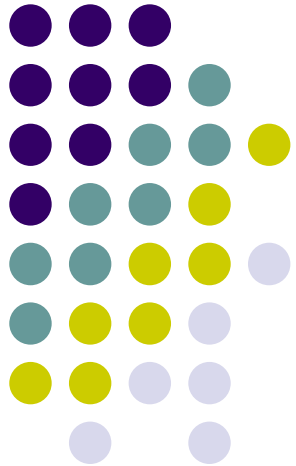
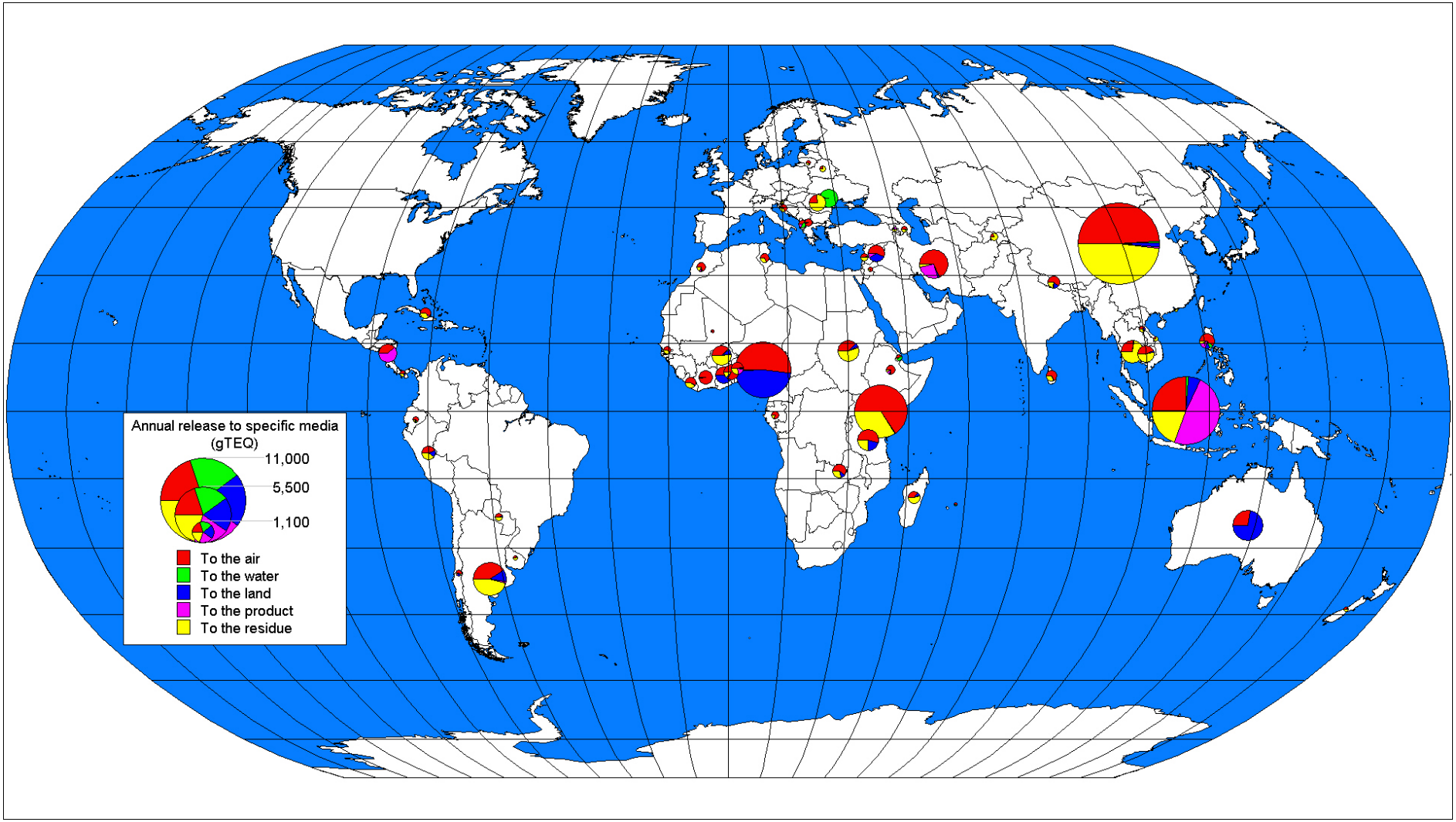
Emissionsinventare im internationalen Vergleich

Dr. Heidelore Fiedler
United Nations Environment Programme (UNEP)
DTIE/Chemicals Branch
chemin des Anémones 11-13
CH-1219 Châtelaine (GE)
Switzerland
e-mail: heidelore.fiedler@unep.org



UNEP

Annual releases from all source groups*

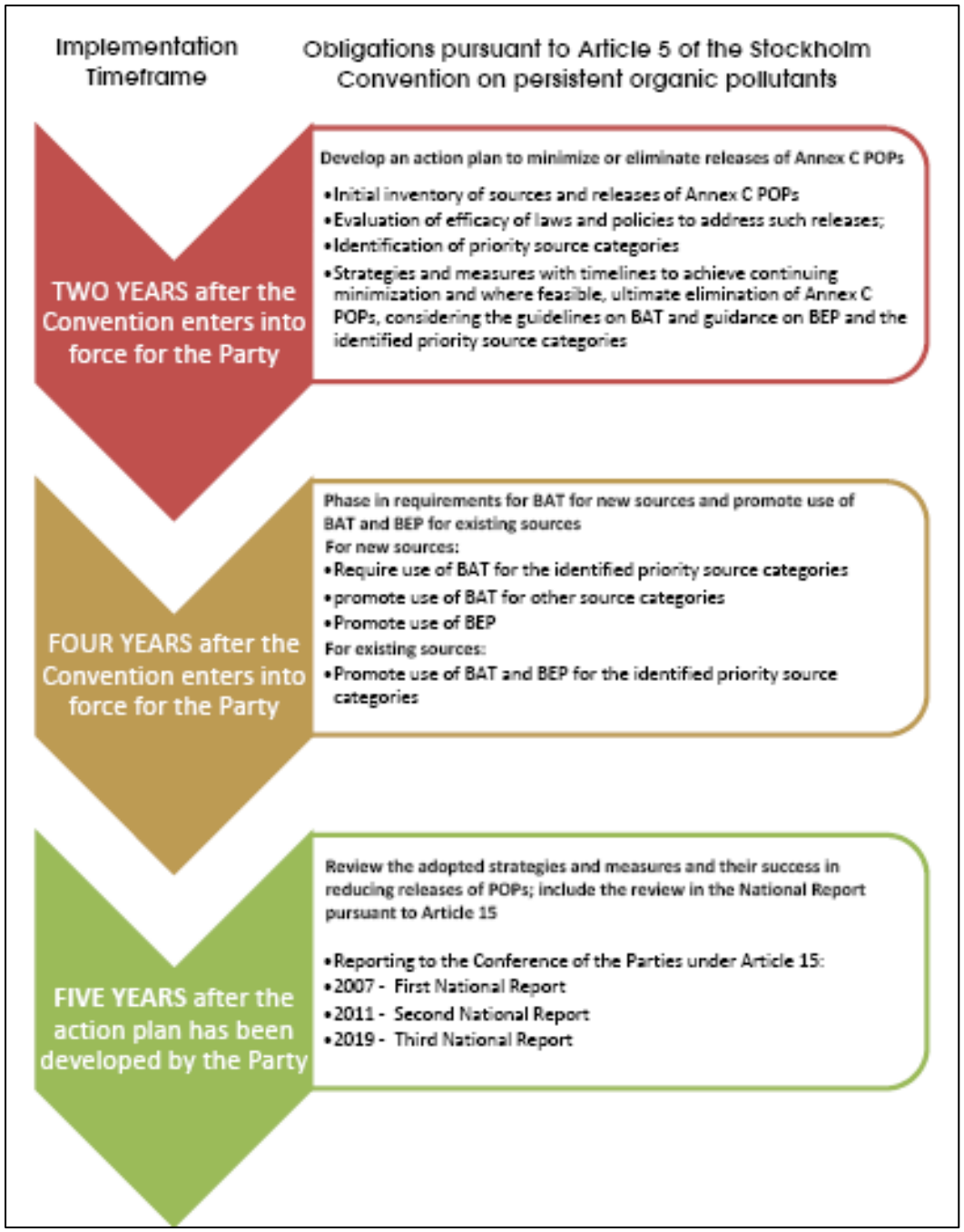


n=62, but 176 Parties to the Stockholm Convention; * Toolkit methodology

Unintentional POPs

… are subject to require-ments according to Article 5 and Annex C of the Stockholm Convention

Each Party shall take measures to reduce the total releases derived from anthropogenic sources of each of the chemicals listed in Annex C with the goal of their continuing minimi-zation and, where feasible, ultimate elimination.



SC-5/12

UNEP

Timetable for implementation of requirements under article 5 – unintentional production:

Annex C includes:

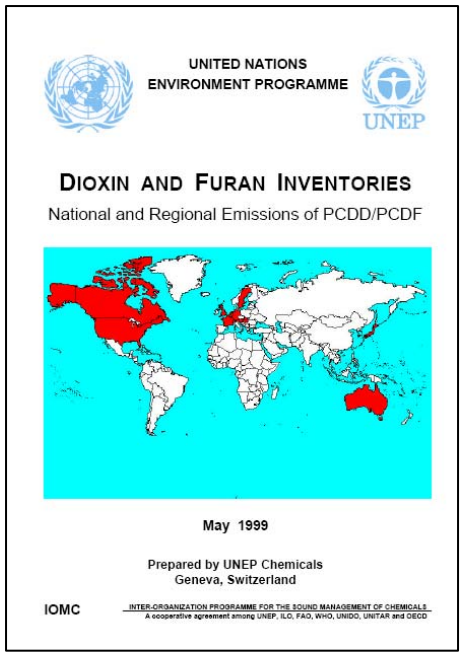
- PCDD/PCDF

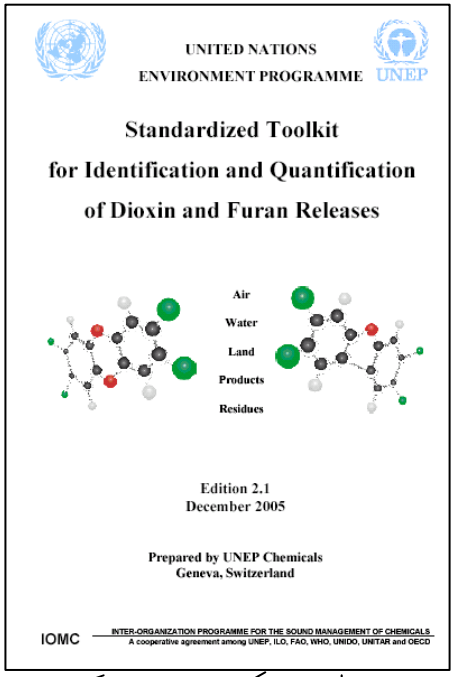
- PCB

- HCB

- PeCBz (QCB)

More than 10 years





SC-2/5, SC-3/6
SC-4/7
SC-5/13

Toolkit update and review process (SSC+CB)

Draft

v1

v2

1999 INC-3

2001 INC-5

2003 INC-7

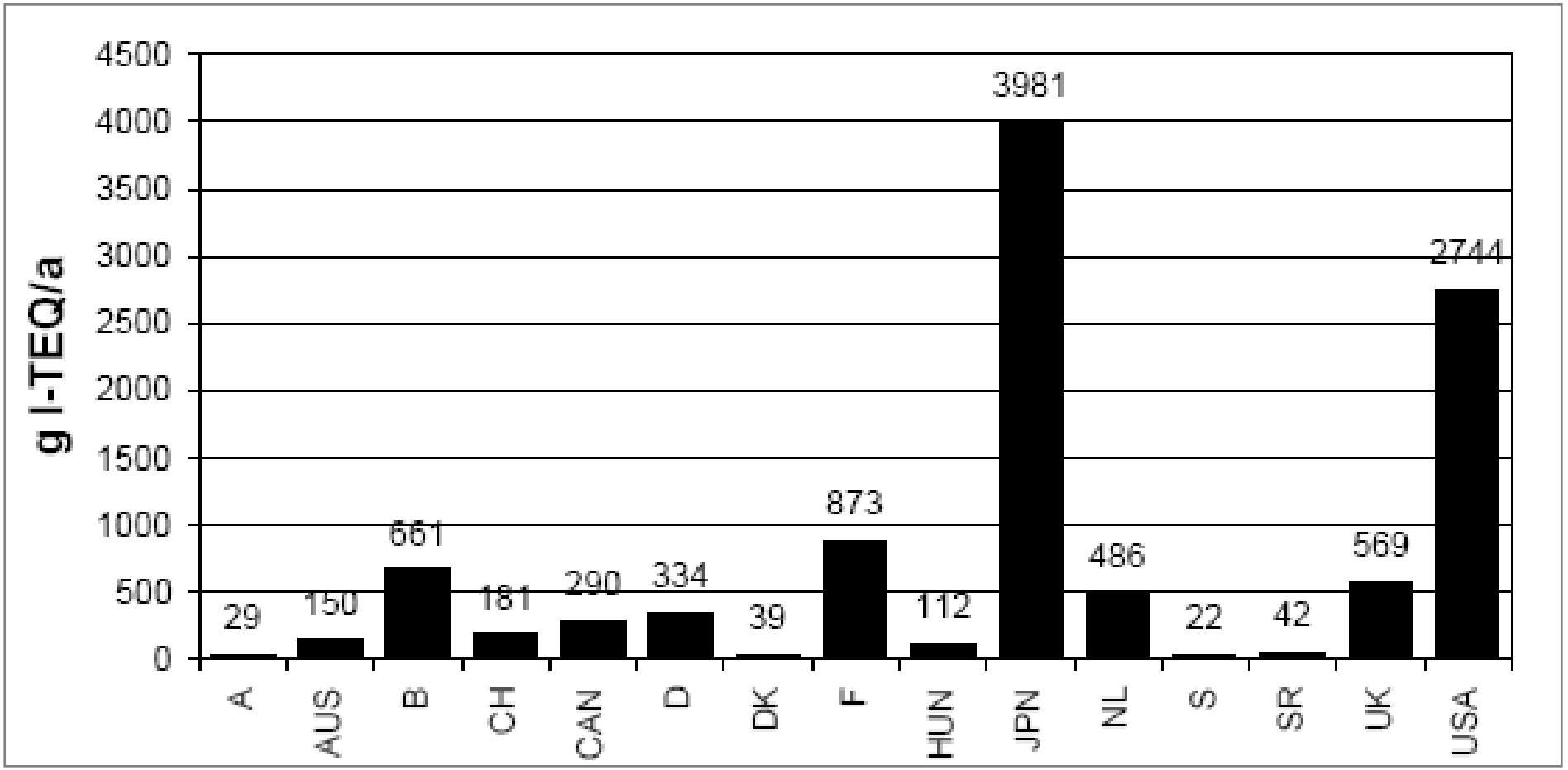
2005 COP-1

2006 COP-2

2011

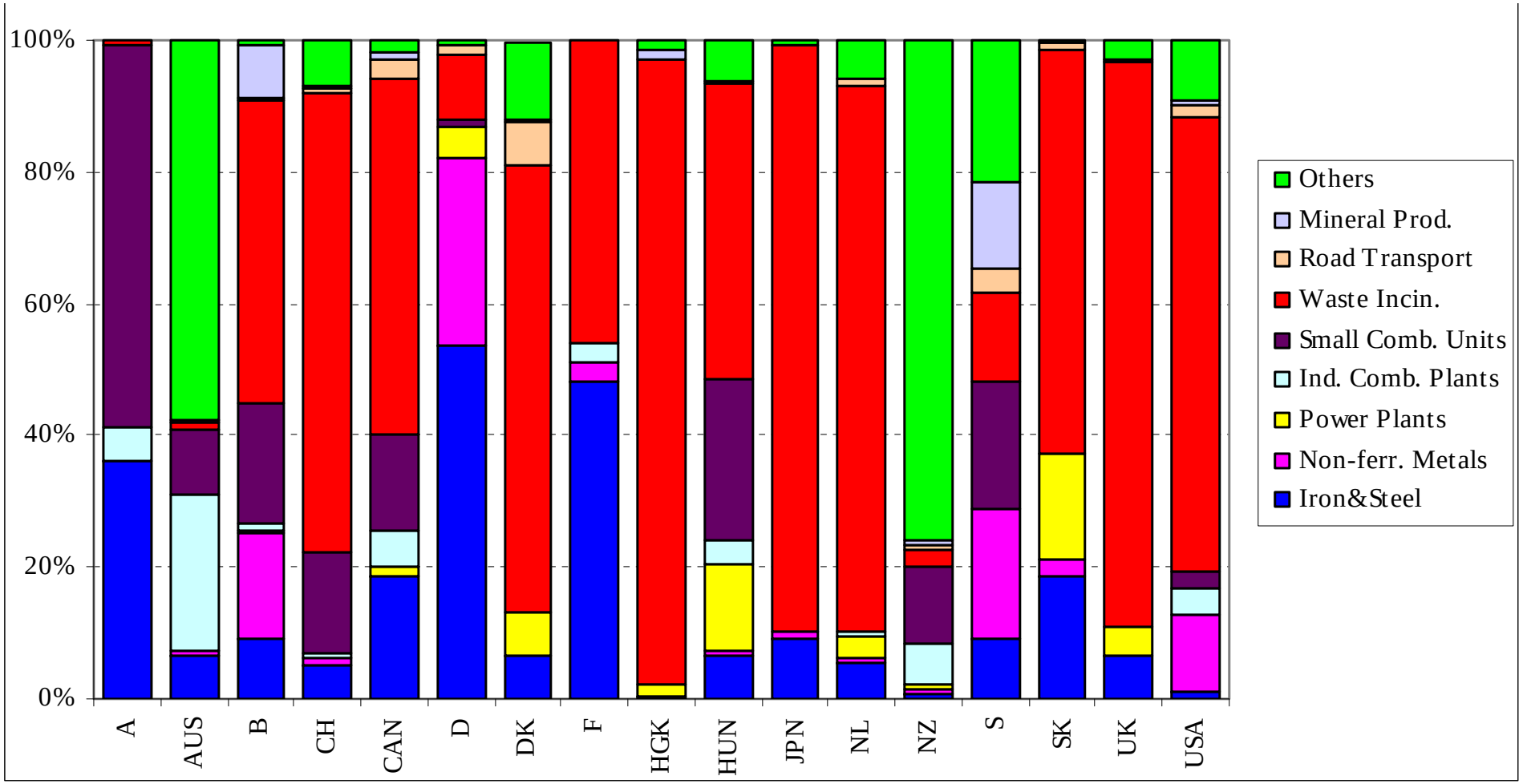
Dioxin Inventories: 1995

- 15 developed countries = 10,500 g TEQ per year
- Emissions to air predominantly



Source Distribution per Country

PCDD/PCDF (TEQ), Reference year around 1995; mainly developed countries

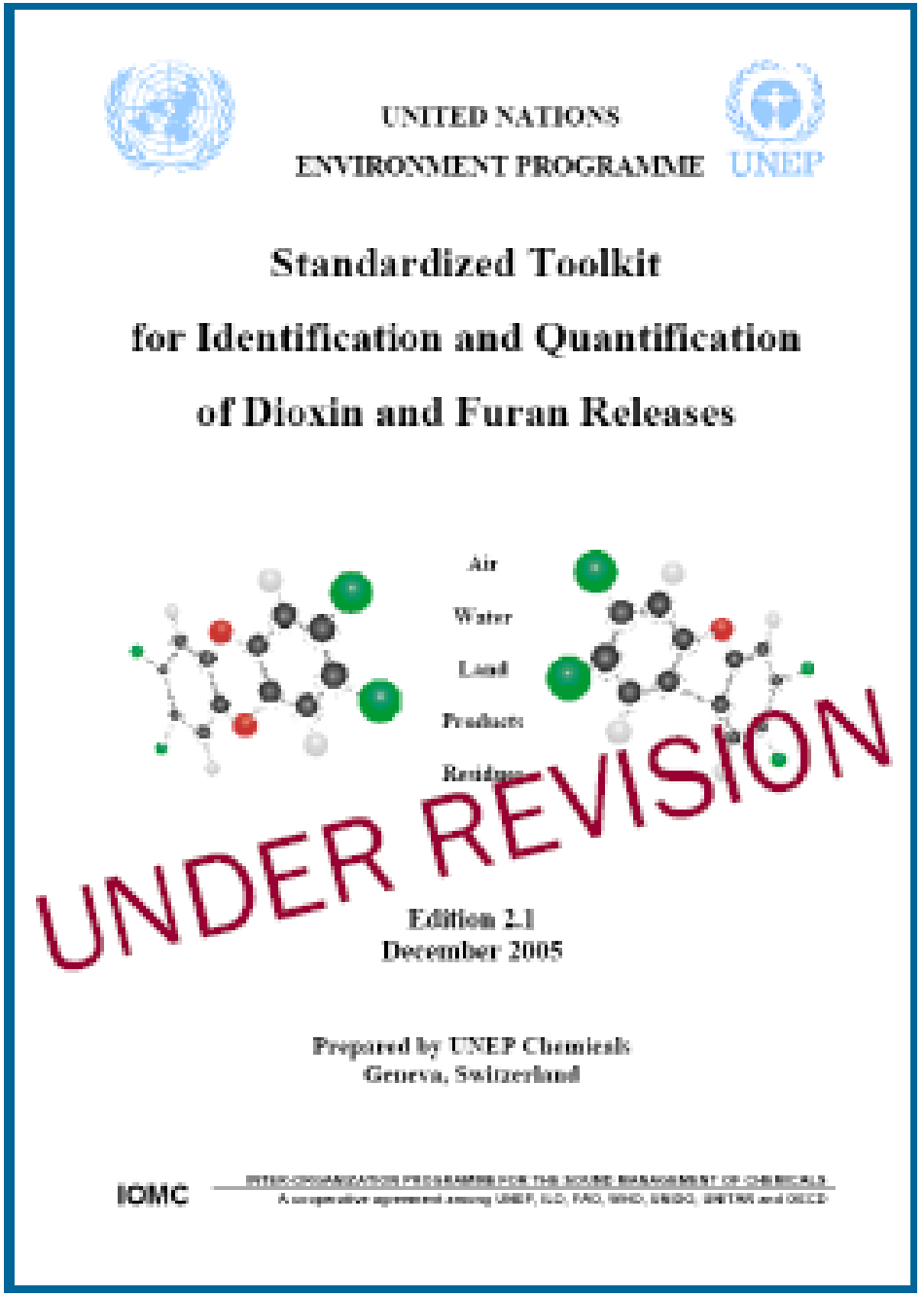


Methodology to establish complete, comparable PCDD/PCDF Inventories

(250 pages + EXCEL file)

Updating and review process mandated by Conference of the Parties, started in 2006

some new emission factors proposed for COP-5 (April 2011)



http://www.chem.unep.ch/pops/pcdd_activities/default.htm

Revised inventory reporting format

Group	Source Groups	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	0.0	0.0	0.0	0.0	0.0
2	Ferrous and Non-Ferrous Metal Production	0.0	0.0	0.0	0.0	0.0
3	Heat and Power Generation	0.0	0.0	0.0	0.0	0.0
4	Production of Mineral Products	0.0	0.0	0.0	0.0	0.0
5	Transportation	0.0	0.0	0.0	0.0	0.0
6	Open Burning Processes	0.0	0.0	0.0	0.0	0.0
7	Production of Chemicals and Consumer Goods	0.0	0.0	0.0	0.0	0.0
8	Miscellaneous	0.0	0.0	0.0	0.0	0.0
9	Disposal	0.0	0.0	0.0	0.0	0.0
10	Identification of Potential Hot-Spots				0.0	0.0
1-10	**Total**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	Grand Total			**0**		

- Updated reporting format
  (under article 15; adopted at COP-5, INF.44)

Source categories	Potential Release Route (µg TEQ/t)					Production	Annual release				
	Air	Water	Land	Product	Residue	t/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a	g TEQ/a
Ferrous and Non-Ferrous Metal Production							Air	Water	Land	Product	Residue
Iron ore sintering						0	0.000	0	0	0	0.0
High waste recycling, incl. oil contaminnated m	20	ND	ND	ND	0.003		0.000				0.000
Low waste use, well controlled plant	5	ND	ND	ND	1		0.000				0.000
High technology, emission reduction	0.3	ND	ND	ND	2		0.000				0.000
Coke production						0	0.000	0	0	0	0
No gas cleaning	3	0.06	ND	ND	ND		0.000	0			
Afterburner/ dust removal	0.03	0.06	ND	ND	ND		0.000	0			
Iron and steel production plants and foundries						0	0	0	0	0	0
Iron and steel plants						*0*	*0*	*0*	*0*	*0*	*0.000*
Dirty scrap, scrap preheating, limited controls	10	ND	ND	NA	15		0.000				0.000
Clean scrap/virgin iron or dirty scrap, afterburn	3	ND	ND	NA	15		0.000				0.000
Clean scrap/virgin iron or dirty scrap, EAF equ	0.1	ND	ND	NA	0.1		0.000				0.000
Blast furnaces with APCS	0.01	ND	ND	NA	ND		0.000				
Foundries						*0*	*0.000*	*0*	*0*	*0*	*0.0*
Cold air cupola or hot air cupola or rotary drum	10	ND	ND	NA	ND		0.000				
Rotary drum - fabric filter or wet scribber	4.3	ND	ND	NA	0.2		0.000				0.000
Cold air cupola, fabric filter or wet scrubber	1	ND	ND	NA	8		0.000				0.000
Hot air cupola or induction furnace, fabric filter or wet scrubber	0.03	ND	ND	NA	0.5		0.000				0.000
Hot-dip galvanizing plants						0	0.000	0	0	0	0.0
Facilities without APCS	0.06	NA	NA	NA	ND		0.000				
Facilties without degreasing step, good APCS	0.05	NA	NA	NA	2,000		0.000				0.000
Facilities with degreasing step, good APCS	0.02	NA	NA	NA	1,000		0.000				0.000
Copper production						0	0.000	0	0	0	0.0
Sec. Cu - Basic technology	800	ND	NA	NA	630		0.000				0.000
Sec. Cu - Well controlled	50	ND	NA	NA	630		0.000				0.000
Sec. Cu - Optimized for PCDD/PCDF control	5	ND	NA	NA	300		0.000				0.000
Smelting and casting of Cu/Cu alloys	0.03	ND	NA	NA	ND		0.000				
Prim. Cu, well-controlled, with some secondary feed materials	0.01	ND	NA	NA	ND		0.000				
Pure prim. Cu smelters with no secondary feed	ND	ND	NA	NA	NA						
Ferrous and Non-Ferrous Metal Production							0.000	0.000	0.000	0.000	0.000

Source Group 2: Aluminium, lead, zinc, brass and bronze, magnesium, other non-ferrous metal production, shredders, thermal wire reclamation

Updated reporting format
(article 15; adopted at COP-5, INF.44)
PCDD/PCDF inventory China

Cat.	Source Categories	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	610				1,147
2	Ferrous and Non-Ferrous Metal Production	2,486	14			2,167
3	Heat and power generation	1,304				588
4	Production of Mineral Products	414				
5	Transportation	120				
6	Open burning processes	64.0				953
7	Production of Chemicals and Consumer Goods	0.68	23	174	68.90	
8	Miscellaneous	44.2				11.0
9	Disposal/Landfilling		4.53			43.2
10	Hot spots					
1-10	**Total**	**5,043**	**41.2**	**174**	**68.9**	**4,910**
	Grand Total	**10,237**				
	per release vector	**49%**	**0.4%**	**1.7%**	**0.7%**	**48%**

Toolkit Meeting, December 2007

The German POPs Inventory

Emissions into air in 2004	PCDD/PCDF [g I-TE/a]		
Source Category	2,5% Percentile	Mean	97,5% Percentile
Waste incineration	1,1	1,6	2,2
Cement kilns	0,4	0,9	1,2
Pulp and paper	0,2	0,3	0,4
Metal industries	31,3	45,9	60,4
Open burning	15,6	32,4	55,3
Residential and commercial combustion	17,1	22,1	27,2
Power plants and combustion in industry	5,3	7,5	10,1
Transport	3,1	3,6	4,0
Other sources		1,8	
Total	75	116	144

Results from Monte Carlo Simulation

Weiterentwicklung der Schätzverfahren für Emissionen von POPs aus technischen Verfahren („Toolkit“)
Forschungsvorhaben im Auftrag des Umweltbundesamtes FKZ: 206 67 405 Endbericht
O. Rentz, U. Karl, M. Haase

Revision of emission factors: House-hold cooking/heating - Fossil fuels

3e Household heating and cooking with fossil fuels		Emission factors – µg TEQ/TJ of fossil fuel burned								Concentration µg TEQ/t ash	
Classification		Air		Water		Land		Product		Residue	
		Old EF	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**
1	**Coal and biomass co-fired stoves with waste**	~~*15000*~~	**1700**							~~*30000*~~	**5000**
2	Coal-fired stoves	*100*	**100**							~~*5000*~~	**5**
3	**Peat-fired stoves**		**100**								
4	Oil-fired stoves	*10*	**10**							*NA*	
5	Natural gas or LPG-fired stoves	*1.5*	**1.5**							*NA*	
6	**Coal and coke-fired simple stoves**		**200**								

For cooking/heating with fossil fuels:

- BAT is dependent on choice of fuel (gas-fired < oil < coal)
- Simple stoves have higher emissions than Western stoves
- Cofiring of waste has highest emissions

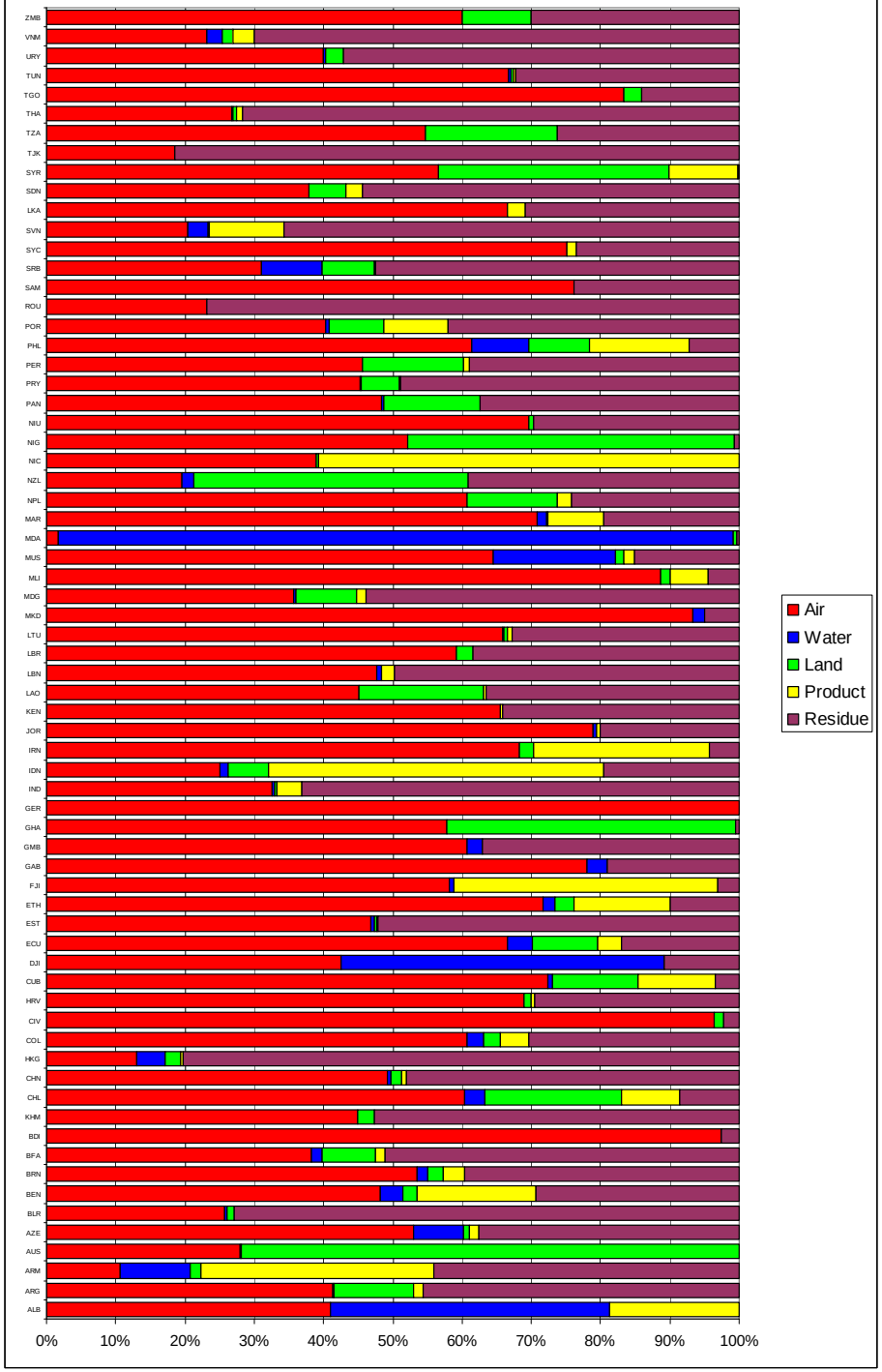
National Dioxin Inventories: Toolkit Summary 2011 (n=68)

68 (most) developing countries
= 3.8 billion population

Releases (g TEQ per year)				
Air	Water	Land	Product	Residue
26,400	1,200	6,000	5,300	19,800
45%	**2%**	**10%**	**9%**	**34%**
Grand total (ca.)			**58,700**	

- Most PCDD/PCDF go to air ⇒ LRT
- Least PCDD/PCDF go to water (directly)

Status: Oct 2011



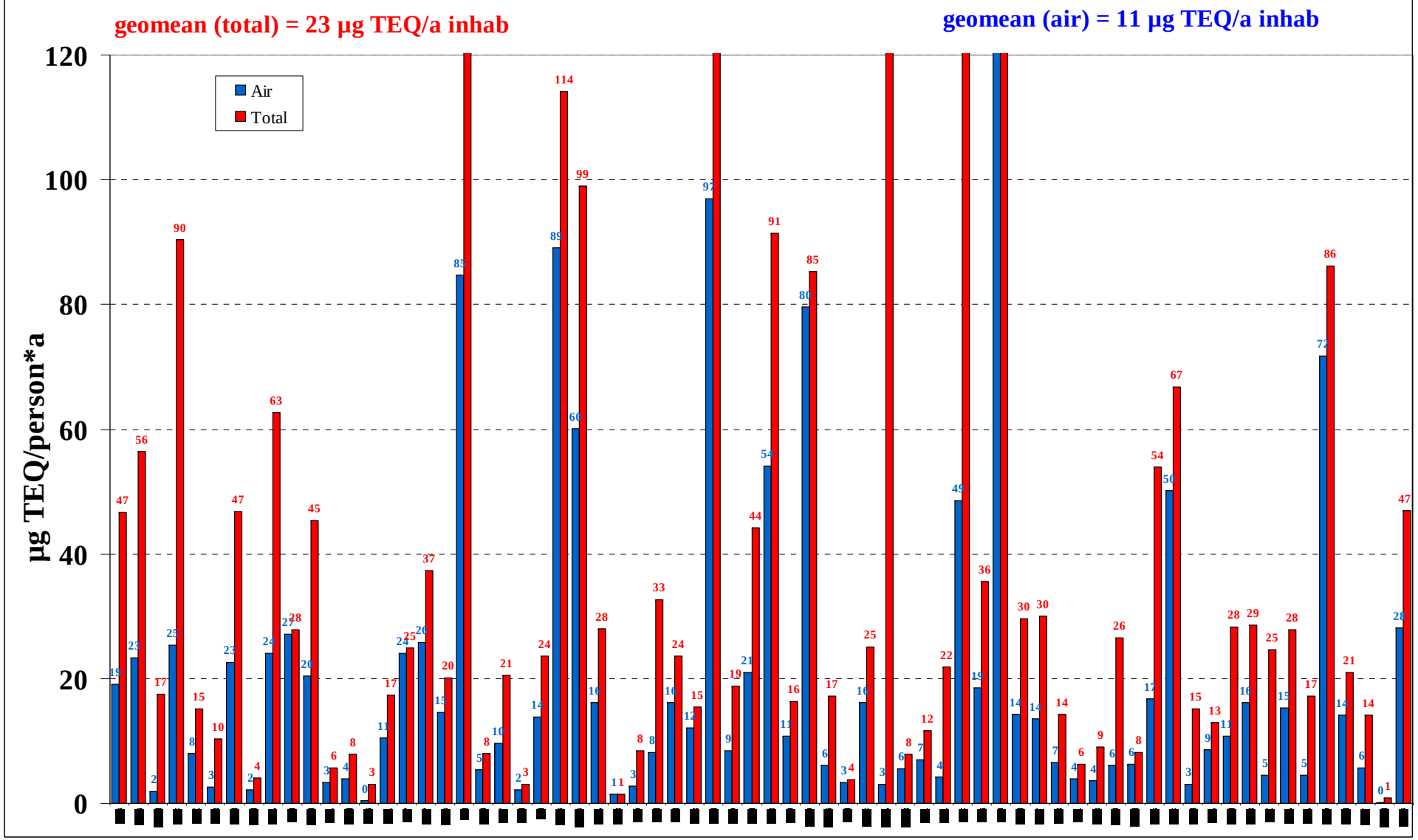
UNEP

Percentage per release vector and country

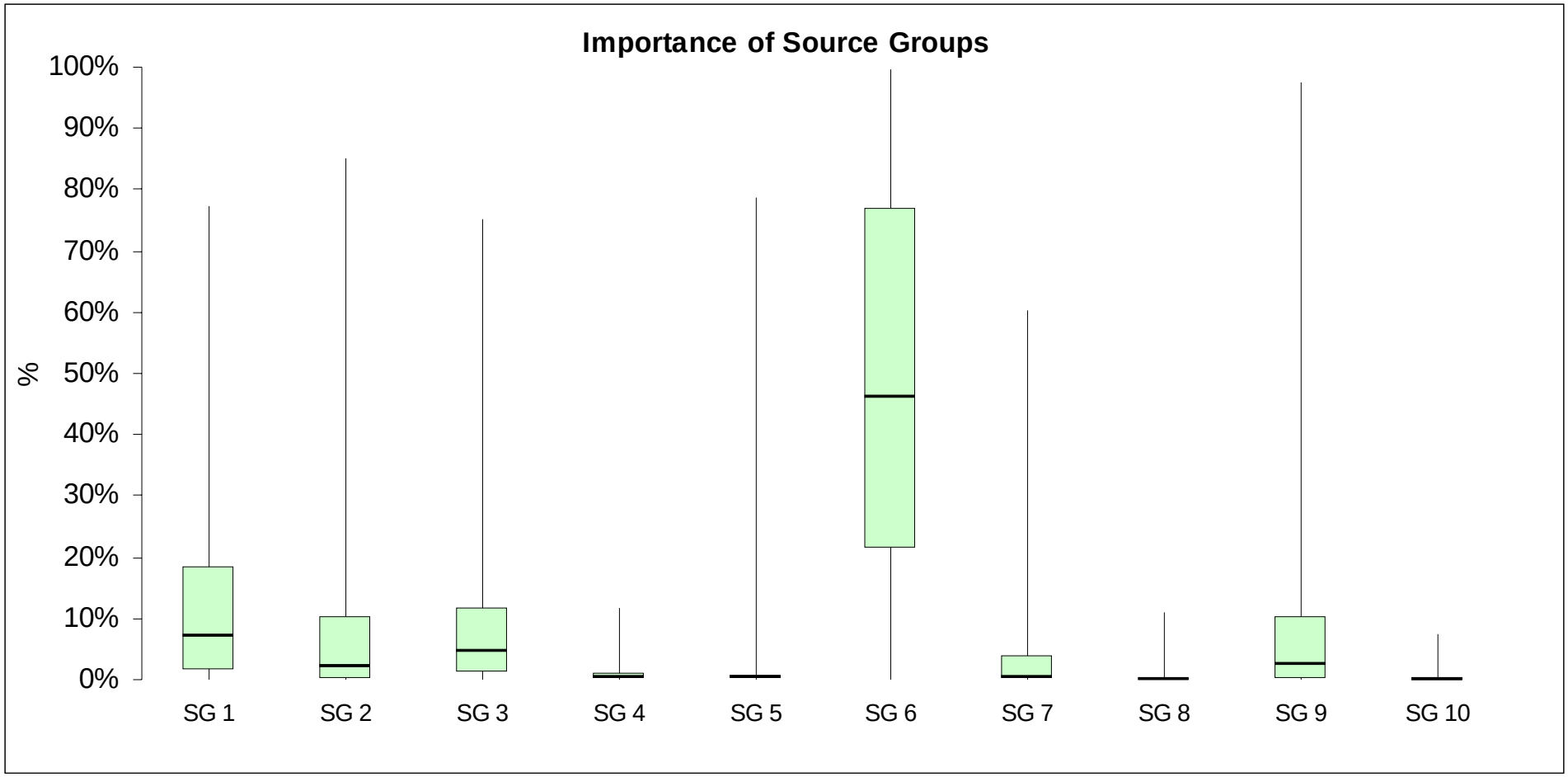
For most countries emissions to air are dominating

Note: GER only air estimated

Releases per inhabitant and year

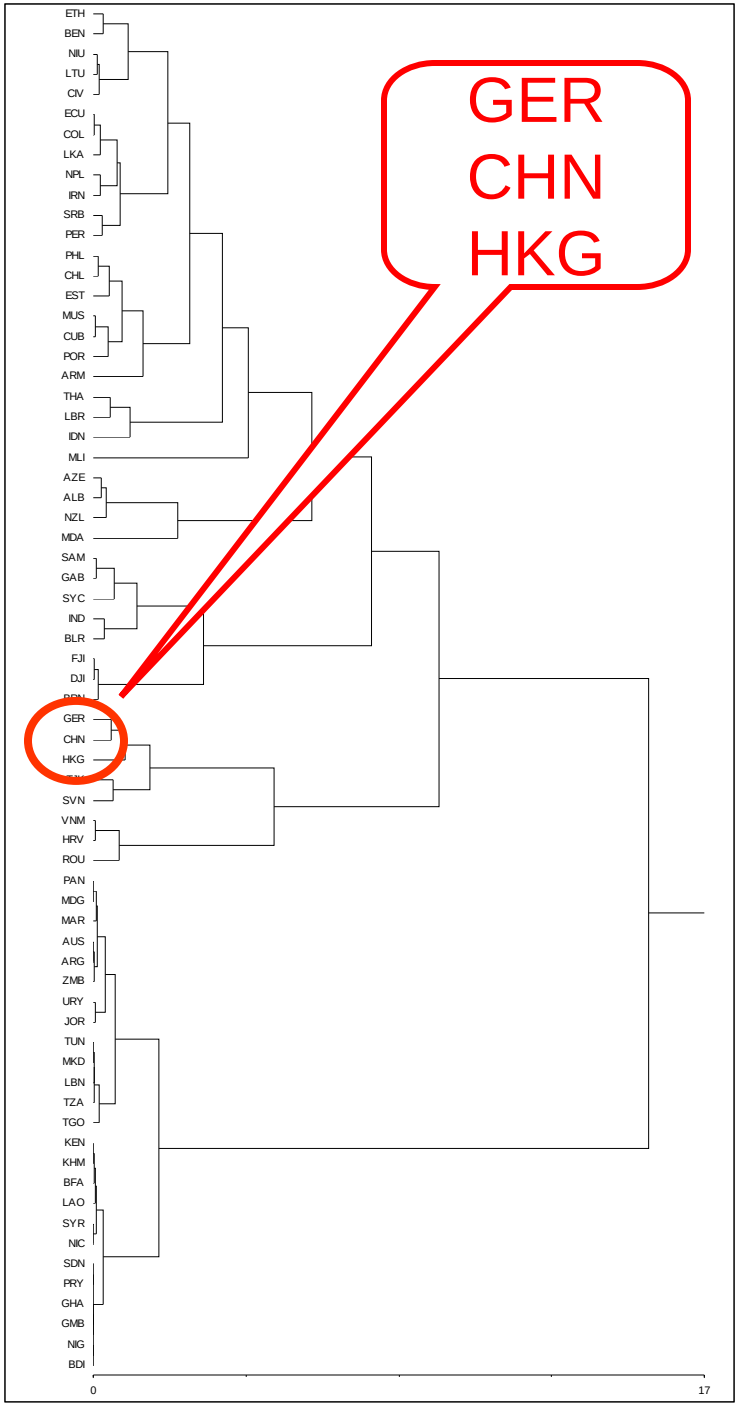


Average (air) = 21 µg TEQ/a inhab; average (total) = 41 µg TEQ/a inhab



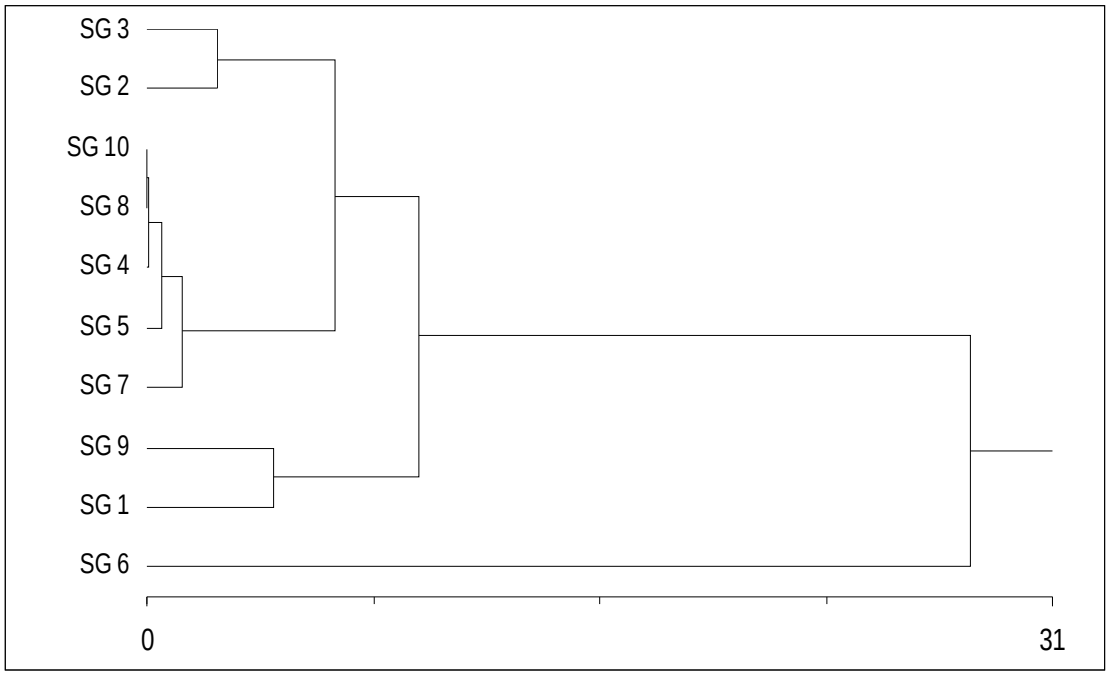
Ranking:
1. SG 6 = Open burning of biomass/waste 48 %
2. SG 1 = Incineration of waste 12 %
3. SG 3 = Conversion of energy 10 %
4. SG 2 = (Non-)ferrous metals production 9 %

n=68



Countries (n=68) according to total releases per Source Group

The differentiation is because of Source Group 6 = open burning processes



	Biomass			Waste			Total Releases		
	Air	Land	Total	Air	Land	Total	Total Air	Total Land	Grand Total
Argentina	203	162	365	353	706.5	1,060	556	869	1,424
Belarus	0.12	1.06	1.2	0.04	0.008	0.1	0.2	1.1	1.2
Bolivia	399	133	533	0	0	0	399	133	533
Cameroon	457	365	822	0	0	0	457	365	822
Chile	13.5	15.8	29.3	4.40	4.37	8.8	18	20	38
China	63.5	953	1,017	0	0	0	63	953	1,017
Costa Rica	58.1	19.6	78	93.0	91.0	184	151	111	262
Côte d'Ivoire	7.50	6.00	14	220	0	220	228	6.0	234
Croatia	0.002	0.002	0.004	0	0	0	0.002	0.002	0.004
Cuba	8.67	3.70	12	39.7	24.1	64	48	28	76
Dominican Rep.	64.5	21.5	86	0.34	0.62	1.0	65	22	87
Guatemala	0	0	0	327	196	524	327	196	524
Haiti	43.5	14.5	58	0.04	0.03	0.1	44	15	58
Honduras	21.2	12.5	34	0	0	0	21	13	34
Iran	95.3	31.8	127	706	0	706	802	32	833
Jordan	0.18	0.07	0.3	51.0	1.88	53	51	2.0	53
Liberia	22.5	7.5	30	160	180	340	183	188	370
Lithuania	0.86	0.3	1.2	12.9	13.0	26	14	13	27
Morocco	0.28	0.22	0.5	135	30.0	165	135	30	166
Mauritius	0.09	0.33	0.4	1.98	3.06	5.0	2.1	3.4	5.5
Mongolia	0.04	0.03	0.1	17.4	34.9	52	17	35	52
Montenegro	0.02	0.0001	0.002	0	0	0	0.02	0.0001	0.02
Nicaragua	6.42	3.10	10	166	300	466	172	303	476
Nigeria	152	121	273	2,600	2,400	5,000	2,752	2,521	5,273
Pakistan	0	0	0	313	626	940	313	626	940
Paraguay	22.4	8.50	31	38.7	76.2	115	61	85	146
Peru	115	61.5	177	2.79	3.44	6.2	118	65	183
Russia	172	137	309	420	1,260	1,680	592	1,397	1,989
Rwanda	1.13	1.85	3.0	45.5	25.3	71	47	27	74
Seychelles	0.001	0.003	0.004	0.38	0.74	1.1	0.4	0.7	1.1
Serbia	0.15	0.12	0.3	84.1	94.0	178	84	94	178
Syrian Arab Rep	0.002	0.002	0.0	339	208	547	339	208	547
Tajikistan	0	0	0	3.97	7.42	11	4.0	7.4	11
Tanzania	227	181	408	124	48.1	172	351	230	580
Thailand	19.9	6.64	27	124	240	364	144	246	391
Tonga	0.04	0.03	0.1	20.4	14.4	35	20	14	35
Uganda	36.6	1.97	39	246	492	738	283	494	777
Ukraine	0.23	0.18	0.4	0	0	0	0.23	0.18	0.4
Uruguay	4.28	1.79	6.1	3.37	6.1	9.5	7.7	7.9	16
Venezuela	54.1	37.6	92	0	0	0	54	38	92
Vietnam	23.7	5.33	29	10.5	0	11	34	5.3	40
Total	2,292	2,317	4,610	6,666	7,088	13,753	8,958	9,405	18,363

UNEP

Split Biomass *vs.* waste fuels

Three countries reported zero emissions from biomass burning

Eight countries reported zero emissions from waste burning

USEPA	CSIRO/UQ	CSIRO/UQ
‘Burn huts’	‘In-field using mobile sampler	Semi-controlled on bricks using mobile sampler (*i.e.*, to assess role of transport and fuel repositioning)
2 x forest litter piled 2 x pine needles piled 2 x forest ‘grass’ piled	4 x open forest (‘Duke forest’) 4 x sugarcane (‘Florida’)	4 x open forest fuels 2 x sugarcane

Sugarcane piled

‘In field sampling’

‘Semi-controlled on bricks’

Publications on biomass burns

Environment International 38 (2011) 62–66

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Emission factors for PCDD/PCDF and dl-PCB from open burning of biomass

R.R. Black [a], C.P. (Mick) Meyer [b,*], A. Touati [c], B.K. Gullett [d], H. Fiedler [e], J.F. Mueller [a]

Chemosphere 83 (2011) 1331–1338

Contents lists available at ScienceDirect

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere

Emissions of PCDD and PCDF from combustion of forest fuels and sugarcane: A comparison between field measurements and simulations in a laboratory burn facility

R.R. Black [a,*], C.P. Meyer [b], A. Touati [c], B.K. Gullett [d], H. Fiedler [e], J.F. Mueller [a]

Revised emission factors for “Open burning of biomass”

6a Biomass burning		Emission factors – µg TEQ/t of biomass burned									
Classification		Air		Water		Land		Product		Residue	
		Old EF	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**
1	Agricultural residue burning in the field of cereal and other crop stubble under unfavourable burning conditions	*30*	**30**	*ND*	*NA*	*10*	**10**	*NA*	*NA*	*NA*	*NA*
2	Agricultural residue burning in the field of cereal and other crop stubble, e.g., cereal crops under favourable conditions	*0.5*	**0.5**	*ND*	*NA*	*10*	**0.05**	*NA*	*NA*	*NA*	*NA*
3	**Sugarcane burning**		**4**		*NA*		**0.05**		*NA*		*NA*
4	Forest fires	~~*5*~~	**1**	*ND*	*NA*	~~*4*~~	**0.15**	*NA*	*NA*	*NA*	*NA*
5	Grassland and savannah fires	~~*5*~~	**0.5**	*ND*	*NA*	*4*	**0.15**	*NA*	*NA*	*NA*	*NA*

Hazardous Chemicals from Open Burning of Waste in Developing Countries

Final Report

United Nations Environment Programme

Division of Division of Technology, Industry, and Economics
Chemicals Branch

June 2010

IOMC

United Nations Environment Programme
Division of Technology, Industry and Economics
Chemicals Branch

Open Burning of Municipal Waste — **Toolkit Update** No.1, August 2010

About the Stockholm Convention and Dioxins/Furans

The **Stockholm Convention on Persistent Organic Pollutants** (POPs) is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have adverse effects to human health or to the environment. In response to this global problem, the text of the Stockholm Convention was adopted in 2001 and the Convention entered into force on 17 May 2004. It requires Parties to take measures to eliminate or reduce the release of POPs into the environment. The Convention is administered by the United Nations Environment Programme (UNEP) with its Secretariat located in Geneva, Switzerland. The Convention makes provisions on the intentional use of certain pesticides and industrial chemicals and attempts to eliminate sources and activities that generate and release unintentional POPs.

Under the Convention, Parties are required to reduce total releases from anthropogenic sources of the chemicals listed in Annex C with the goal of continually minimize and, where feasible, ultimately eliminate releases of these unintentionally generated chemicals. Toward this end, Parties must develop action plans designed to identify, characterize and address the releases of unintentional POPs listed in Annex C. Action plans to be developed according to Article 5 of the Convention shall include evaluations of current and projected releases that are derived through the development and maintenance of source inventories and release estimates, taking into consideration the source categories identified in Annex C.

Unintentional POPs in Annex C include:

- Polychlorinated dibenzo-para-dioxins (PCDD)
- Polychlorinated dibenzofurans (PCDF)
- Polychlorinated biphenyls (PCB)
- Hexachlorobenzene (HCB)
- Pentachlorobenzene (PeCBz) *

* Newly listed at 4th Conference of the Parties

Toolkit

UNEP's Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases (Toolkit) was developed to facilitate implementation of Article 5. Parties recognized the need for a harmonized framework for elaboration of comparable release inventories for Annex C chemicals, and for detailed state-of the-art guidelines on best available techniques and guidance on best environmental practices.

Development of such a harmonized framework and guidance was initiated by UNEP Chemicals in broad cooperation with experts from developed as well as developing countries, before the Convention entered into force. Currently, a process to update and review the Toolkit is mandated by Conference of the Parties through decisions SC-3/6 and SC-4/7 and continues jointly between the Secretariat of the Stockholm Convention and UNEP Chemicals Branch with the goal of keeping all relevant documents and procedures up-to date and developing them further as necessary and appropriate. When implementing the Toolkit review and updating process, adequate emphasis should be placed on the key sources for which limited monitoring data is available, including sources of hexachlorobenzene and polychlorinated biphenyls, and to support developing countries in their efforts to further verify their emission factors.

The Toolkit and the associated Excel files are available in UN languages and can be downloaded from:
http://www.chem.unep.ch/pops/pcdd_activities/default.htm

Urban waste in Mexico

New sampler developed for sampling fumes from open burn events:

High-volume sampler with sampling head downwards; filter and PUF cartridge

Mexico Rural waste; poor combustion

Publication on waste burns

Chemosphere 84 (2011) 994–1001

Contents lists available at ScienceDirect

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere

Emissions of unintentional persistent organic pollutants from open burning of municipal solid waste from developing countries

Tingting Zhang [a], Heidelore Fiedler [b], Gang Yu [a,*], Gustavo Solorzano Ochoa [c], William F. Carroll Jr. [d], Brian K. Gullett [e], Stellan Marklund [f], Abderrahmane Touati [g]

[a] POPs Research Centre, Department of Environmental Science and Engineering, Tsinghua University, Beijing 100084, China
[b] UNEP/DTIE Chemicals Branch, 11-13, Chemin des Anémones, CH-1219 Châtelaine (GE), Switzerland
[c] Instituto Nacional de Ecología – CENICA, 09340 México DF, Mexico
[d] American Chemistry Council, Chlorine Chemistry Division, 700 Second St., NE, Washington, DC 20002, USA
[e] US Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory (E343-04), Research Triangle Park, NC 27711, USA
[f] Chemistry Department, Environmental Chemistry, Umeå University, SE-901 87 Umeå, Sweden
[g] ARCADIS-US, Research Triangle Park, NC 27709, USA

Revised emission factors for “Open burning of waste”

6b Waste burning and accidental fires		Emission factors – µg TEQ/t of material burned									
Classification		Air		Water		Land		Product		Residue	
		Old EF	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**	*Old EF*	**New EF**
1	**Fires at waste dumps (compacted, wet, high C_{org} content)**	~~*1000*~~	**300**	*ND*	**ND**	~~*[600]*~~	**10***	*NA*	**NA**	*600*	**NA**
2	Accidental fires in houses, factories (per burn event)	*400*	**400**	*ND*	**ND**	*[400]*	**400**	*NA*	**NA**	*400*	**NA**
3	Open burning of domestic waste	~~*300*~~	**40**	*ND*	**ND**	~~*[600]*~~	**1***	*NA*	**NA**	*600*	**NA**
4	Accidental fires in vehicles (µg TEQ per vehicle)	~~*94*~~	**100**	*ND*	**ND**	*[18]*	**18**	*NA*	**NA**	*18*	**NA**
5	Open burning of wood (construction, demolition)	*60*	**60**	*ND*	**ND**	*[10]*	**10**	*NA*	**NA**	*10*	**NA**

NIP Update

	Party	Date of entry into force of the Convention	Date of entry into force of the amendments adopted at COP4	Date of transmission of the first NIP	Date of transmission of the second NIP
1.	Albania	2 Jan 05	26 Aug 10	12 Feb 07	
2.	Algeria	21 Dec 06	26 Aug 10	6 Oct 07	
3.	Angola	21 Jan 07	26 Aug 10		
4.	Antigua and Barbuda	17 May 04	26 Aug 10	26 Nov 08	
5.	Argentina	25 Apr 05	*	25 Apr 07	
6.	Armenia	17 May 04	26 Aug 10	29 Apr 06	
7.	Australia	18 Aug 04	*	10 Aug 06	
8.	Austria	17 May 04	26 Aug 10	28 Aug 08	
	Germany	17 May 04	26 Aug 10	1 May 06	
	Ghana	17 May 04	26 Aug 10	21 Jan 08	

NIPs are due two years after entry-into-force for a party = **26 August 2012**

* did not submit instrument of ratification to the amendment

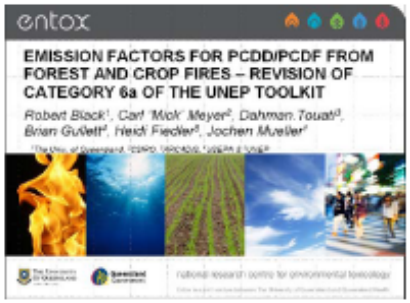
United Nations Environment Programme
Division of Technology, Industry and Economics
Chemicals Branch

www.chem.unep.ch

Stockholm Convention COP-5

http://www.chem.unep.ch/Pops/pcdd_activities/projects/

Projects on open burning



http://www.chem.unep.ch/Pops/pcdd_activities/inventories

Further information

- Stockholm Convention WebPage: www.pops.int
- UNEP/DTIE Chemicals: www.chem.unep.ch
- Contact:

heidelore.fiedler@unep.org

Vielen Dank !