cooking stoves (ICS)** intermediate solution).
- **Substitute cooking and heating with fossil fuel by renewable energy.**

https://www.iea.org/reports/a-vision-for-clean-cooking-access-for-all/

https://www.worldbank.org/en/topic/energy/publication/the-state-of-access-to-modern-energy-cooking-services

STOCKHOLM CONVENTION

United Nations Framework Convention on Climate Change

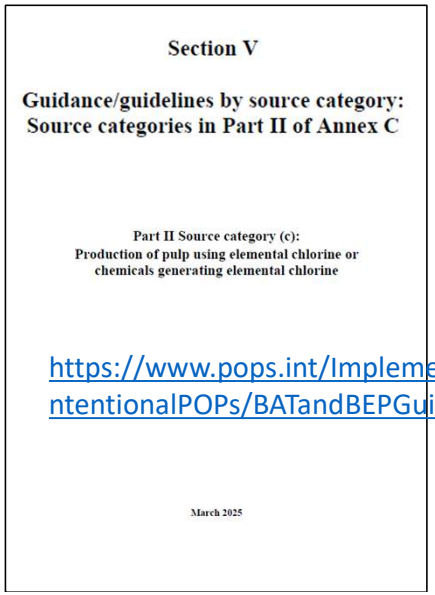
7. Reduction of UPOPs release from other Annex C Part III sources

Background: There are further Annex C Part II and III sources which can be addressed by BAT/BEP or by alternative technologies

Objective: UPOPs from other Annex C sources are reduced and eliminated by BAT/BEP.

Recommended activity options:

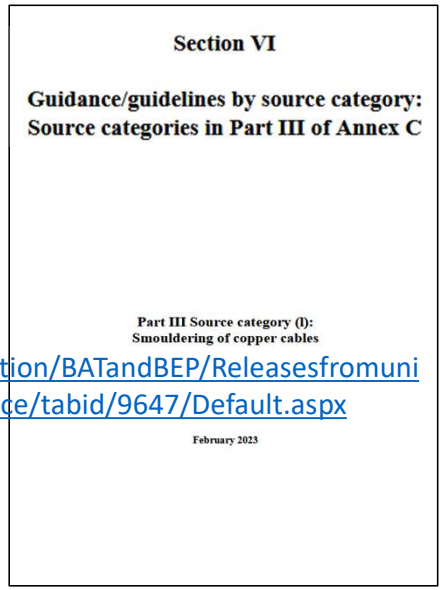
- Substitution of elemental chlorine in remaining pulp and paper industries by alternatives.
- Apply BAT/BEP to shredder plants for the treatment of end-of-life vehicles and WEEE;
- Substitute the smouldering of copper cables by cable stripping and cable chopping.


Section V

Guidance/guidelines by source category: Source categories in Part II of Annex C

Part II Source category (c): Production of pulp using elemental chlorine or chemicals generating elemental chlorine

March 2025

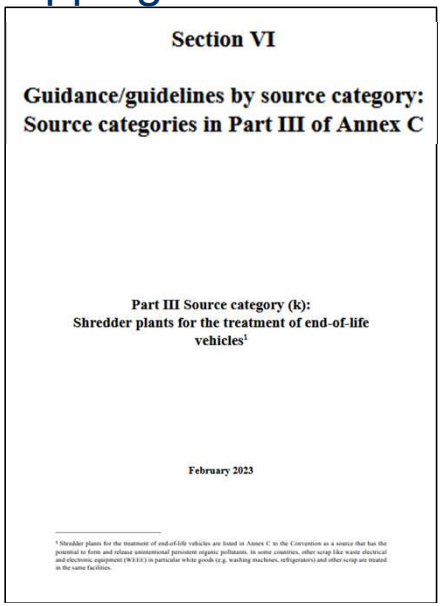

Section VI

Guidance/guidelines by source category: Source categories in Part III of Annex C

Part III Source category (l): Smouldering of copper cables

February 2023

https://www.pops.int/Implementation/BATandBEP/ReleasesfromunintentionalPOPs/BATandBEPGuidance/tabid/9647/Default.aspx


Section VI

Guidance/guidelines by source category: Source categories in Part III of Annex C

Part III Source category (k): Shredder plants for the treatment of end-of-life vehicles[1]

February 2023

8. Reduction of UPOPs from specific chemical production processes and substitution of chemicals and materials (Annex C Part III)

Background: Chemicals such as pesticides have been major sources of PCDD/Fs and still can contain PCDD/Fs. Unintentional produced PCBs in pigment/dye & other OC-production are major PCB sources; HCBD in Arctic air is high & increasing likely from increased OC-solvent production.
Weber et al. (2008) ESPR 15, 363-393; Zhao et al. (2020), ES&T 54, 2163–2171; Megson et al. (2024) STOTEN 924, 171436.

Objective: Use of substitutes or modified materials, products and processes to prevent the formation and release of the chemicals listed in Annex C.

Recommended activity options:

- Identify the production and use of chemicals containing UPOPs (e.g., certain pesticides, triclosan, pigments or (secondary) HCl) and evaluate their UPOP content, release, resulting contamination and risk.
- Identify and promote feasible & affordable alternatives to chemicals and materials contributing to UPOPs release.

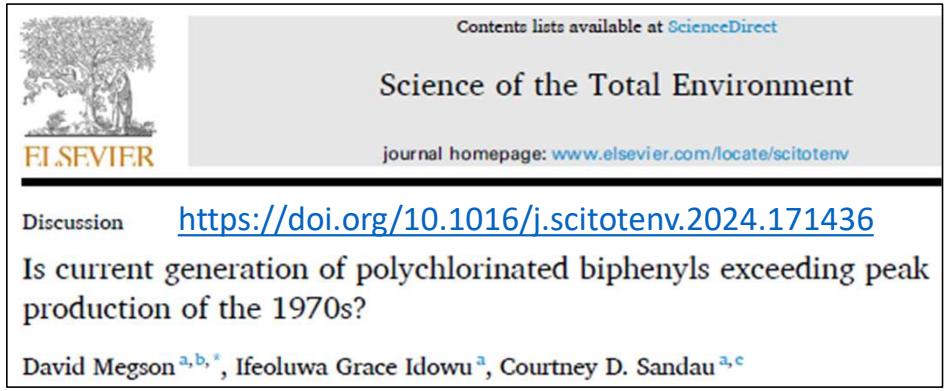
8. Reduction of UPOPs from specific chemical production processes and substitution of chemicals: unintentional PCBs in pigments

Background: Unintentional produced PCB in pigment/dye & other OC-production are major PCB sources and the environmental level of uPCB in some regions are higher than industrial PCB.

Evidence for major contributions of unintentionally-produced PCBs in the air of China: implications for the national source inventory

https://doi.org/10.1021/acs.est.9b06051

Shizhen Zhao, Kevin C. Jones, Jun Li, et al.



Objective: Use of substitutes or modified materials, products and processes to prevent the formation and release of the chemicals listed in Annex C.

Recommended activity options:

- Promotion of alternatives to chemicals containing unintentional PCBs (pigments/dyes, silicones).

https://www.chemforward.org/ipcb-pigment-resource

8. Reduction of UPOPs from specific chemical production processes and substitution of chemicals: Perchloroethylene & trichloroethylene

Background: Perchloroethylene and trichloroethylene production are major sources of HCBD in the environment with high and increasing levels in the Arctic.

GHS07 Harmful | GHS08 Health hazard | GHS09 Environmental hazard | Carcinogenic/ Mutagenic/ reprotoxic | Endocrine disrupting chemicals

FACT SHEET
2024 Final Risk Management Rule for Trichloroethylene under TSCA

EPA

https://www.epa.gov/system/files/documents/2024-12/tce-fact-sheet.pdf

20 Case Studies on

HOW TO PREVENT THE USE OF TOXIC CHEMICALS

frequently found in the Mediterranean Region

https://backend.orbit.dtu.dk/ws/files/163013878/Weber_2018.pdf

Objective: Use of substitutes or modified materials, products & processes to prevent the formation and release of the chemicals listed in Annex C.

Recommended activity option:

- Substitute perchloroethylene in cleaning of clothes with alternatives. (E.g., alternatives to dry cleaning systems are liquid carbon dioxide (LCO2) or wet cleaning and hydrocarbon solvent-based systems).
- Assessment and substitution of the use of perchloroethylene & trichloroethylene in degreasing of metals, as lubricants and other uses by alternatives where feasible.

UN environment | Regional Activity Centre for Sustainable Consumption and Production | switchmed

8. Reduction of UPOPs from specific chemical production processes and substitution of chemicals: Triclosan

Background: Triclosan containing and forming PCDD/F is included in soups and toothpaste as antimicrobial. Science shows that triclosan causes harm but does not provide relevant benefit.

https://www.youtube.com/watch?v=JIAbs3lhbK4

Objective: Use of substitutes or modified materials, products & processes to prevent the formation and release of the chemicals listed in Annex C.

Recommended activity option:

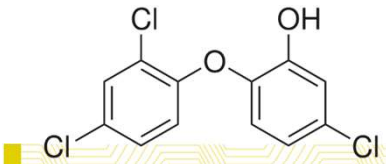
- Eliminate the use of triclosan (and triclocarban) in consumer products.

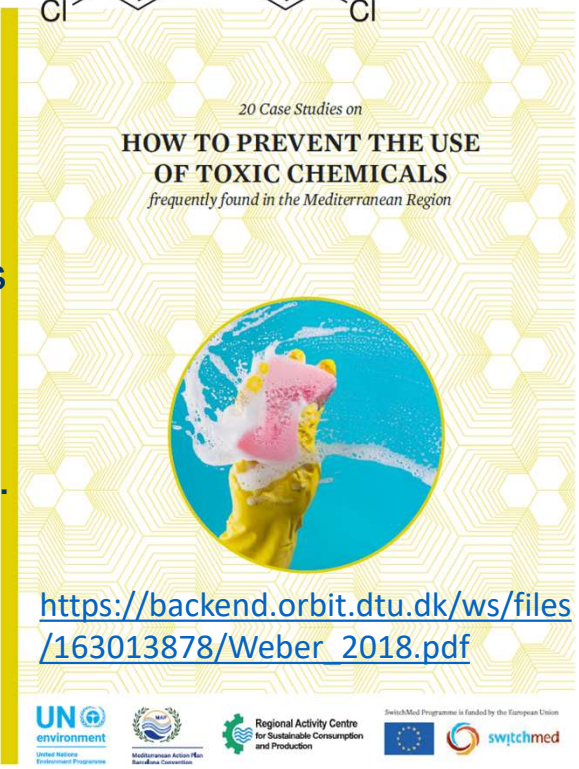
The Florence Statement on Triclosan and Triclocarban

ehp Environmental Health Perspectives

Rolf U. Halden,[1] Avery E. Lindeman,[2] Allison E. Aiello,[3] David Andrews,[4] William A. Arnold,[5] Patricia Fair,[6] Rebecca E. Fuoco,[7] Laura A. Geer,[8] Paula I. Johnson,[9] Rainer Lohmann,[10] Kristopher McNeill,[11] Victoria P. Sacks,[12] Ted Schettler,[13] Roland Weber,[14] R. Thomas Zoeller,[15] and Arlene Blum[16]

https://doi.org/10.1289/EHP1788





https://backend.orbit.dtu.dk/ws/files/163013878/Weber_2018.pdf

UN environment · Regional Activity Centre for Sustainable Consumption and Production · switchmed

9. Awareness raising and education for relevant stakeholder groups on dioxins and other unintentional POPs

Objective: Major stakeholders are awareness and know the fundamentals on PCDD/F, other UPOPs, and other major pollutant releases from SC Annex C Part II and III sources.

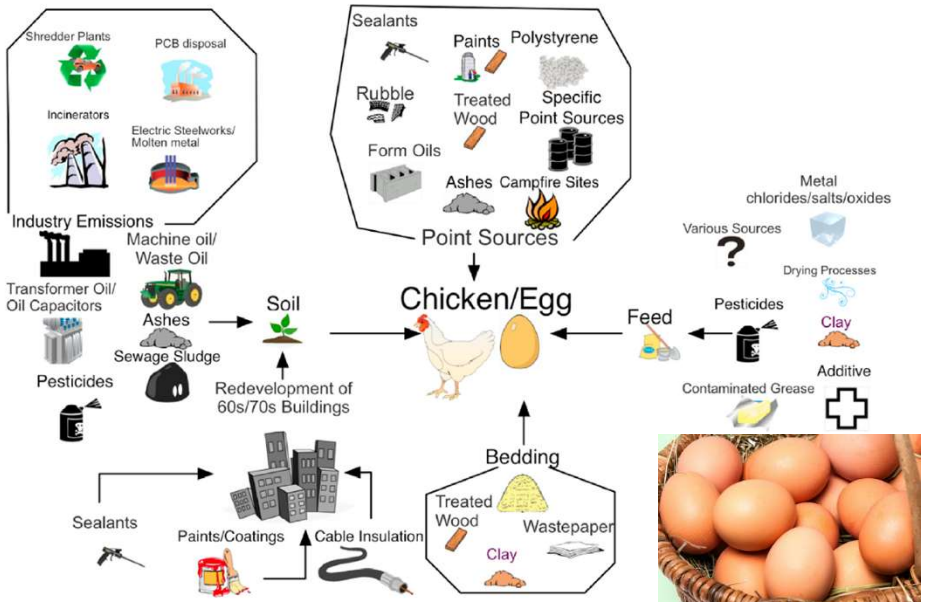
- Develop educational and awareness materials on the health and environmental impact of dioxins, other UPOPs and other co-pollutants (PM, PAH, black carbon/soot).
- Raise awareness among stakeholders and the public of the environmental and health impacts of PCDD/F and other UPOPs and human exposure from contaminated sites and food.
- Conduct awareness and training for stakeholders on legal issues of PCDD/Fs & other UPOPs.
- Run awareness-raising campaigns on dioxins, other POPs and pollutants of concern for relevant stakeholders and sources, such as industrial sources, incinerators, and open burning.

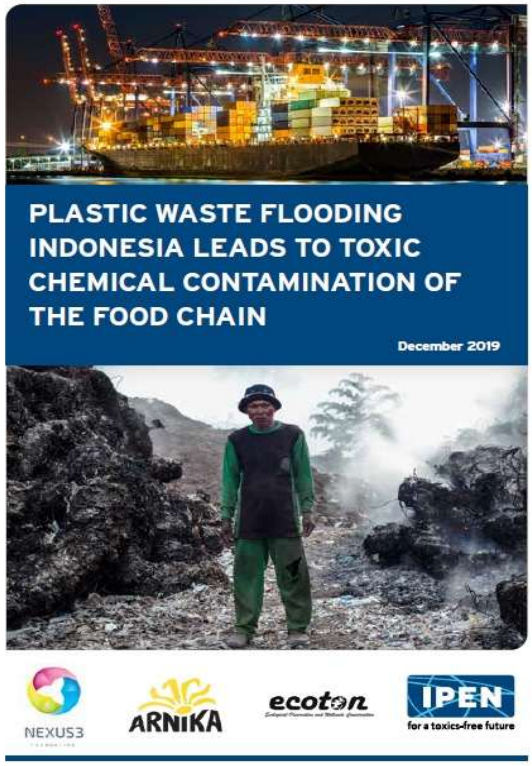
9. Awareness raising for relevant stakeholder groups on Dioxins and other unintentional POPs

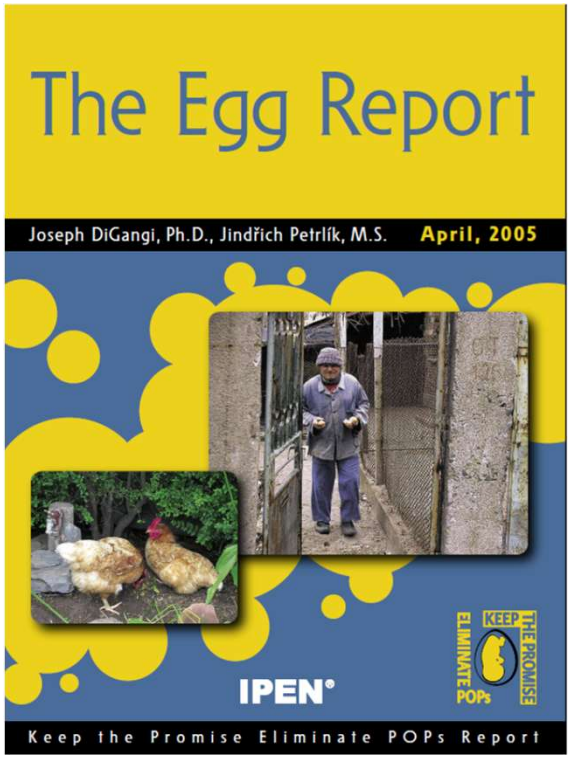
Objective: Major stakeholders are awareness and know the fundamentals on PCDD/F, other UPOPs, and other major pollutant releases from SC Annex C Part II and III sources.

- Chicken egg review paper and IPEN Reports on POPs in eggs around pollutant sources (Petrlik et al. 2022 Emerging Contaminants 8, 254-279 https://doi.org/10.1016/j.emcon.2022.05.001).
- Review on dioxins & PCBs in livestock.

Weber et al. (2018) Environ Sci Eur 30, 42, https://doi.org/10.1186/s12302-018-0166-9



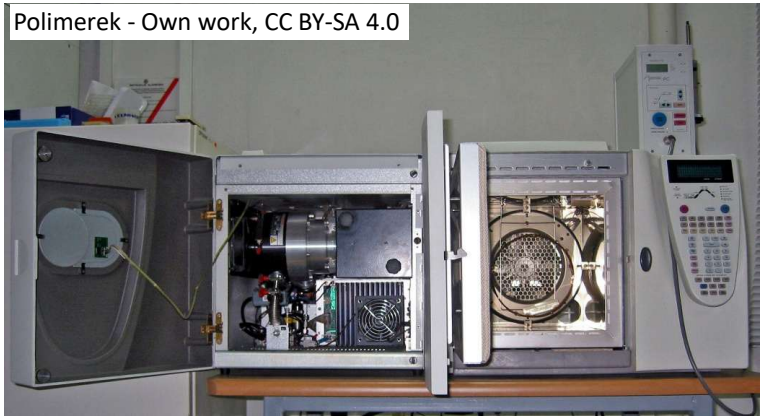




10. Analysis and monitoring of PCDD/F and other UPOPs in the technosphere and other priority areas

Objective: Established monitoring of PCDD/F and other UPOPs and relevant pollutants from Annex II and III sources and human exposure.

- **Assessment of the need and the options** for monitoring PCDD/F and other UPOPs from **industry/ priority sources** (e.g., incinerators, metal industry) and for human exposure (food, feed, soils).
- Establish international **co-operations or strengthen the national capacity** for UPOPs monitoring.
- **Evaluating instrumental analysis and dioxin bio-assays** for potential use in the country.
- Monitoring of incinerators and industrial emissions (metal industries, chemical industries).
- Monitor priority foods and environmental samples for PCDD/F and possibly other UPOPs (e.g. samples with potential human exposure for residents around suspected contaminated sites).



11. Assessment & management of UPOP contaminated sites - **Background**

- PCDD/F contaminated sites are a **large legacy** of the past nearly 200 years of industrial releases.
- PCDD/F are highly persistent and the generated contaminated sites have the potential to impact human health and the environment for long periods.
- **Article 6 of the Convention says (paraphrased) "that Parties shall endeavour to develop appropriate strategies to identify POPs contaminated sites; if remediation is undertaken then in an environmentally sound manner"**.
- To minimise the impacts on vulnerable population and current & future generations, it is important that PCDD/F (& other UPOPs) contaminated sites are identified, inventoried and assessed to evaluate the need for securing and possibly remediation of sites.

Dioxin- and POP-contaminated sites—contemporary and future relevance and challenges

Overview on background, aims and scope of the series

https://doi.org/10.1007/s11356-008-0024-1

Life cycle of PCBs and contamination of the environment and of food products from animal origin

https://doi.org/10.1007/s11356-018-1811-y

Roland Weber[1] · Christine Herold[1] · Henner Hollert[2] · Josef Kamphues[3] · Linda Ungemach[4] · Markus Karlheinz Ballschmiter[6]

KeAi
CHINESE ROOTS GLOBAL IMPACT

Emerging Contaminants

journal homepage: www.keaipublishing.com/cn/journals/emerging-contaminants

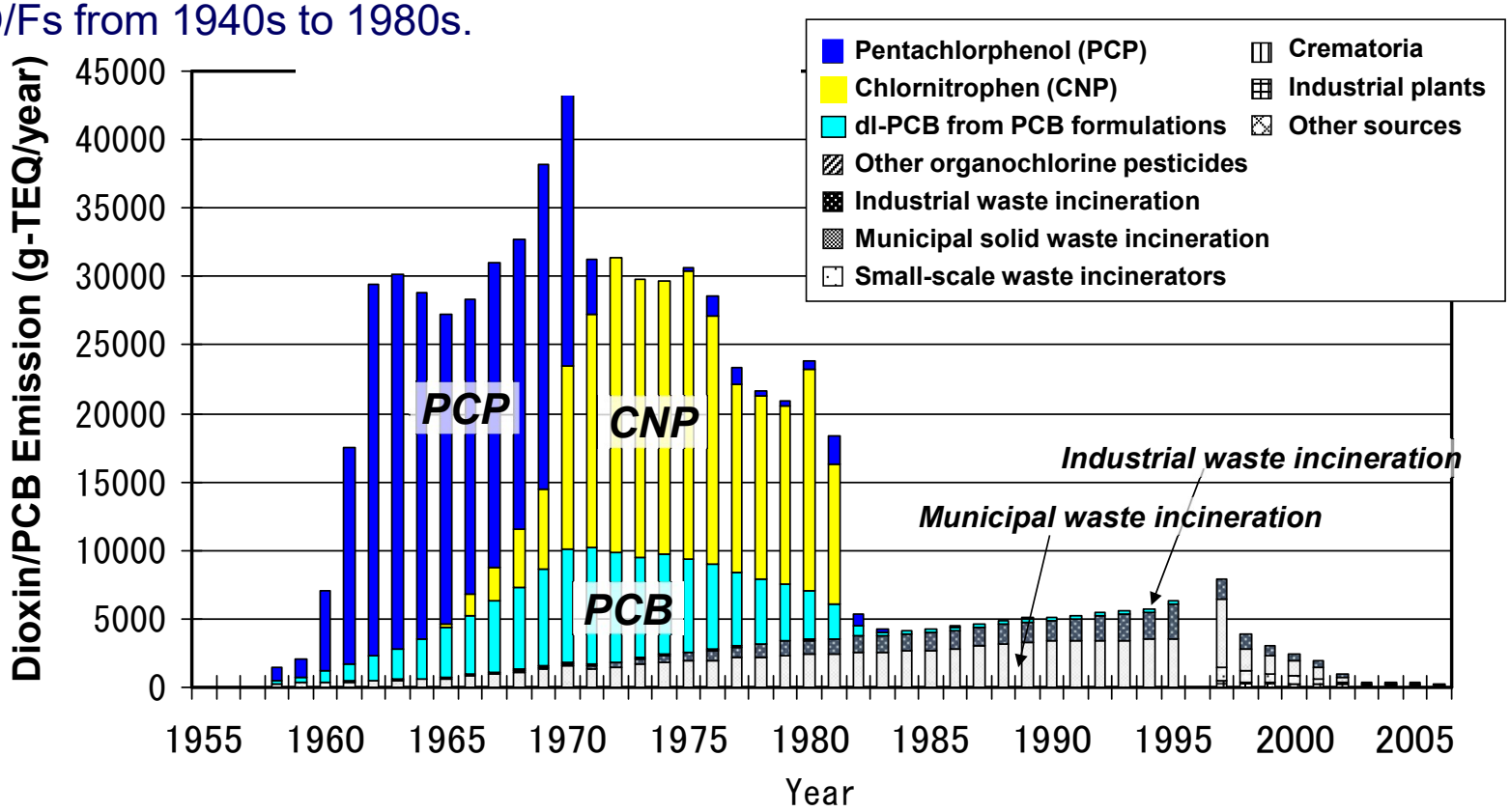
Review article https://doi.org/10.1016/j.emcon.2022.05.001

Monitoring dioxins and PCBs in eggs as sensitive indicators for environmental pollution and global contaminated sites and recommendations for reducing and controlling releases and exposure

Jindrich Petrlik [a, b], Lee Bell [a, c], Joe DiGangi [a], Serge Molly Allo'o Allo'o [d], Gilbert Kuepouo [e], Griffins Ochieng Ochola [f], Valeriya Grechko [b, g], Nikola Jelinek [b], Jitka Strakova [a, b], Martin Skalsky [h], Yuyun Ismawati Drwiega [i], Jonathan N. Hogarh [j], Eric Akortia [k], Sam Adu-Kumi [l], Akarapon Teebthaisong [m], Maria Carcamo [n], Bjorn Beeler [a], Peter Behnisch [o], Claudia Baitinger [p], Christine Herold [q], Roland Weber [q, *]

11. Assessment & management of UPOP contaminated sites - **Background**

The production and use of chlorinated aromatic pesticides were a major source of global contamination with PCDD/Fs from 1940s to 1980s.



~460 kg TEQ has been released into the Japanese environment from pesticide use and ~120 kg TEQ from the PCB use. This can again be compared to the total global dioxin inventory of ~100 kg TEQ today.

Masunaga 1999; Weber et al. (2008) Env Sci Pollut Res 15, 363-393;

11. Assessment & management of UPOP contaminated sites – **Background**: Close to 90% of soils/eggs @ PCDD/Fs pollution sources are contaminated

Contents lists available at ScienceDirect

Emerging Contaminants

journal homepage: www.elsevier.com

Monitoring dioxins and PCBs in eggs as sensitive indicators for environmental pollution and global contaminated sites and recommendations for reducing and controlling releases and exposure

Jindrich Petrlik [a, b], Lee Bell [a, c], Joe DiGangi [a], Serge Molly Allo'o Allo'o [d], Gilbert Kuepouo [e], Griffins Ochieng Ochola [f], Valeriya Grechko [b, g], Nikola Jelinek [b], Jitka Strakova [a, b], Martin Skalsky [h], Yuyun Ismawati Drwiega [i], Jonathan N. Hogarh [j], Eric Akortia [k], Sam Adu-Kumi [l], Akarapon Teebthaisong [m], Maria Carcamo [n], Bjorn Beeler [a], Peter Behnisch [o], Claudia Baitinger [p], Christine Herold [q], Roland Weber [q, *]

Petrlik et al. (2022) Emerging Contaminants 8, 254-79 https://doi.org/10.1016/j.emcon.2022.05.001

- By 2022, IPEN had monitored 113 chicken flocks at potential PCDD/F- and PCB-contaminated sites and **88% of the pooled egg samples were above the EU maximum limits** for PCDD/Fs (2.5 pg PCDD/F-TEQ/g fat) or the sum of PCDD/Fs and dioxin-like PCBs (5 pg PCDD/F-PCB-TEQ/g fat).
- **Children consuming just one egg per day exceed the guidance value of the FAO/WHO (70 pg TEQ/kg bw/month) as well as that of the EU (2 pg TEQ/kg bw/week). This indicates that close to 90% of areas around these industrial emitters and open burning sources in developing countries were unsafe for free-range egg production.**

11. Assessment and management of PCDD/F and other UPOPs contaminated sites (1)

Objective: Identification, assessment and management of sites potentially contaminated with PCDD/F and other UPOPs and securing /remediation.

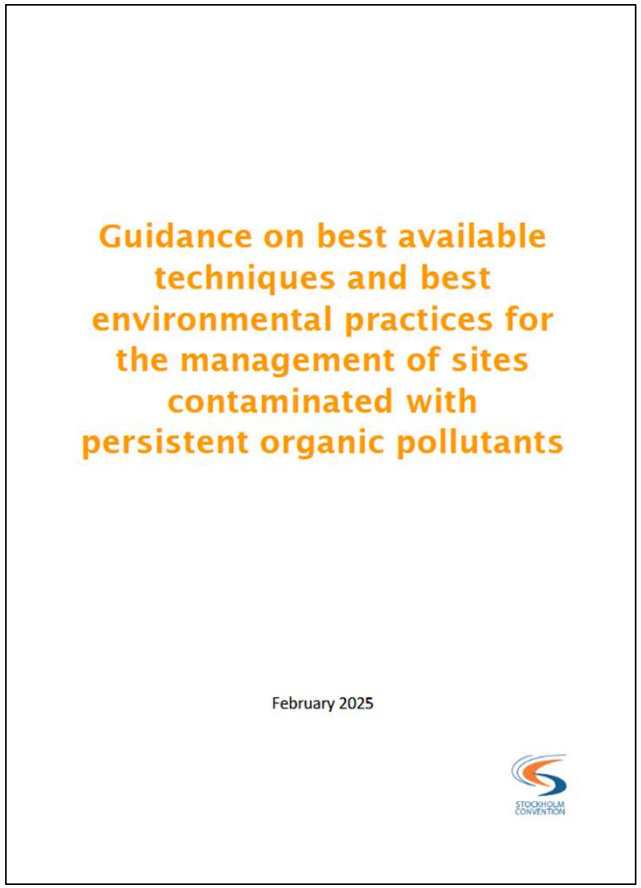
Recommended activity options:

- Develop/update legislation to set criteria for determining contaminated soils and sediments.
- Establish legislation on polluter pays principle for contaminated sites
- Consider guidelines for identification and assessment of sites contaminated with unintentional POPs (please considering the UNEP Toolkit Chapter https://toolkit.pops.int/Publish/Main/II_10_HotSpots.html and the recent BAT/BEP guidance on POPs contaminated sites https://www.pops.int/Implementation/BATandBEP/POPscontaminatedsites/Guidance/tabid/9649/Default.aspx)
- Education and training in identification and management of contaminated sites.
- Establish conceptual site models of potentially UPOP contaminated sites, develop a database and prioritization of the sites for further assessment & management.
- Assessment/monitoring of UPOPs contamination and major co-pollutants for the identified locations (considering prioritization list).

POP contaminated site BAT/BEP guidance (2025)

Module	Title	English
	Executive Summary and Introduction	
1	Background on POPs Contaminated Sites	
2	Principles and Approaches for POPs Contaminated Sites Management and Remediation	
3	Site Investigation, Assessment and Conceptual Site Model	
4	Environmental Risk Assessment	
5	Remediation Technologies and Techniques	
6	Technology Selection Tool for remedial options to be used in Phase 3 - the Remediation Assessment	
7	Stakeholder Engagement, Public and Worker Safety and Health	
8	Contaminated Sites Remediation and Monitoring and Aftercare	
9	Getting Started: Legislation, Policy, Inventory Development and Financing Remediation	
10	Case study - Environmental Management Plan Lâm Hoá site, Viet	

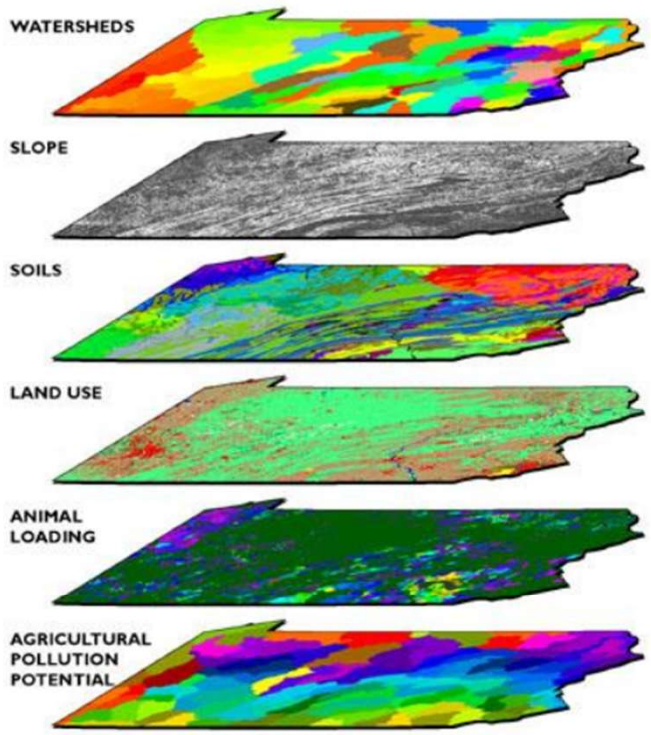
The guidance consists of nine modules, an executive summary and a first case study.



https://www.pops.int/Implementation/BATandBEP/POPscontaminatedsites/Guidance/tabid/9649/Default.aspx

Caribbean regional database on POPs contaminated sites and other POP inventory information

- The POPs – RIS was created to spatially represent the data that is provided and validated by each country, represented in the following data formats:
  (i) **GPS Coordinates or Mapped boundaries** of where POPs chemicals are stores, used or disposed
  (ii) **Name and Information on Facility** – e.g Landfill, Warehouse, Incinerator
  (iii) **Nearby Sensitive Areas** – e.g Water bodies, Residential Areas, Protected Ecosystems or Agricultural Lands
- The data should be in a **"GIS-Ready" format** e.g Shapefiles, Attribute tables.
- **Key stakeholders** to support in this process would be Ministries of Planning (for geospatial data), Environment, Health, Agriculture etc. to provide data or information on the sites as well as technical personnel to be trained.



https://thegreenforum.org/knowledge/pops-regional-information-system-caribbean-region Dana Lewis, 28.10.2025, GGKP Webina

Synergies of addressing UPOPs and mercury – chemical industry

- Also some major sources of mercury in the chemical industry – chloralkali electrolysis and PVC production - are/were major UPOP sources which can be addressed together.
- The PVC production via acetylene releases mercury and UPOPs.
- Depending on the chloralkali technology used, chloralkali plants release mercury and UPOPs and often different technologies have been used over time at a site. Therefore chloralkali sites are frequently contaminated by mercury and PCDD/F, PCNs and other UPOPs. This needs to be considered in the assessment and remediation. Mercury electrodes are being phased out.

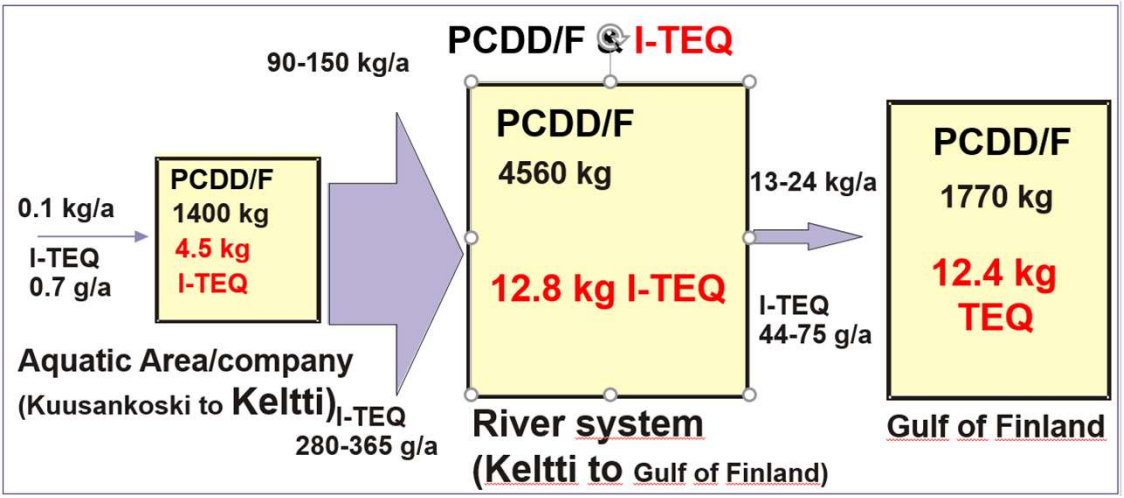
https://www.youtube.com/watch?v=ai1olQPYT98&t=1113s

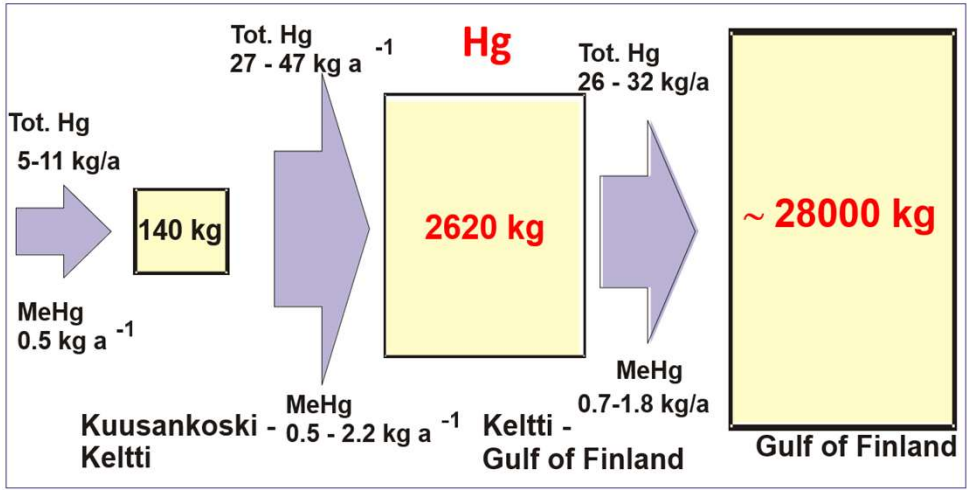
0:00:00 Intro
0:00:40 1. Ben Vauter (ONLINE). CHLOR ALKALI INDUSTRY, GLOBAL MERCURY PARTNERSHIP AND THE MINAMATA CONVENTION ON MERCURY.
0:18:33 2. Roland Weber. RELEVANCE OF MERCURY CONTAMINATED SITES FOR GLOBAL MERCURY RELEASE AND IMPLEMENTATION SYNERGY OF THE MINAMATA & STOCKHOLM CONVENTION.
0:32:09 3. Nikola Jelinek. MERCURY CONTAMINATION AS A LEGACY OF CHEMICAL PRODUCTION IN THE CEE REGION.
0:45:00 4. Guido Van de Coterlet. WHERE STOCKHOLM MEETS MINAMATA – MERCURY AND HCH ISSUES AS CHLOR-ALKALI FACILITIES.
1:02:24 5. Xavier Ibarz. ECON INDUSTRIES: VACUDRY® TECHNOLOGY, CASE STUDY: MERCURY AND HCH WASTE TREATMENT FROM CHLOR-ALKALI PLANTS.

Dioxin & mercury contaminated site from chloralkali plant (Finland): Sediment burdens and fluxes

A **chloralkali production site with** organochlorine (PxCP) manufacturing **(1940-1984)** released:

- around 30 kg TEQ PCDD/F into the River Kymijoki, of which 12.8 kg TEQ still remain in the river sediments and 12.4 kg TEQ have migrated into the Baltic Sea contaminating the fishes there.
- More than 30 tonnes of mercury were released into the River Kymijoki, with 2760 kg still remaining in the river. 28 tonnes have migrated into the Baltic Sea, contaminating the fishes.





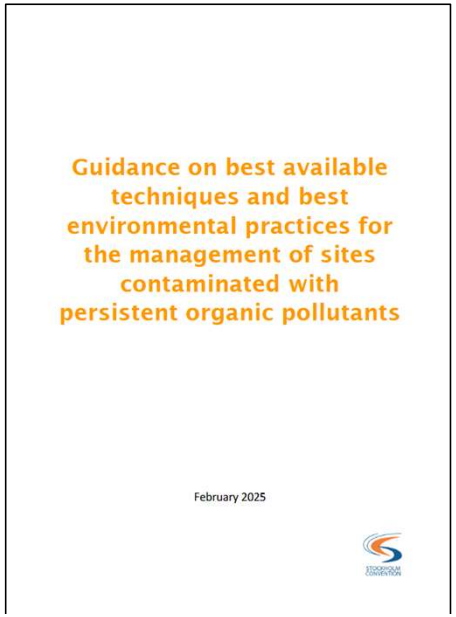
Sources: Verta et al. (2009) Environ Sci Pollut Res 16, 95–105 https://doi.org/10.1007/s11356-008-0061-9

11. Assessment & management of PCDD/F & other UPOPs contaminated sites (2)

Objective: Identification, assessment and management of sites potentially contaminated with PCDD/F and other UPOPs, and securing /remediation.

Recommended activity options:

- **Develop strategies** for the environmentally sound management of POPs contaminated sites.
- **Secure contaminated sites considering priority ranking and need to stop exposure.**
- Identification of clean-up measures and initiate clean-up procedures for high priority contaminated sites.
- Develop monitoring for contaminated and secured and cleaned sites.



Thank you for your attention ! Questions?

More Information https://www.thegef.org/; https://en.wikipedia.org/wiki/Triple_planetary_crisis

Basel Convention: www.basel.int

Rotterdam Convention: www.pic.int

Stockholm Convention: http://chm.pops.int/;

Montreal Protocol/Vienna Convention: http://ozone.unep.org

GFC: https://www.chemicalsframework.org/ **FAO:** www.fao.org **WHO** www.who.int/

Climate Convention https://unfccc.int/ **Biodiversity Convention:** https://www.cbd.int/

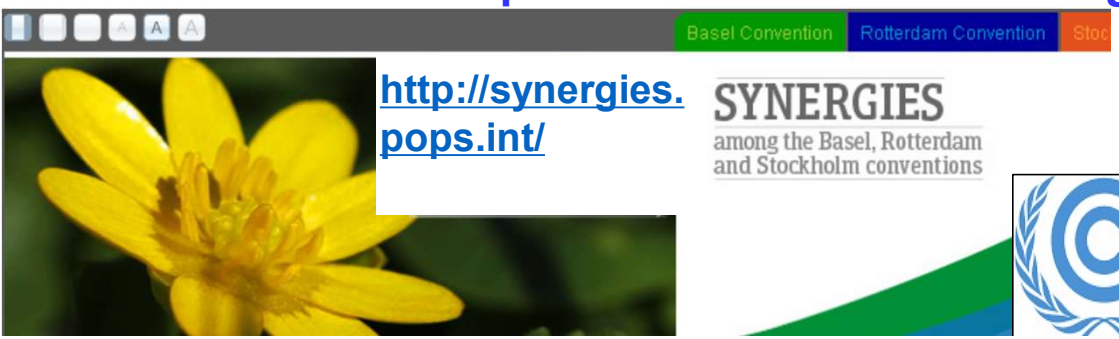
OECD/IOMC: http://www.oecd.org/chemicalsafety/

Science:; https://www.ipcc.ch/; https://www.ipbes.net/; https://www.unep.org/isp-cwp; https://www.ipcp.ch/

Industry: http://www.suschem.org/; https://icca-chem.org/; https://cefic.org/

NGO: www.ipcp.ch; www.ipen.org; www.ciel.org/; www.ban.org; www.chemsec.org; www.wecf.org

Better-world-links: http://www.betterworldlinks.org/



http://synergies.pops.int/

SYNERGIES
among the Basel, Rotterdam and Stockholm conventions

UN environment programme
Global Framework on Chemicals

GREEN GROWTH Knowledge Partnership

United Nations Framework Convention on Climate Change

Convention on Biological Diversity