

Dioxin Contamination in Vietnam, Risk Assessment and Health Effects



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Outline

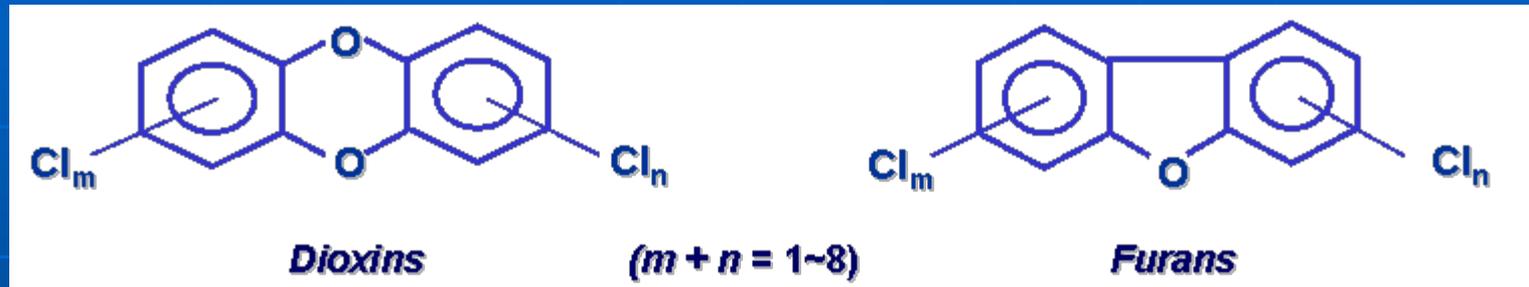
- ✓ **Role of environmental analysis & current demands**
- ✓ **Dioxin emissions status in Vietnam**
- ✓ **Risk Assessments and Health Effects**

Environmental pollution in industry-related areas in Vietnam

- Official/major industrial zones (parks): > 300 industrial zones
- Informal trade/industrial sites: craft villages, recycling villages in sub-urban areas, landfill dumping sites
- Historical pollution areas: POPs pesticides stockpiles, Agent Orange (AO) Dioxin
- Newly identified issues: new chemicals, potential areas for releasing new chemicals

Dioxins & Furans

Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans
(Dioxins; Dioxin: 75 congs, Furan: 135 congs)



Formation of Dioxins:

- Burning processes (waste incineration, open burning ...)
- Thermal processes from industries
- By-products of chemical manufacturing industries



Impacts of dioxins to human health

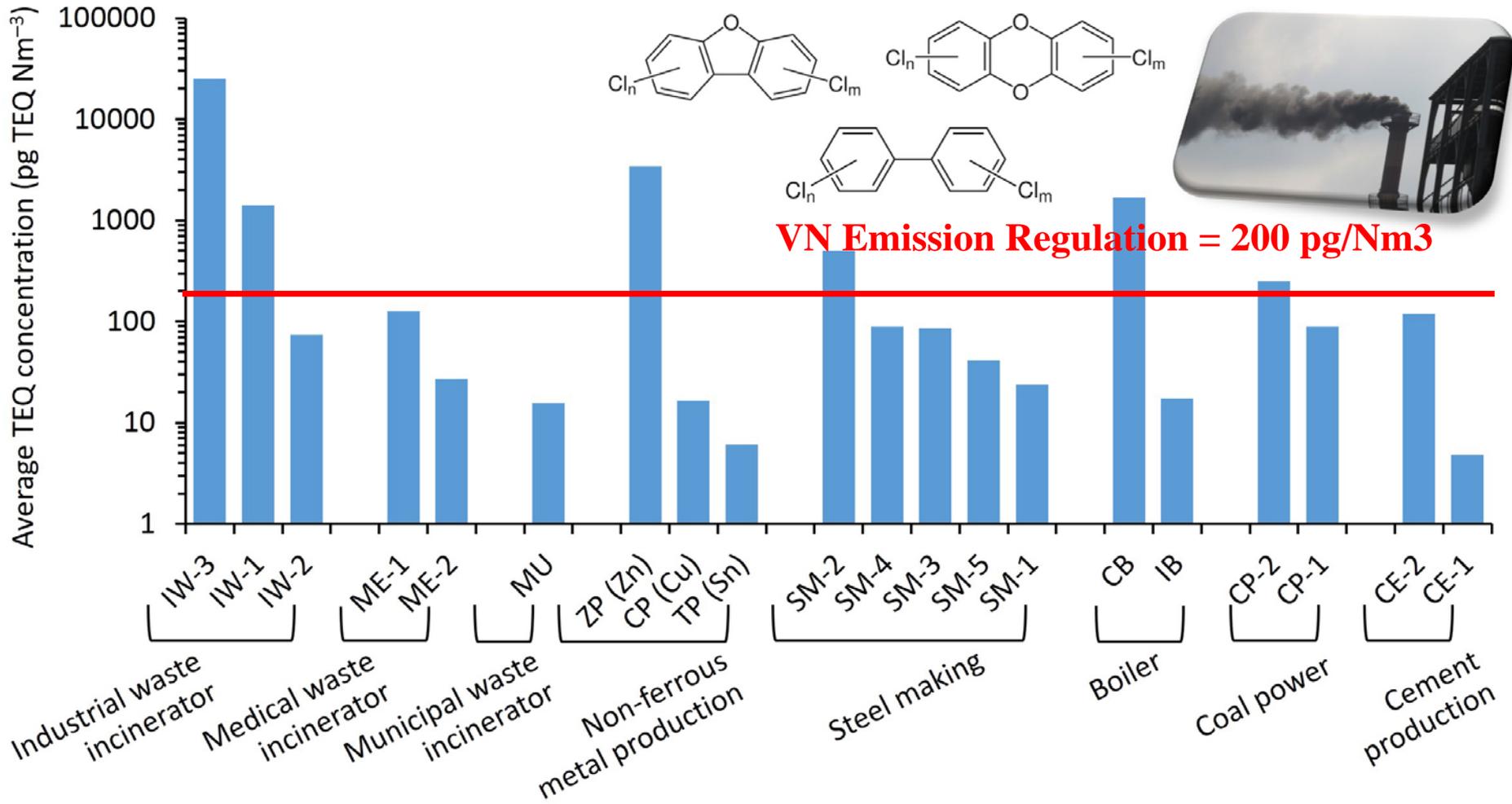
- Evidences for toxic poisoning in the world
 - PCBs/PCDD/Fs
 - Japan (“Yusho”)
 - Taiwan (“Yucheng”)
 - TCDD
 - Seveso, Italy
 - Ukraine
 - Vietnam



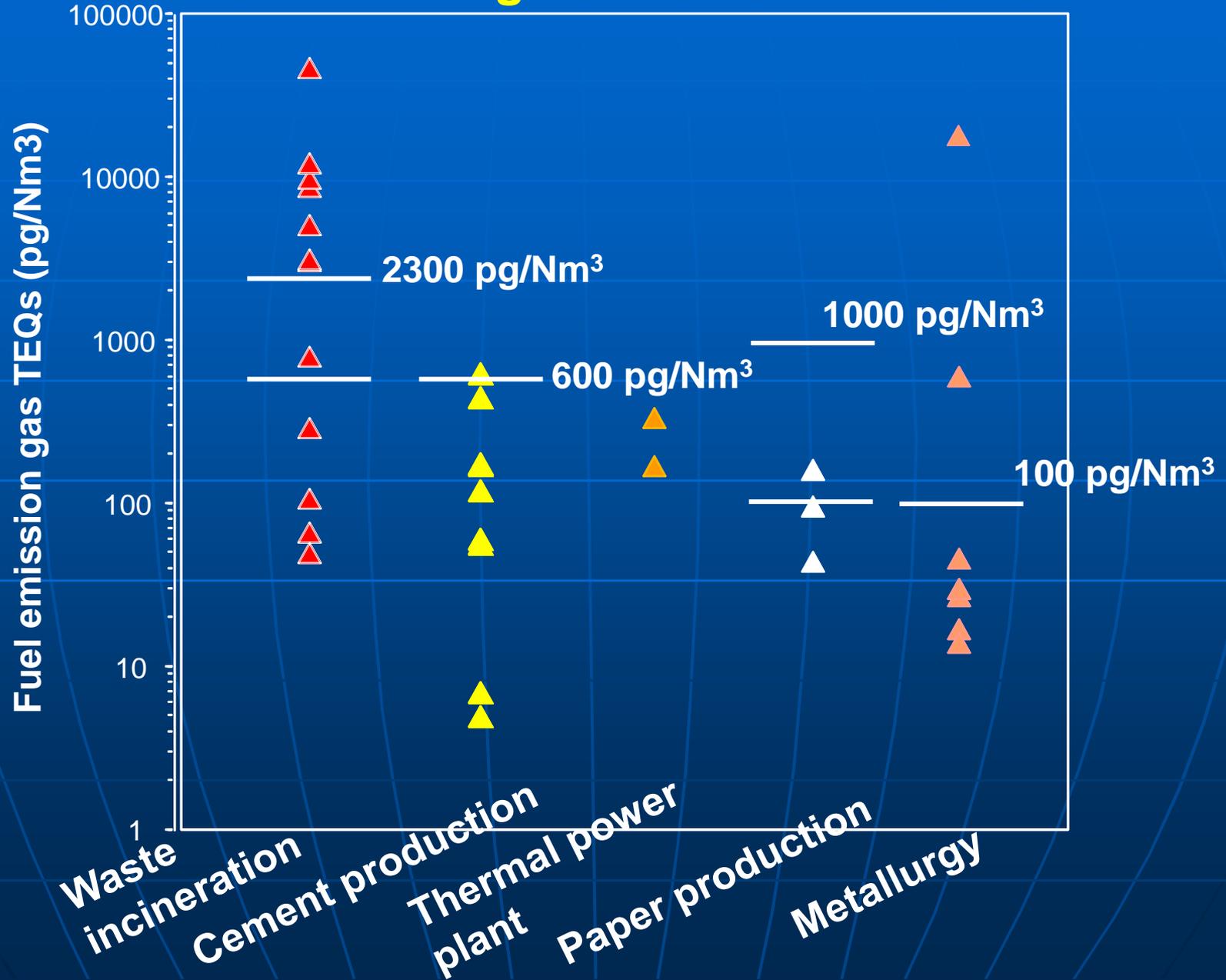
Research programs on dioxins in industry & environment in Vietnam

- BAT-BEP Project supported by GEF-UNIDO and VEA, MONRE: demonstration of dioxin reduction in selected industrial sectors
- AO/Dioxins Project supported by UNDP and MONRE: baseline surveys for dioxins emissions in potential sectors
- Surveys programs conducted by Dioxin labs (VEA, CRETECH...)
- Several research programs collaborating with international labs: Japan, Korea

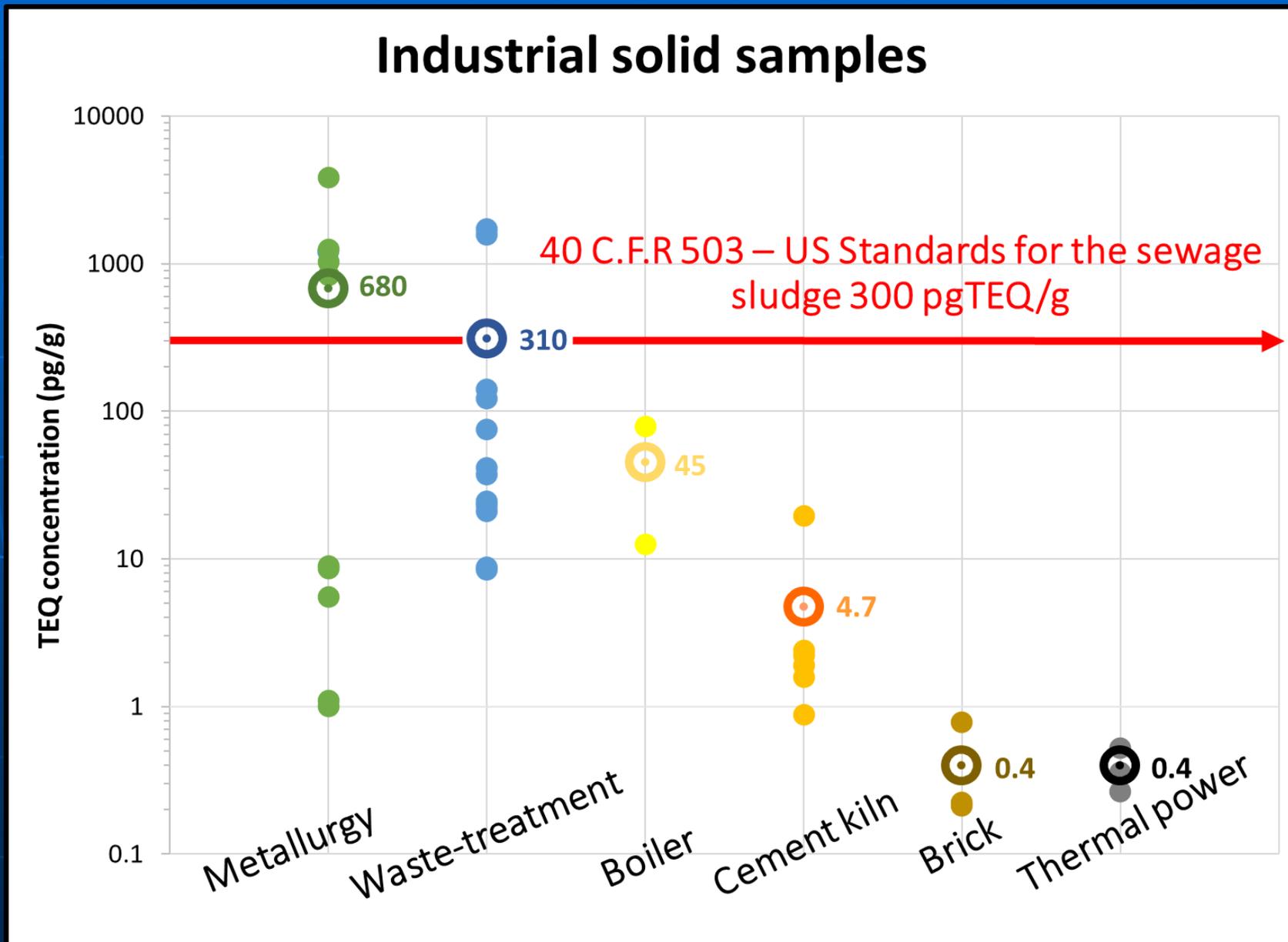
PCDD/Fs in flue gas samples from some industrial sectors in Vietnam



Dioxins emission (in flue gases) from selected industrial sectors and guideline values



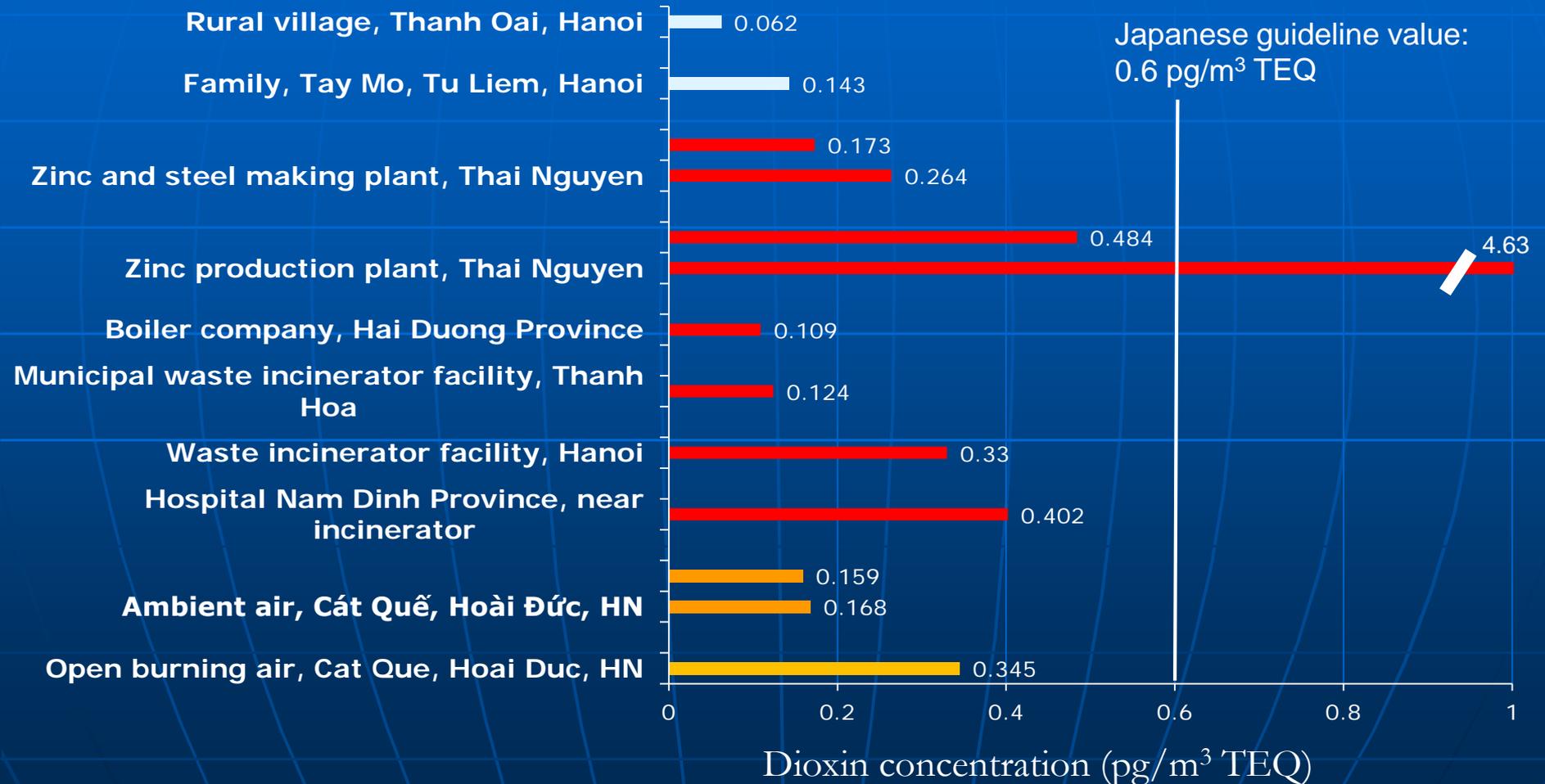
Dioxin from industrial solid samples (fly ash, bottom ash) from different industrial sectors in Vietnam



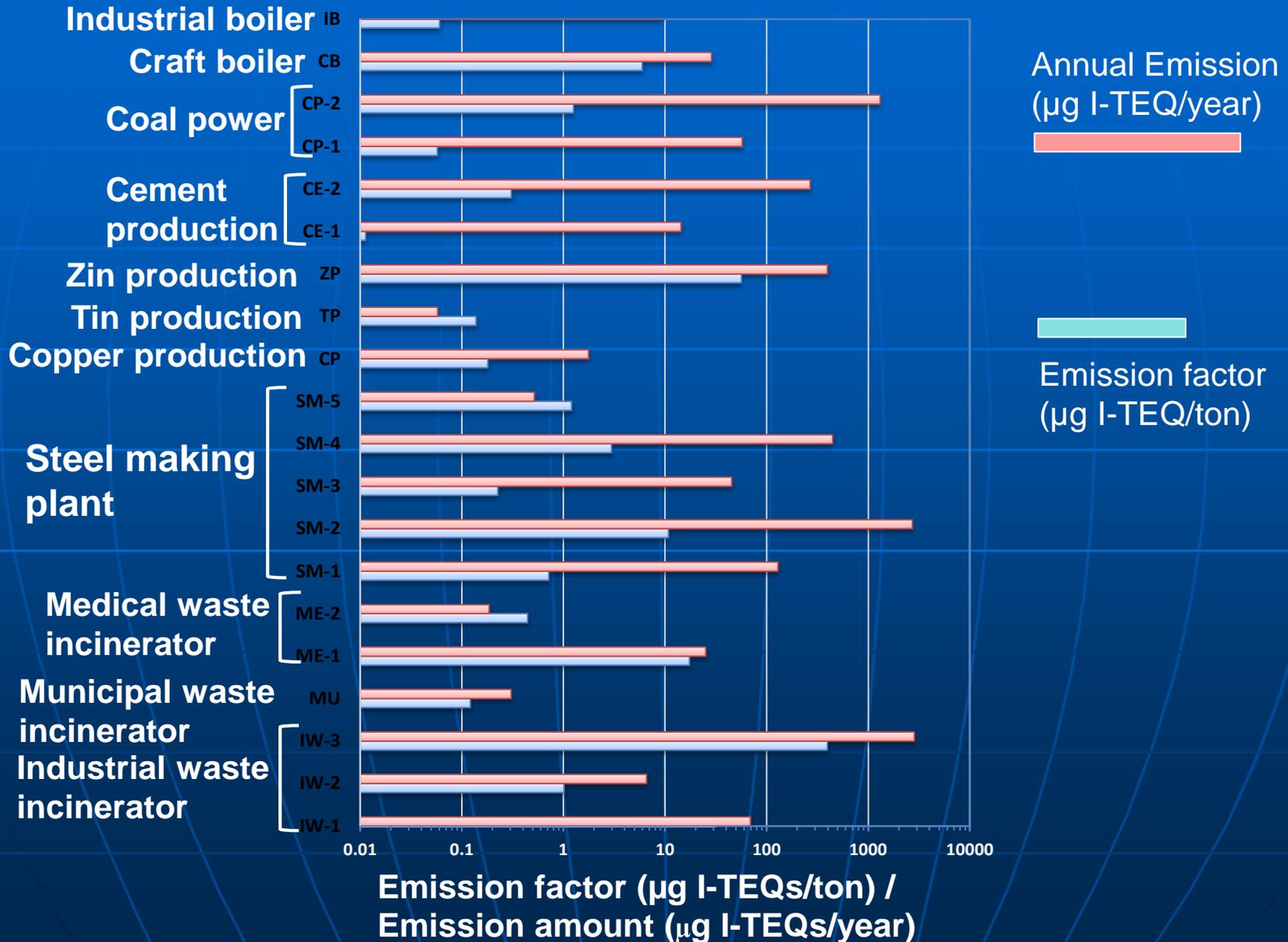
Dioxin in ambient air

Standard

values: Japan: 0,6 pg TEQ/m³
US: 0,045 – 32 pg TEQ/m³
Canada: 0,1 pg/m³



Stack gas emissions of PCDD/Fs from different industrial facilities in Vietnam



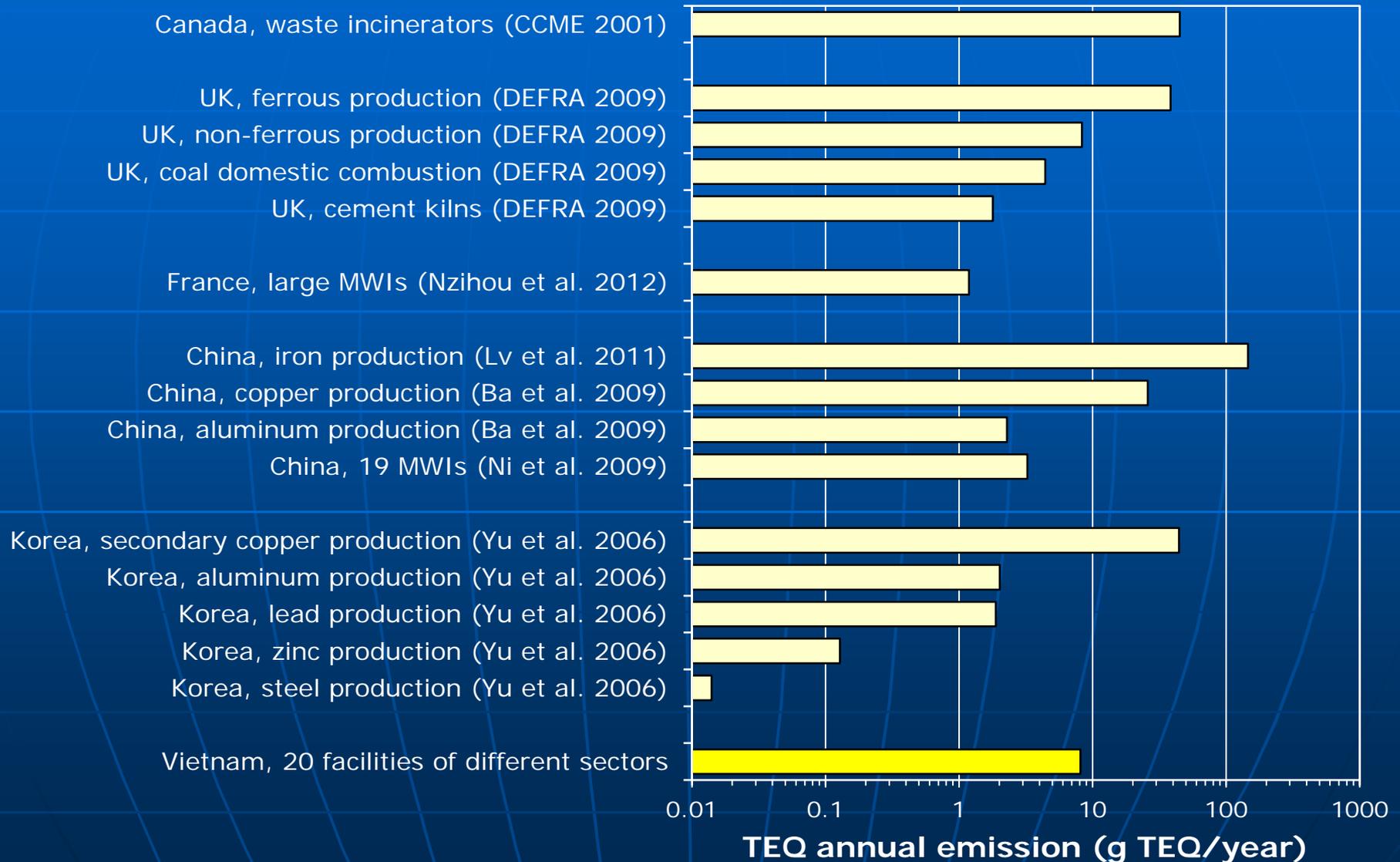
Stack gas emissions of PCDD/Fs from different industrial facilities in Vietnam

1. Industrial Waste Inc (973 μg TEQ/year) >
2. Coal Power (682 μg TEQ/year) >
3. Steel Making (666 μg TEQ/year) >
4. Zin Production (395 μg TEQ/year) >
5. Cement production (141 μg TEQ/year) >
6. Craft Boiler (28.7 μg TEQ/year) >
7. Medical waste incinerator (12.6 μg TEQ/year) >
Industrial boiler (9.44 μg TEQ/year) >
8. Cooper Production (1.76 μg TEQ/year) >
9. Municipal waste incinerator (0.306 μg TEQ/year) >
10. Tin Production (0.058 μg TEQ/year)

Total annual
stack
emission for
20 Facilities
belong to 10
sectors:

**4.89 – 11.4 g
TEQ/year**

Comparison of annual TEQ emissions in flue gas among different countries



Demonstrations of the emission reduction

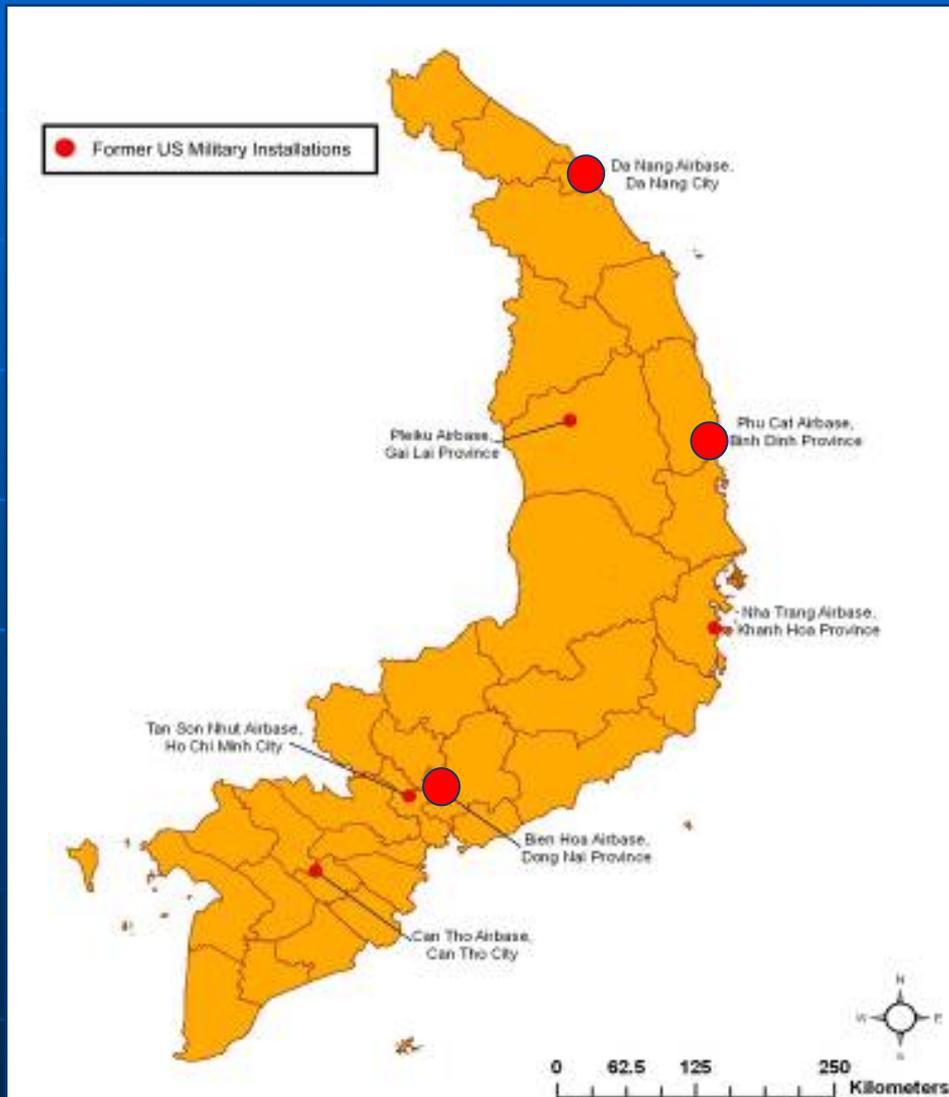
BAT-BEP: Best available techniques/Best environmental practices

- ❑ Techniques that are able to implement by operators
- ❑ **BAT:** The latest stage of development of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste”.
- ❑ **BEP:** the application of the most appropriate combination of environmental control measures and strategies

Demonstration of BAT/BEP in waste incineration

Type of incinerator	BAT/BEP measures	Dioxin levels	
		Current	After BAT/BEP
Industrial waste incinerator	<ul style="list-style-type: none"> -Classification of wastes: remove plastics, polymer wastes - Control temp. of secondary chamber -Control air flow for cooling -Better control & upgrade APCD 	4940 pg TEQ/m ³	383 pg TEQ/m ³
Municipal waste incinerator	<ul style="list-style-type: none"> - remove plastics, polymer wastes -Cleaning, upgrading temperature cooling devices -Provide oxygen to soaking chamber -Maintain temperature > 850oC in both chambers 	6120 pg TEQ/m ³	15,0 ;19,03 pg TEQ/m ³
Medical waste incinerator	<ul style="list-style-type: none"> - Install the charcoal in APCD 	* Flue gas: 437 ; 32,6 pg TEQ/m ³ *Ash 1531; 1677 pg/g	*Flue gas: 13,8 ;18,4 pg TEQ/m ³ *Ash: 22,9; 74,9 pg/g

Dioxin contamination in AO/Dioxin “hotspots”



- Intensive and careless handlings of Agent Orange caused serious leaking and spills of AO/Dioxin in several US former airbases
- Three airbases were well investigated and showed high contamination: Da Nang, Bien Hoa and Phu Cat



Dioxin contamination in AO/Dioxin “hotspots”



Remediation status in the three severe AO/Dioxin “hot spots”

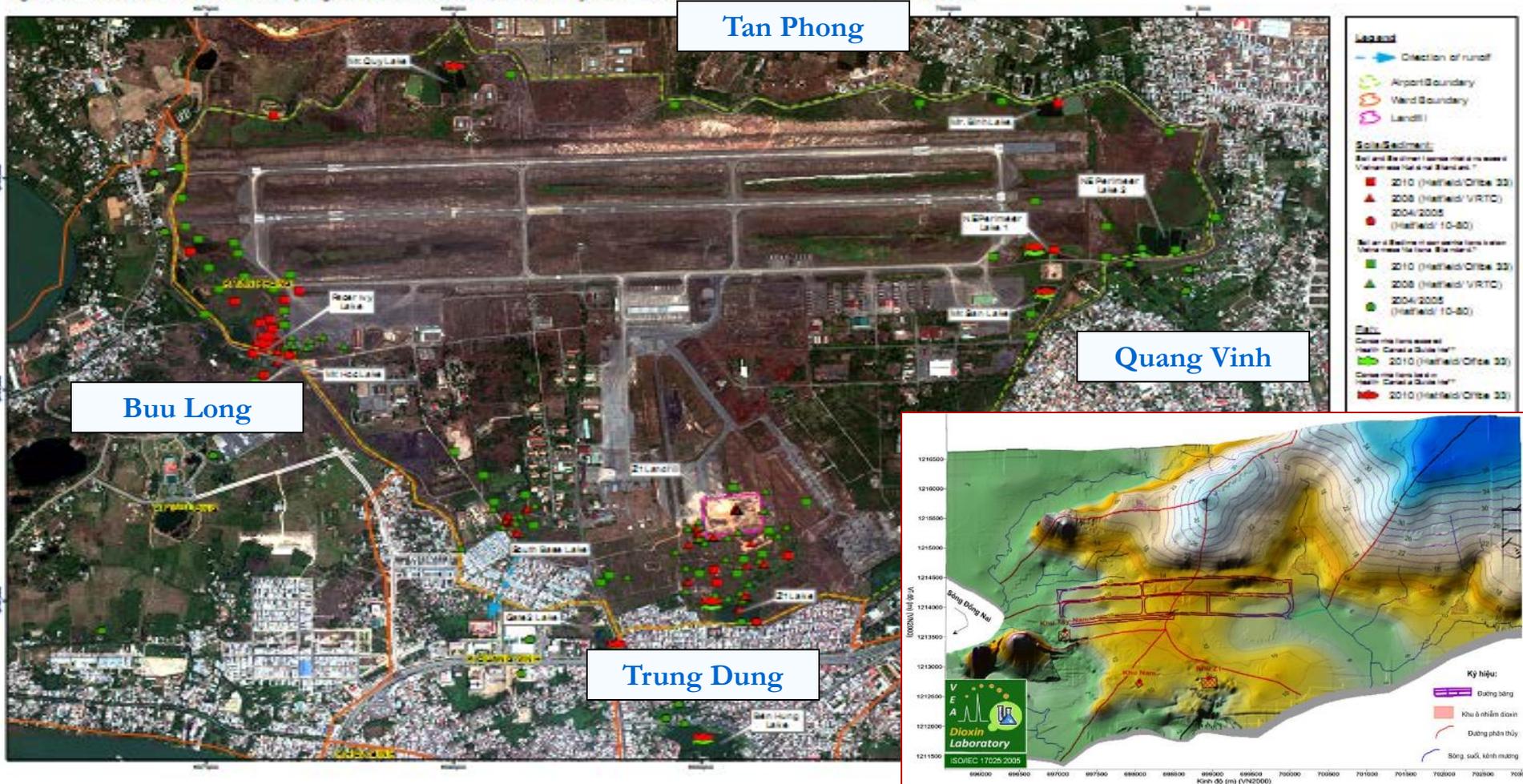
	Phu Cat	Da Nang	Bien Hoa
<i>Highest recorded levels of dioxin in soil</i>	283,000 ppt TEQ	365,000 ppt TEQ	962,559 ppt TEQ
in Sediment	5,970 ppt TEQ	8,580 ppt TEQ	201 ppt TEQ
Total volumes of the dioxin contaminated soil & sediment	7,000 m ³	94,000 m ³ (high conc.)	495,000 m ³
Cleanup technology	Secured landfill	In-pile Thermal Desorption	To be selected
Cleanup completion date (cost in USD)	2011 (5M)	2018 (110M)	2030 (390M)
Cooperation agencies	MOD/MONRE & UNDP/GEF	MOD & USAID	MOD & USAID

Completion of remediation Da Nang AO/Dioxin “hotspot”



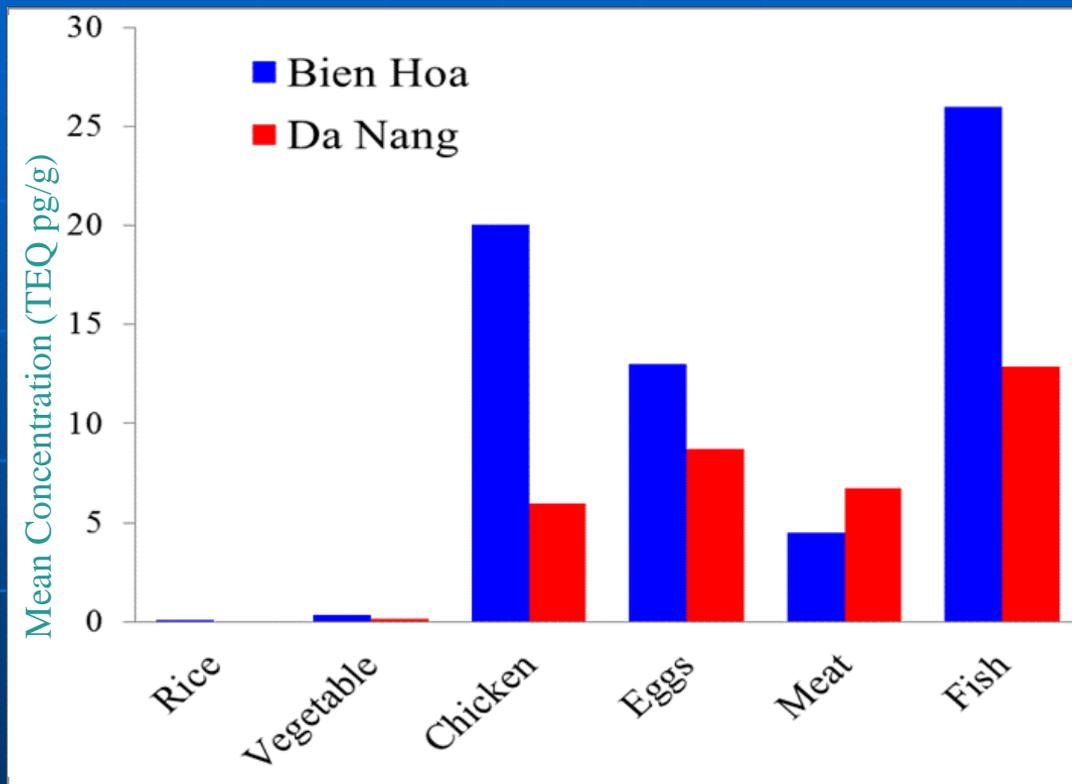
Contamination of Agent Orange/Dioxin in Bien Hoa Airbase

Figure 1.1 Overview of all dioxin sampling locations in Bien Hoa, Viet Nam by Hatfield/10-80 Division/VRTC/Office 33, 2004 to 2010.



Potential for the contaminated soil to be carried away by rain and flood water

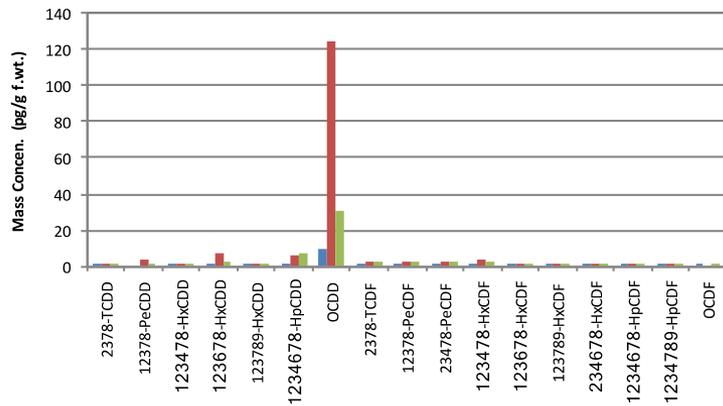
Dioxin in selected foodstuffs near AO “hot spots”



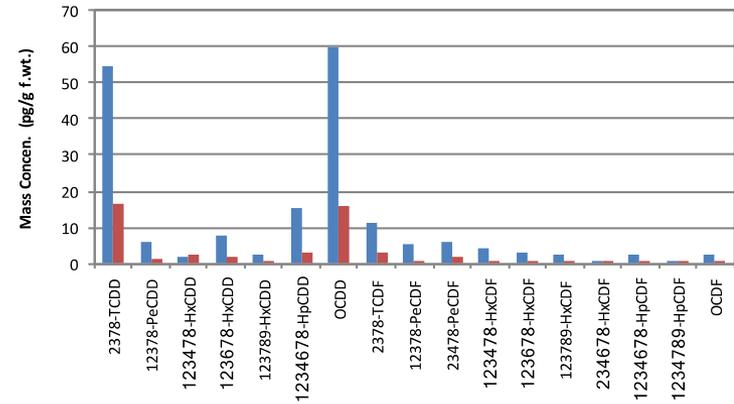
Bien Hoa airbase: Fish > Chicken > Egg > Pork/Beef > Veget > Rice
Da Nang airbase: Fish > Egg > Chicken > Pork/Beef > Veget > Rice

TEQ profile in chicken and egg samples

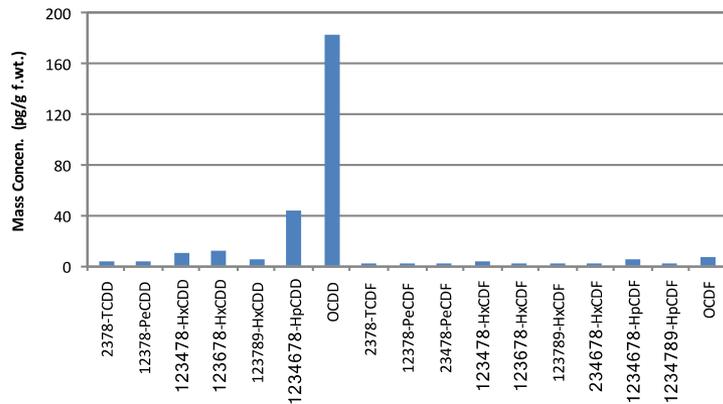
PCDD/Fs Profile of Tan Phong chicken/duck samples (n = 3)



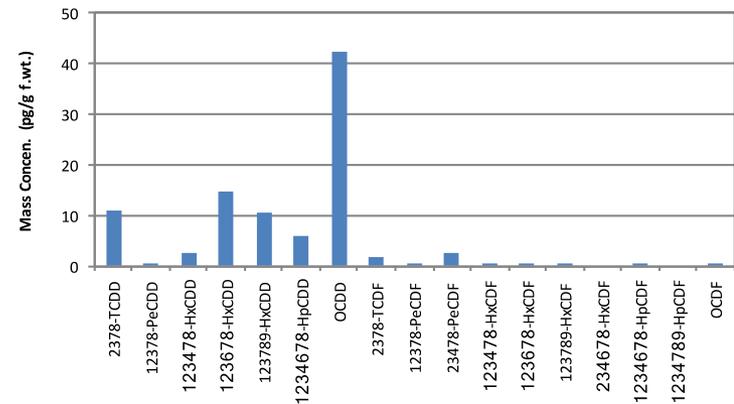
PCDD/Fs Profile of Buu Long chicken/duck samples (n = 2)



PCDD/Fs Profile of egg samples (n = 4)



PCDD/Fs Profile of Buu Long egg sample (n = 1)

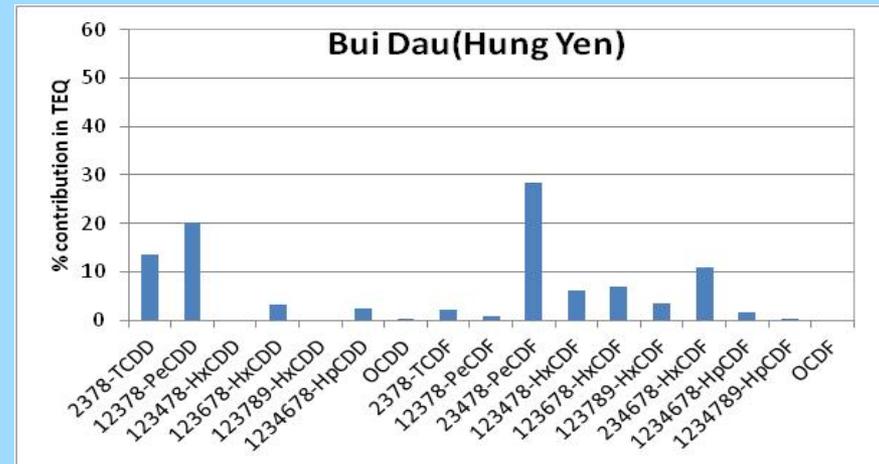
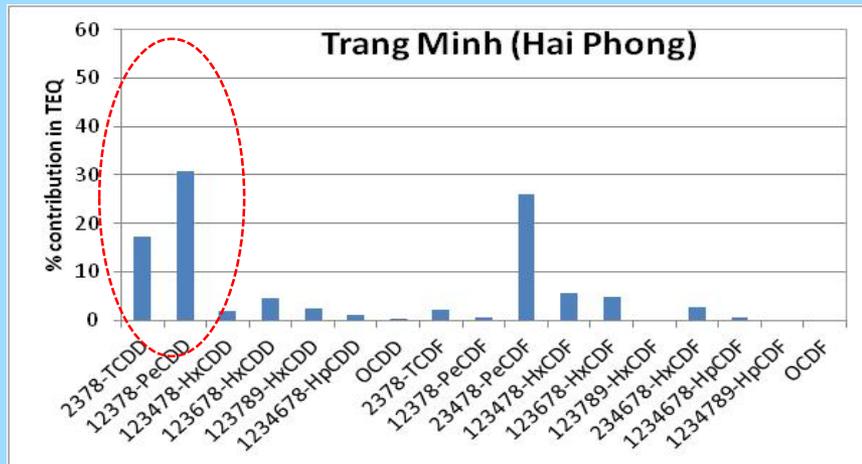
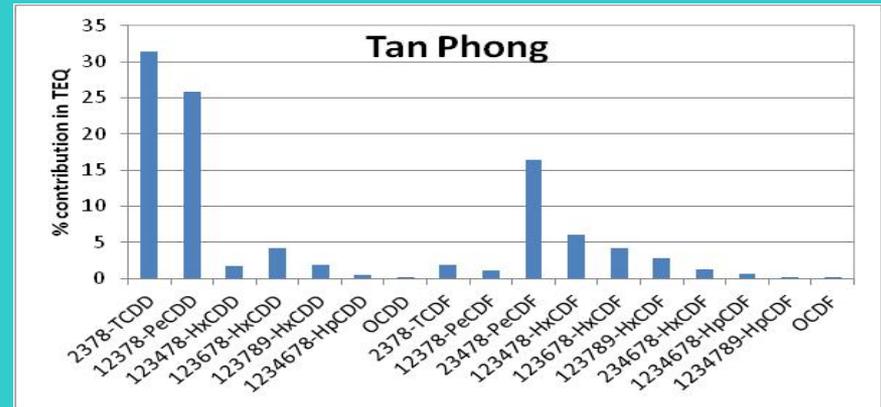
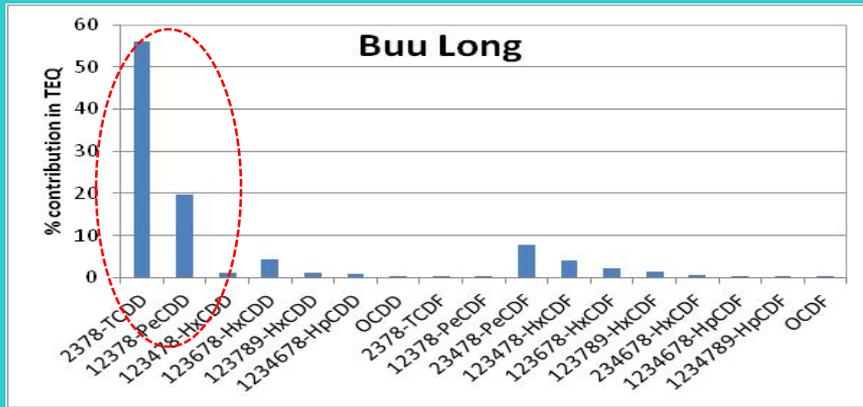


Dioxin Levels in the mother milk in several areas

Location	Year of sampling	TEQ-PCDD/Fs (pg/g lipid)	Reference
Vietnam			
Thach Hoa (Hanoi)	2008	1.7	Tue et al., 2014
Trang Minh (Hai Phong)	2008	1.8	Tue et al., 2014
Bui Dau (Hung Yen)	2008	1.4	Tue et al., 2014
Kim Bang (Thai Binh)	2008	4.3	Manh et al., 2015 (control site)
Bien Hoa (2014)	2014	9.6 (1.8-26)	Hue et al., 2018
Bien Hoa (2010)	2008-2010	9.3	Manh et al., 2015
Quy Nhon (near Phu Cat airbase)	2008-2010	14.1	Manh et al., 2015
Da Nang (near DN airbase)	2011-2012	19.2	Hue et al., 2014
Asian countries			
China	2006-2007	4.2	Sun et al., 2010
China	2008	2.8	Shen et al., 2012
China	2007	3.73	Li et al., 2009
Japan	2002-2004	7.4	Tokada., 2008
Taiwan	2001	7.37	Chao et al., 2005

Dioxin profile in mother milk near AO hot spots

Different TEQ contribution of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD in hot spots and other areas



Dioxin related compounds in e-waste processing sites

WHO-TEQs (pg/g dry weight) of PCDD/Fs, Co-PCBs, and PBDD/Fs in surface soils and river sediments collected in Bui Dau, Hung Yen province, Vietnam, January 2012.^a

Surface soils	Footpaths in rice paddies (n = 19)			Open-burning sites (n = 3)			E-Waste-processing workshop (n = 10)		
	Median	Min	Max	Median	Min	Max	Median	Min	Max
PCDDs	0.72	0.076	1.1	13	1.2	13	0.84	0.070	4.6
PCDFs	0.46	ND	13	64	2.6	120	3.7	0.21	13
Co-PCBs	0.32	0.00078	1.7	4.8	0.55	6.6	1.3	0.29	5.8
PBDDs	ND	ND	ND	ND	ND	3.2	0.013	ND	15
PBDFs	0.025	ND	5.4	14	0.19	83	20	0.83	270
Sum of target compounds	1.5	0.29	20	100	4.5	230	28	1.7	310
River sediments	Upstream area (n = 1)			E-Waste-processing area (n = 3)			Downstream area (n = 4)		
				Median	Min	Max	Median	Min	Max
PCDDs		0.92		1.0	0.79	9.2	1.2	0.38	1.6
PCDFs		0.011		6.3	2.2	42	0.043	0.025	4.6
Co-PCBs		0.0050		0.89	0.67	4.9	0.0055	0.0027	0.54
PBDDs		ND		0.0050	ND	0.0063	ND	ND	ND
PBDFs		0.028		4.3	2.2	8.9	0.33	ND	1.0
Sum of target compounds		1.0		13	12	58	1.6	1.1	7.1

^a ND, not detected.

- In open burning sites, the level is from 12 – 58 pg TEQ/g dry wt
- In ewaste processing workshop, the level is from 1.1 – 7.1 pg TEQ/g dry wt

Future perspectives

- Groups of chemicals under concerns:
 - ✓ Dioxins unintentionally produced,
 - ✓ AO/Dioxins in Bien Hoa airbase,
 - ✓ Halogenated persistent substances: brominated dioxins, diphenyl ethers, PAHs, PFOS
- New chemicals in current use & continuously releases:
 - ✓ phthalates, bis-phenolic compounds
 - ✓ pharmaceuticals & personal care products

Thank you!

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