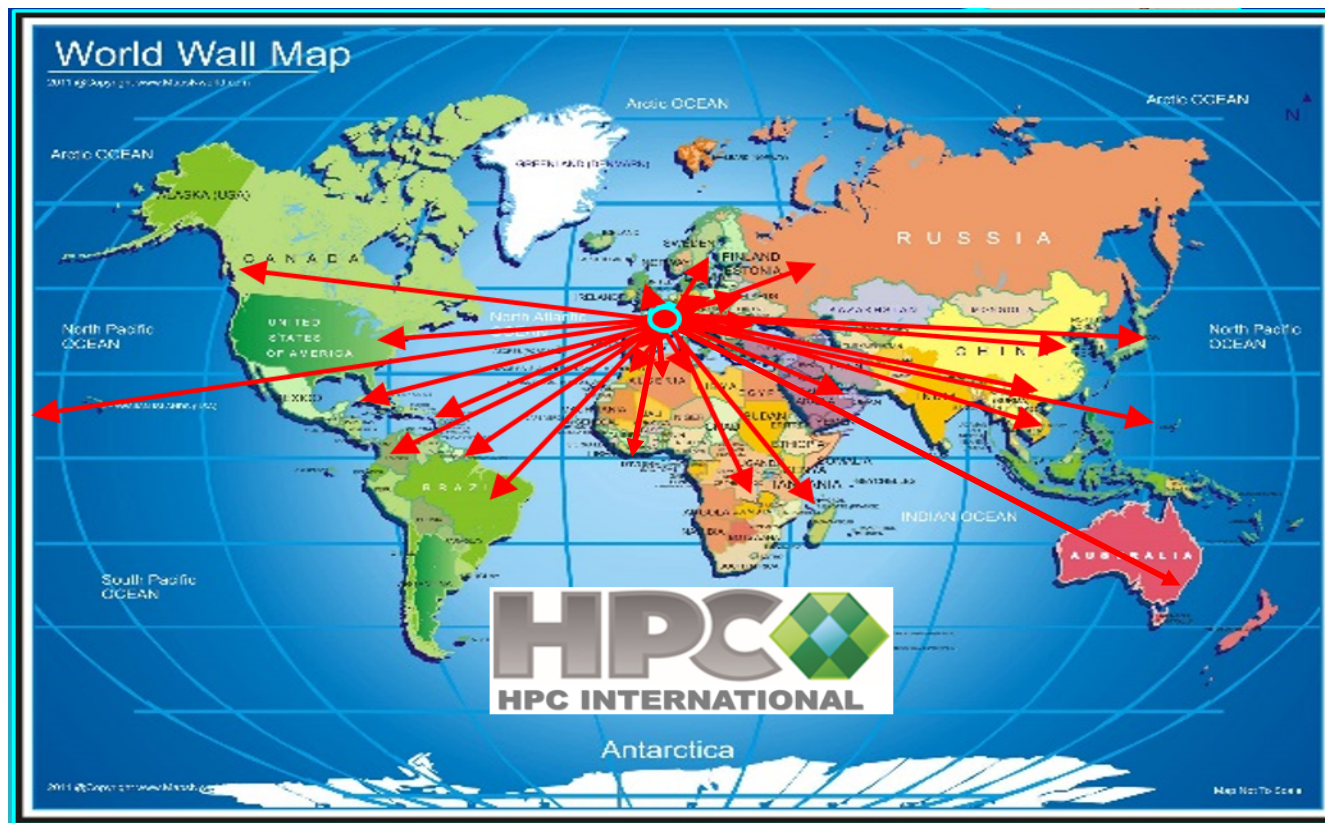




HPC INTERNATIONAL SAS



HPC INTERNATIONAL SAS

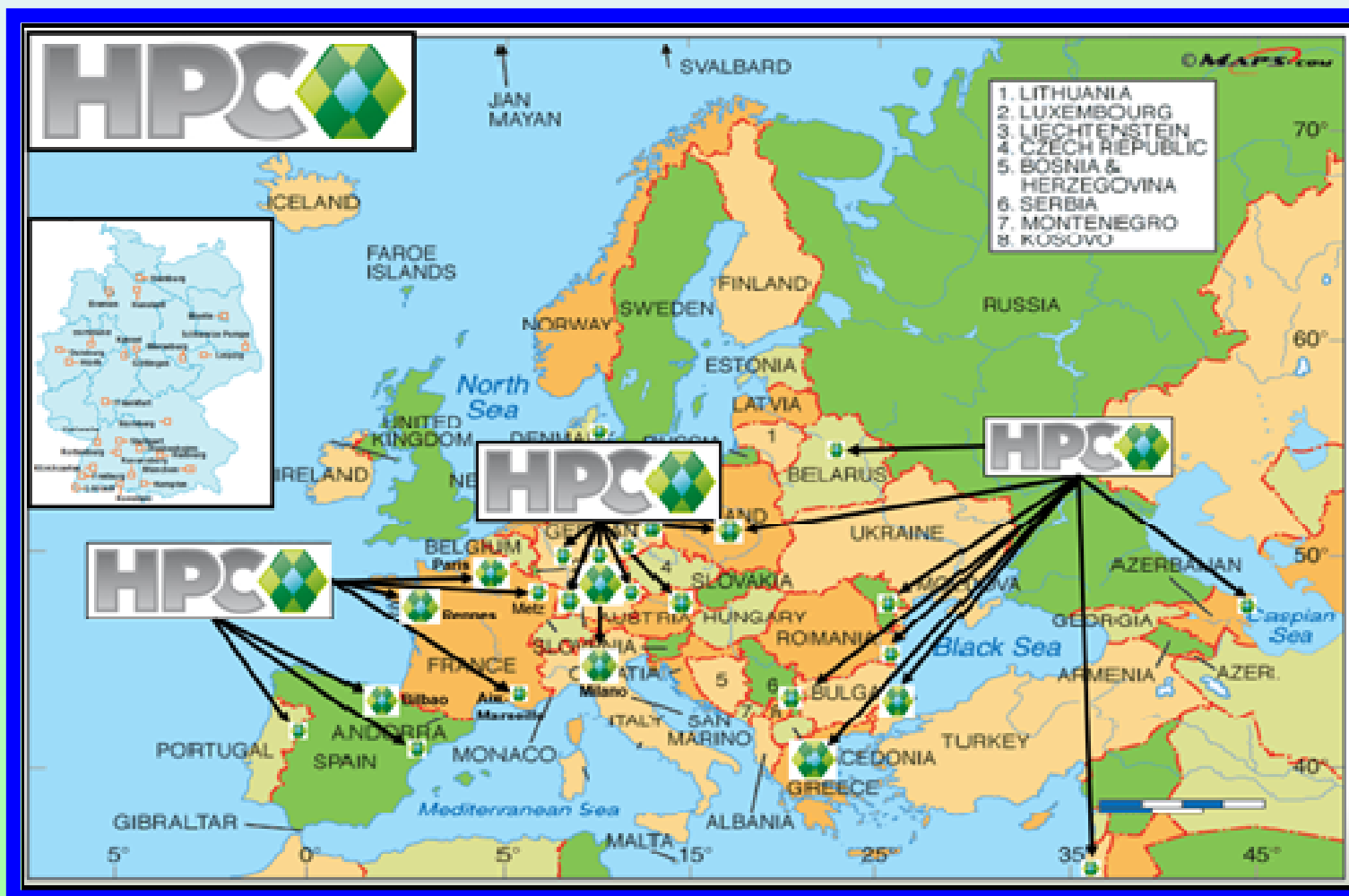
*1 rue Pierre Marzin
Noyal-Châtillon sur Seiche CS83001
F-35230 SAINT ERBLON / France*

&

*Lichtenberg / Berlin &
Neumarkt 7-11
D-47119 Duisburg / Germany*



HPC in Europe

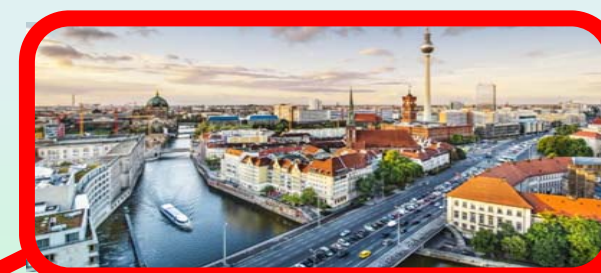


HPC: Engineering - Investments - Realizations

Renewable Energies



Infrastructure



Mining & Minerals



Industry



Education +



Agriculture



CWA Treatment



Environment & Health



HPC: Engineering - Investments - Realizations

Environment & Health

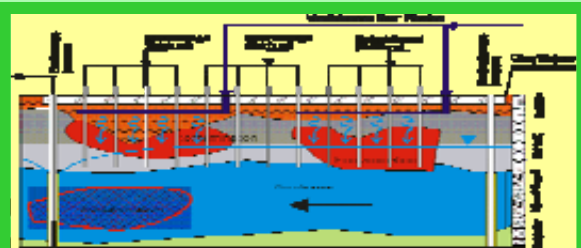
HSE-Audits & Controlling



Contamination Investigations



Polluted Site Remediation



Waste Water Treatment



Waste Treatment & Recycling



Bio-technologies & Modelling





Air Pollution: Environment & Health



Air Pollution: Environment & Health

Systematic Approach & Master Plan:

1. Identification of Pollution Sources & Pollutants (organics & inorganics)
2. Definition of Threshold Limit Value Concentrations & Toxic Risks Limits.
3. Definition of Corrective anti-pollution Actions.
4. Installation of Monitoring Net & Central Controlling for selected Pollutants.
5. Health Bio-Monitoring (Epidemiology).
6. Modelling of Pollution Events & Forecast.
7. Corrective Actions Implementation.
8. Administrative Commando Structures & Reporting Training, Maintenance & Modernization.
9. Emerging Pollutants.

→ **Environmental POLICE !**



Air Pollution: Environment & Health

Systematic Approach & Master Plan:

- 1. Identification of Pollution Sources & Pollutants** (organics & inorganics)
→ by Screening: Detection & GC-MS (qualitative & quantitative).



Air Pollution: Environment & Health

Systematic Approach & Master Plan:

1. Identification of Pollution Sources & Pollutants:



Air Pollution: Environment & Health

Systematic Approach & Master Plan:

2. Definition of Threshold Limit Values Concentrations & Toxic Risks

For ex.: according WHO, EC: Directive 2008/50/EC, US-Clean Air Act /National Ambient Air Quality Standards (NAAQS), Specific TERQ-Values, etc.:

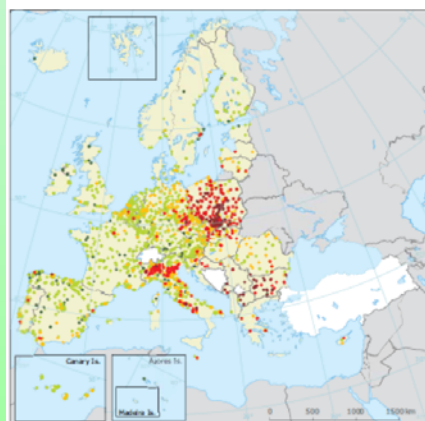
→ Strong Evaluation Differences for "Gravity" !!!

Europe EU

Table ES.1 Percentage of the urban population in the EU-28 exposed to air pollutant concentrations above certain EU and WHO reference concentrations (2012-2014)

Pollutant	EU reference value (%)	Exposure estimate (%)	WHO AQ6 (%)	Exposure estimate (%)
PM ₁₀	Year (20)	8-12	Year (10)	10-15
PM _{2.5}	Day (50)	18-21	Year (20)	10-15
O ₃	8-hour (120)	8-17	8-hour (100)	10-15
NO ₂	Year (40)	7-9	Year (40)	7-9
SO ₂	Year (1)	20-24	Year (1.5) (8.5)	20-24
SO ₂	Day (120)	4-1	Day (200)	10-15

Map 4.1 Concentrations of PM₁₀ in 2014



European Environment Agency



Germany / AT

Bewertung	Index	Bedeutung
sehr gut	0-5	Sehr gute Ausprägung auf Ökosysteme und noch deutlich geringe Auswirkungen auf die menschliche Gesundheit.
gut	6-10	Alle Gesundheitsschutzziele werden eingehalten. Auswirkungen auf Ökosysteme sind noch nicht messbar.
Schadlos	11-15	Die Gesundheitsschutzziele werden eingehalten. Auswirkungen auf Ökosysteme sind in manchen Fällen messbar.
schadlos	16-20	Die Messwerte befinden sich auf dem Niveau von Gesundheitsschutzziele. Gesundheitliche Beeinträchtigungen von empfindlichen Personengruppen werden nicht beobachtet.
schlecht	21-25	Die Gesundheitsschutzziele werden überschritten. Gesundheitliche Beeinträchtigungen von empfindlichen Personengruppen werden beobachtet. Die Bevölkerung wird informiert.
sehr schlecht	26-30	Die Messwerte befinden sich in der Nähe von Alarmwerten. Die Gesundheitsschutzziele werden überschritten. Gesundheitliche Beeinträchtigungen von empfindlichen Personengruppen werden beobachtet.

Die Zuordnung von Luftwertwerten zum Schadstoffindex wird anhand eines einfachen Bewertungssystems vorgenommen:

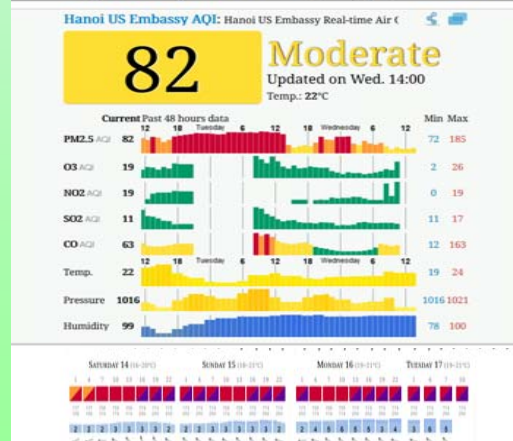
Bewertung	Index	O ₃ , µg/m ³	Feinstaub, PM ₁₀ , µg/m ³	Feinstaub, PM _{2.5} , µg/m ³	Schwefeldioxid, SO ₂ , µg/m ³	Kohlenmonoxid, CO, µg/m ³
Sehr gut	1	0-40	0-20	0-10	0-50	0-3.0
Gut	2	41-80	21-35	11-10	51-80	3.1-5.0
Schadlos	3	81-120	36-50	11-140	81-120	5.1-10.0
Unschadlos	4	121-160	51-100	141-200	121-200	10.1-20.0
Schlecht	5	161-240	101-180	201-400	201-400	20.1-50.0
Sehr schlecht	6	241-320	181-250	401-600	401-600	50.1-100.0

Pollution	Index Value
Very low	0/25
Low	25/50
Medium	50/75
High	75/100
Very high	>100

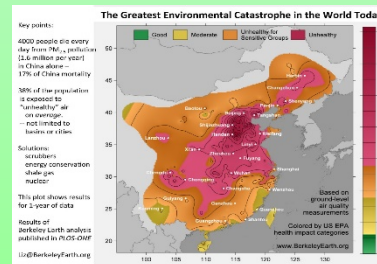
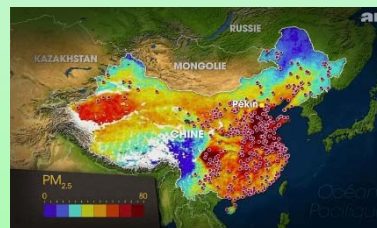
USA / EPA

AQI	Air Pollution Level	Health Implications
0-50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk.
51-100	Moderate	Air quality is acceptable, however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101-150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151-200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
201-300	Very Unhealthy	Health warnings of emergency conditions. The entire population is more likely to be affected.
301-400	Hazardous	Health alert: everyone may experience more serious health effects.

Air Quality Index (AQI) Values



China /Beijing



Air Quality Target & Limit Values for Air Pollutants



Pollutant	Europe EU: 2016 (Directive 2008/50/EC) <small>http://ec.europa.eu/environment/air/quality/standards.htm</small>			USA / EPA (2016) <small>http://www.epa.gov/criteria-air-pollutants/naaqs-table</small>		WHO (2005): Air Quality Guidelines	
	Unit [$\mu\text{g}/\text{m}^3$]	Averaging period	Permitted exceed- ances each Year	Unit [$\mu\text{g}/\text{m}^3$]	Averaging period	Unit [$\mu\text{g}/\text{m}^3$]	Averaging period
PM2.5	25	1 year	n/a	15	1 year	10	1 year
	18 ₍₂₀₂₀₎	1 year	n/a	35	1 day	25	1 day
PM10	50	1 day	35	150	1 day	50	1 day
	40	1 year	35	50	1 year	20	1 year
SO ₂	350	1 hour	24	75 ppbV	1 day	500	10 min.
	125	1 day	3	0.5	3 hours	20	1 day
NO ₂	200	1 hour	18	100 ppbV	1 hour	200	1 hour
	40	1 year	n/a	100 (53 ppbV)	1 year	40	1 year
Pb	0.5	1 year	3 month max.	0.15	3 month	?	
CO (max.)	10 000	8 hours	n/a	9 ppmV	8 hours	?	
CO				35 ppmV	1 hour		
Benzene	5	1 year	n/a	?		?	
O ₃ (max.)	120	8 hours	n/a	0.07 ppmV ?	8 hours	100	8 hours
O ₃				12 ?	1 year		
As	0.006	1 year	n/a	?		?	
Cd	0.005	1 year	n/a	?		?	
Ni	0.02	1 year	n/a	?		?	
PAHs (BaP)	0.001	1 year	n/a	?		?	

Air Pollution

Systematic Approach & Master Plan:

2. Definition of Threshold Limit Values

**Important International
Management
Differences !:
Pollutants & Cocktails**

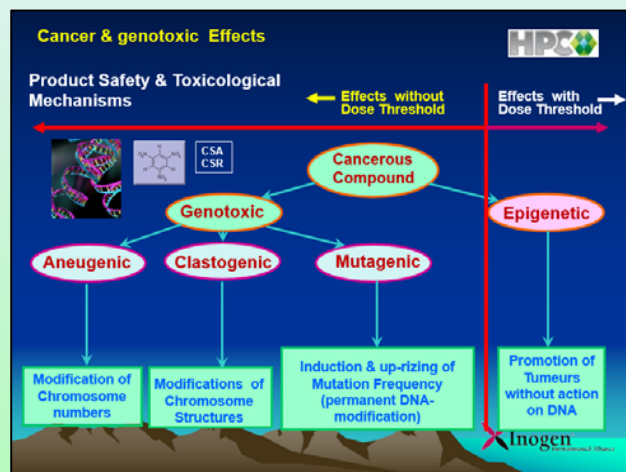




Air Pollution: Environment & Health

Systematic Approach & Master Plan:

2. Definition of Threshold Limit Values Concentrations & Toxic Risks (TERQ). Toxicological Assessment & City Specific TERQ-Values !



Hazard / Danger Types	Hazard / Danger (Potential Effect)	
	Effect without Dose-Effect Threshold	Effect with Dose-Effect Threshold
	<ul style="list-style-type: none"> • Cancergenic, • Mutagenic, • Teratogenic. 	<ul style="list-style-type: none"> • Hepatotoxic, • Nephrotoxic, • Neurotoxic, etc.....
Risk	> or < ICR = 10 ⁻⁵	> or < ADI (etc.)
Gravity	Independent of Dose	Dependent of Dose

Air Pollution: Environment & Health

Systematic Approach & Master Plan:

3. Definition of Corrective anti-pollution Actions. Examples:

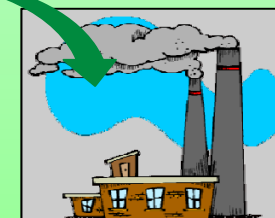


Emission Limitations:

- Traffic: Limitations, Combustible change,
- Coal & Oil Burning,
- Incinerators & Open Fire,
- Dust creation,
- Changing of Electricity Production (IED: EU, etc.)
- Industrial Decentralization,
- Off Gas Treatments, Agriculture, Smooking, etc.
- Industrial Emission Control & Limitation (IED...).



Cities: Decentralization of Industry





Air Pollution: **Environment & Health**

Systematic Approach & Master Plan:

3. Definition of Corrective anti-pollution Actions. Examples: **Emission Limitations (ex. Directive 2010/75/EU):**



- **Traffic:** partial Interdiction of old Cars & Bikes (> 10 y), limitation of Gasoil, Emission Control: → Combustible change (to H₂, Gas, Electricity, Public Transportation: Subway, etc., free bicycles...),
- **Coal Burning:** Limitation, Interdictions, Emission Treatments etc.,
- **Open Fire / Incinerators:** interdiction / Limitation (Waste, Coal, etc.)
- **Dust Limitation:** Humidification, Covering of Materials Storage,
- **Changing of Electricity Production:** Wind, Solar, Pyrolysis, Geothermic Energy, Hydro-electric Power Plants,
- **Construction Sites:** Firing and Dust limitation,
- **Industrial Decentralization** (→ out from the City),
- **Agriculture:** Dust, Pesticides, Fertilizers,
- **Reinforced Permission Systems,**
- **Smoking Interdictions, etc.**



Air Pollution: Environment & Health

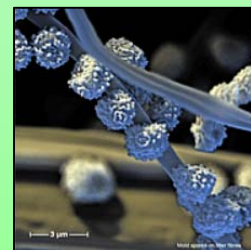
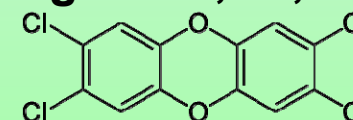
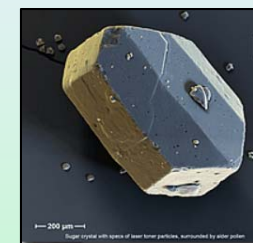
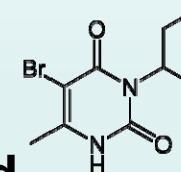
Systematic Approach & Master Plan:

4. Installation of Monitoring Net & Central Controlling for selected

➤ Pollutants, for ex.: Dust (**PM₁₀**, **2.5** & **1**), **PAH**, **NO_x** (**NO₂**, **NO**, **N₂O**), **SO₂**, **VOC** (Benzene, BTEX, etc.), **CO**, **O₃**, **CO₂**, **Pb**,

➤ Other Important Pollutants:

- **VOC:** Volatile Organic Compounds (BTEX, Polar Solvents, Halogenated Compounds, as: Haloformes (DCM, TCM, TCE, VC, EDC, etc.), FHCs,
- **Heavy Organics;** as Dioxins PCDD/F, chlorinated PAH, PCB, POP, Pesticides,
- **Other Heavy Metals;** as: Hg: Mercury, Fe: Iron, Mn: Manganese, Cr, Zn, Cu,...
- **Acids:** HCl, HF, H₂SO₄, HBr, HNO₃, etc.,
- **Microbiological Agents;** as Virus, Bacteria, Mushrooms, Pollen, etc.
- **Others:** Asbestos, Al, NH₃, Salts, Radio-elements, Aromatic Amines, HET, etc.



Air Pollution: Environment & Health

Systematic Approach & Master Plan:

4. Installation of Monitoring Net & Central Controlling



<http://>



PM10	0.12	0.08	0.05
PM2.5	0.08	0.05	0.03
NO2	0.05	0.03	0.02
CO	0.02	0.01	0.01
O3	0.05	0.03	0.02
TEMP	15.0	15.0	15.0
HUMID	65.0	65.0	65.0
WIND	0.0	0.0	0.0
STATUS	STOPPED	STOPPED	STOPPED

Air Pollution: Environment & Health

Systematic Approach & Master Plan:

5. Health Bio-Monitoring (Epidemiology).

Asthmatic, Bronchitis,
Pseudocroup, Lung
Cancer, Allergies, etc.



A Kien Giang Province local collects half a kilogram of cement dust by sweeping part of his floor one morning.
Photo: Tien Trinh



Possible air pollution link to Alzheimer's

Country	Population (million)	Mortality due to traffic accidents for all ages (1)	Mortality due to traffic air pollution for adults > 30 (2)	Ratio (1)/(2)
France (1996) ^a	58.3	153 per million	501 per million	
Austria (1996) ^a	8.1	119 per million	487 per million	
Switzerland (1996) ^a	7.1	84 per million	400 per million	
New Zealand (2002) ^b	3.7	137 per million	196 per million	
Hai Phong, Vietnam (2007) ^c	0.6	307 per million	1572 per million	1:5.1
Ha Noi, Vietnam (2009)	2.6	174 per million	2473 per million	1:14.2



^aKunzli *et al.* [20]; ^bFisher *et al.* [23]; ^cVu *et al.* [38].

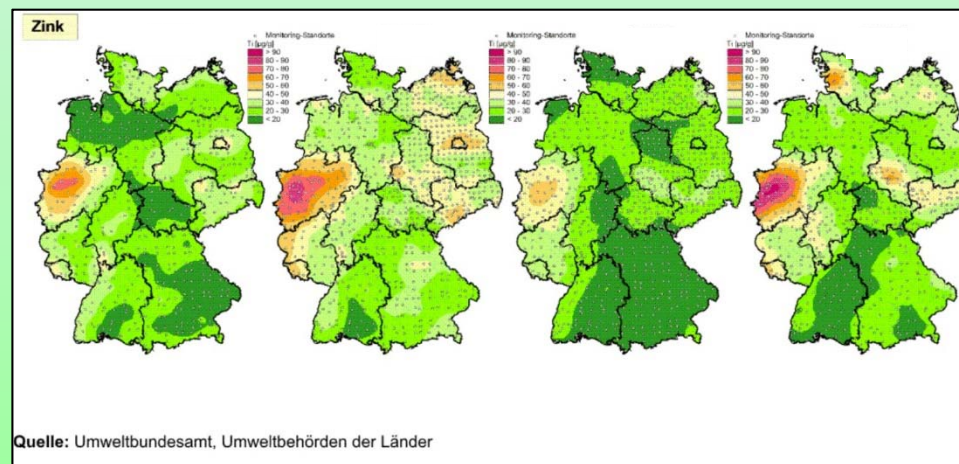
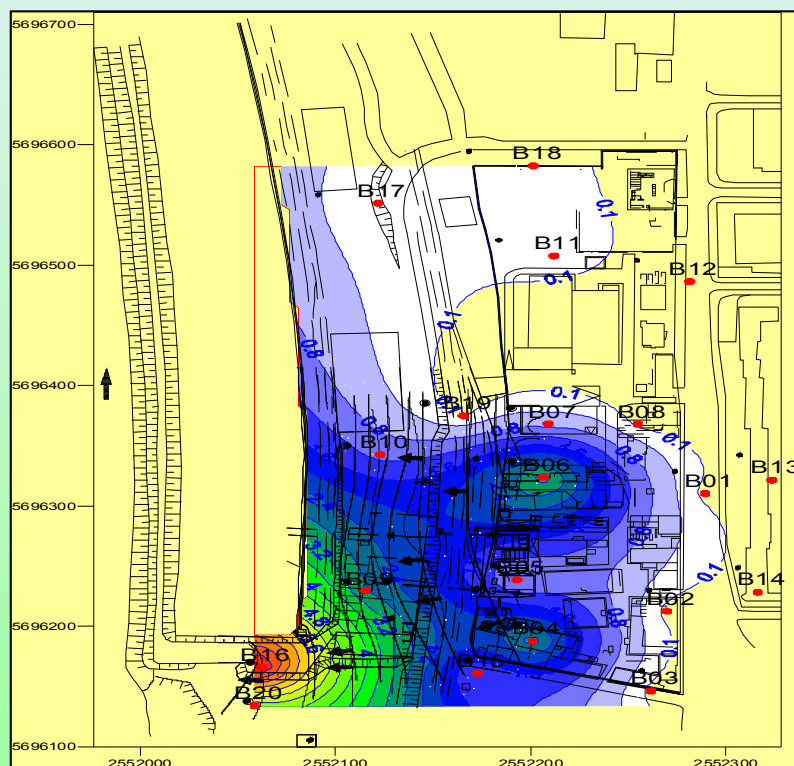
Air Pollution: Environment & Health

Systematic Approach & Master Plan:

6. Modelling of Pollution Events & Forecast

Modelling of:

- Weather,
- Pollution Concentrations,
- Smog distribution,
- Toxicological Risks and
- Needed Corrective Actions.





Air Pollution: **Environment & Health**

Systematic Approach & Master Plan:

7. Corrective Actions, including Prevention.

Examples: Main targets include:

- Tighten the controls for power plant emissions to reduce emissions.
- Introducing cleaner fuel standards and switching to electric vehicles.
- Restrict the construction of power plants and other energy-intensive industries near residential areas.
- Improve urban planning to increase green spaces.
- Take air quality into consideration when conducting environmental assessments for major projects; for example, flyovers and highways should be far away from residential areas.
- Reduction of emissions from coal burning industries and vehicles .
- Boost cleaner (Public Buildings, etc.) and more efficient use of coal
- Promote the use of electricity and natural gas in place of coal
- Increase wind, solar, hydro and bio power sectors (clean energy).
- Encourage the use of waste straw as a resource.
- Reduction in-field burning.
- Implementation of control measures to deal with air pollution.
- Establish legally binding and regional coordinated plans to reach national air quality standards that include clear timelines.
- Introduce a national coal consumption cap.
- Hike up pollution discharging charges and strengthen supervision efforts.
- Shutdown inefficient coal-fired industrial boilers.







Air Pollution: **Environment & Health**

Needs for specific Pollution Cocktail Management:

7. Assessments & Corrective Actions

- Systematic City specific Air Pollution Screenings are needed to identify & quantify the real local Pollutant Mix acting as Exposure Cocktail to Human Health.
- Only in that way a real realistic **Toxicological Exposure Risk Quantification (TERQ) / Health Risk Assessment (HRA)** can be ensured for the existing Pollutant Cocktail and for the needed Corrective Actions concerning Emission Reductions.
- The Pollutant Cocktail can be assessed via the MOA-Methodology, where Pollutant Cocktails are assessed.
- Definition of TEQ for City (& City Quarter) specific Pollutant Cocktails !
- Only this approach can overcome the non-satisfactory “Single-Pollutant Evaluation by Table-List Threshold Values.!”



Air Pollution: **Environment & Health**

Needs for specific Pollution Cocktail Management:

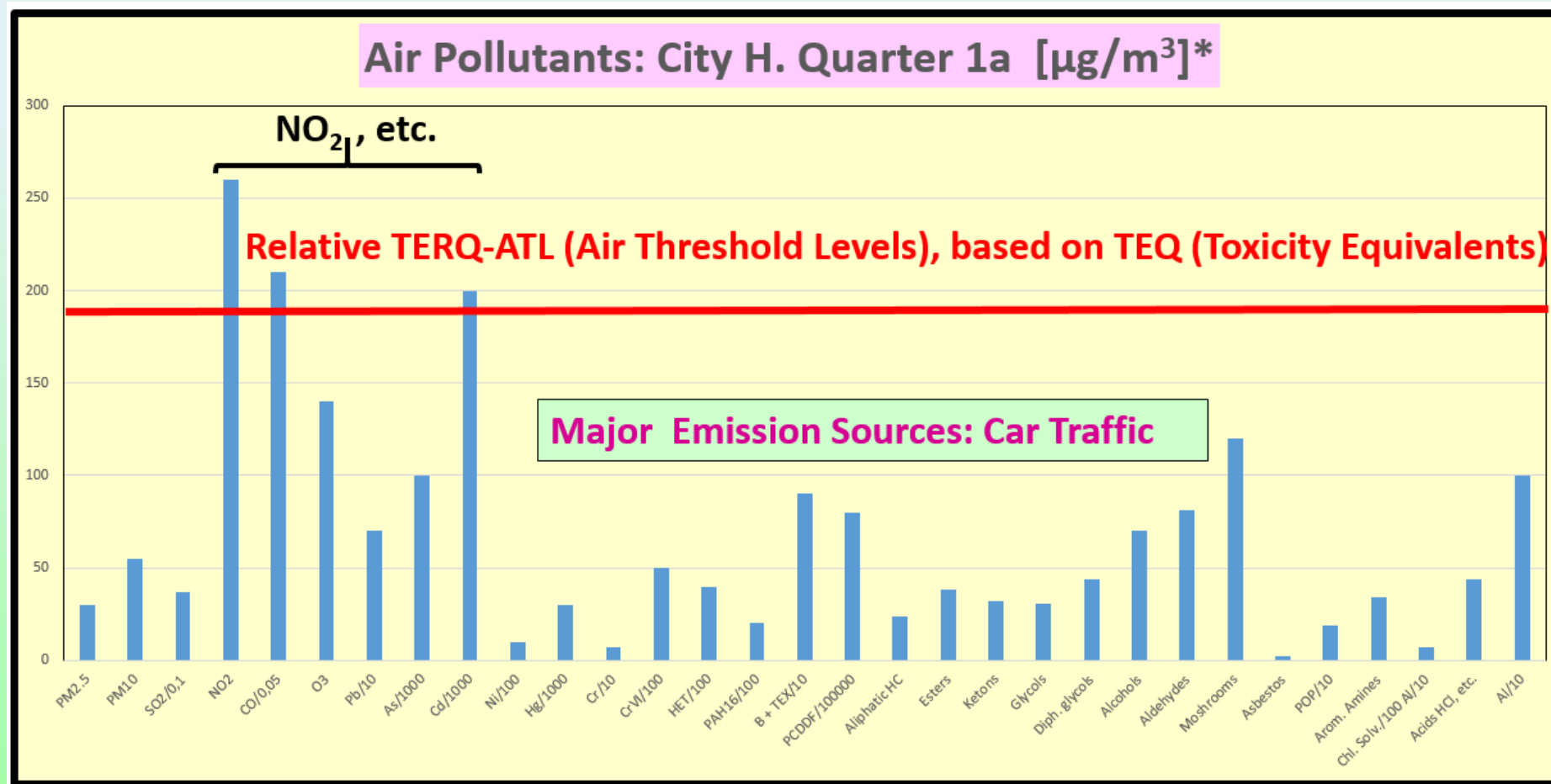
7. Additional Pollutant Survey & TERQ

- **Alcohols:** ethanol, 1-propanol, 2-propanol, 1-butanol, 2-propanol, iso-butanol, etc.,
- **Isoprenes:** alpha-pinene, beta-pinene, Δ^3 -carene, longifolene, beta-phellandrene, camphene, myrcenecarvone, limonene, etc.,
- **Aldehyds:** pentanal, hexa2-pentenal, heptanal, octanal, nonanal, decanal, undecanal, 2-pentenal, 2-hexenal, 2-heptenal, 2-octenal, 2-nonenal, 2-decenal, 2,4-heptadienal, 2,4-nonadienal,
- **Monomers:** styrene, vinyltoluene, 2-phenyl-1-propane, 1,6-hexanediol-diacylate, 2-ethylhexyl-acrylate, butyl-acrylate, methyl-methacrylate, butyl-methacrylate, phenoxyethyl-acrylate, 1,6-hexane-diisocyanate,
- **Aliphatic Hydrocarbons:** Hexane, heptane, octane, nonane, decane, undecane, dodecane, tri-decane, tetra-decane, penta-decane, cyclo-hexane, methyl-cyclo-hexane, etc.,
- **Aromatic Hydrocarbons:** Toluene, ethyl-benzene, o-, m- & p-xylene, 1,3,5-trimethylbenzene, 1-methyl-ethyl-benzene, styrene, etc.
- **Esters:** n-butyl-acetate, iso-butyl-acetate, ethyl-acetate, 1-butanol-3-methoxy acetate, 1-ethoxy-2-propyl-acetate, 1-methoxy-2-propyl-acetate, 1-ethoxy-2-propyl-acetate, 2,2,4-trimethyl-1,3,-pentane-diol-mono-iso-butyrate (Texanol), 2,2,4-trimethyl-1,3,-pentane-diol-di-iso-butyrate (TXIB), etc.
- **Ketones:** 2-butanone, 4-methyl-2-pentanone, acetone, 1-methyl-2-pyrrolidone, 4-hydroxy-4-methyl-2-pentanone, etc.,
- **Glycols:** 2-butoxy-ethanol, 2-(2-butoxyethoxy)-ethanol, 1-methoxy-2-propanol, 1-butanol, 2-butanol, etc.,



Case Studies from East Asia:

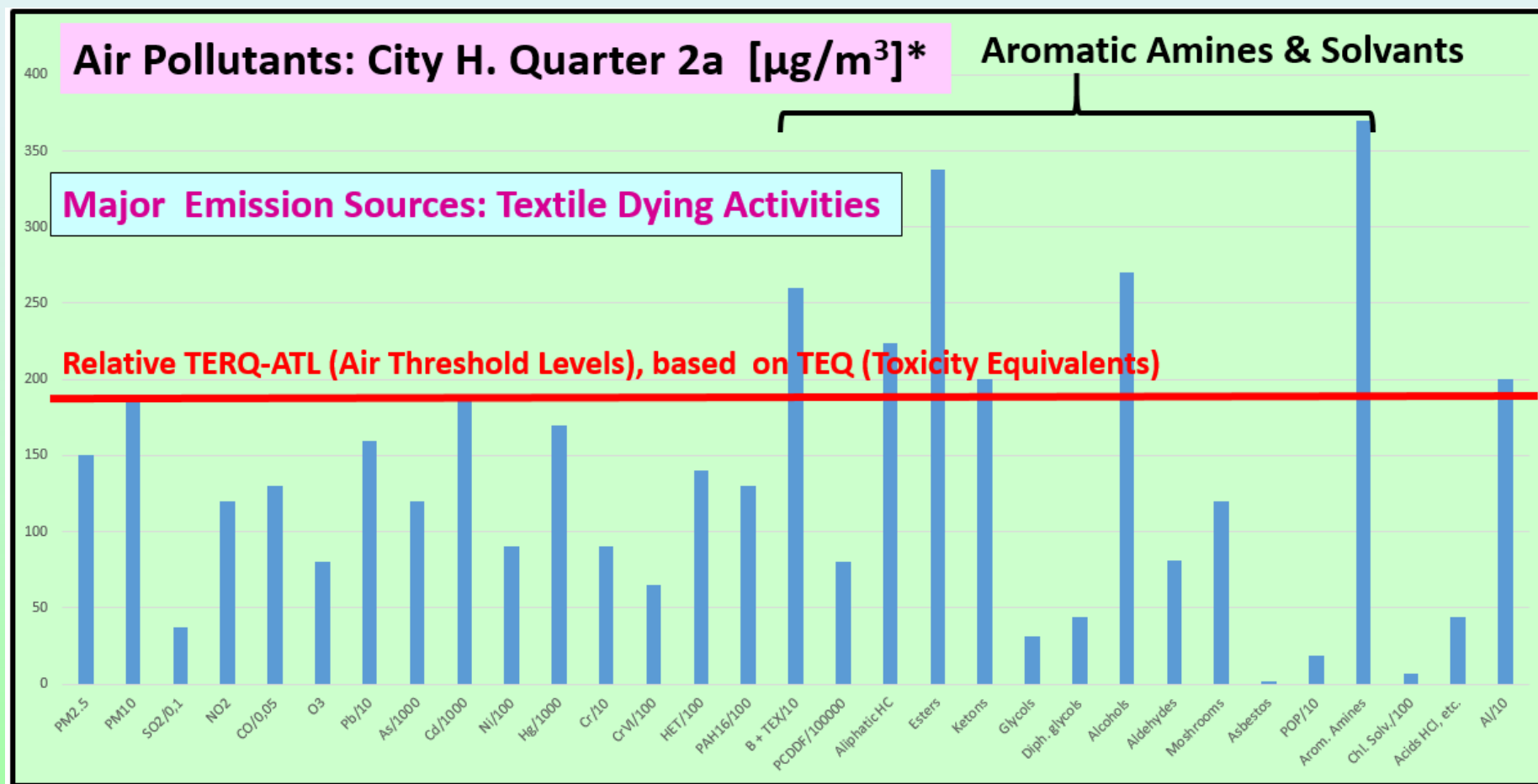
TERQ (MOA-HRA) Risk Assessment Monitoring on TEQ Base: ICR 10E-5 & ADI





Case Studies from East Asia:

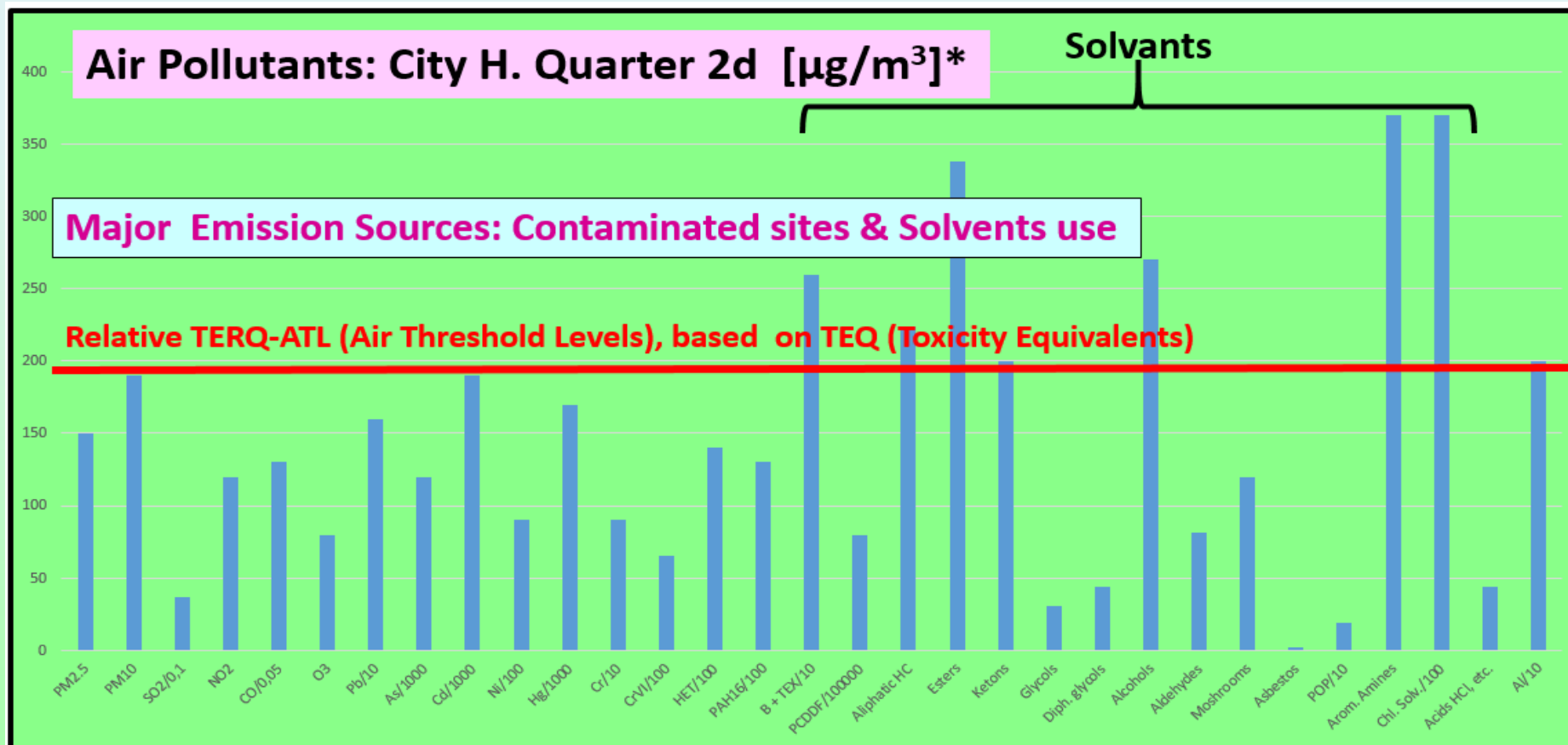
TERQ (MOA-HRA) Risk Assessment Monitoring on TEQ Base: ICR 10E-5 & ADI





Case Studies from East Asia:

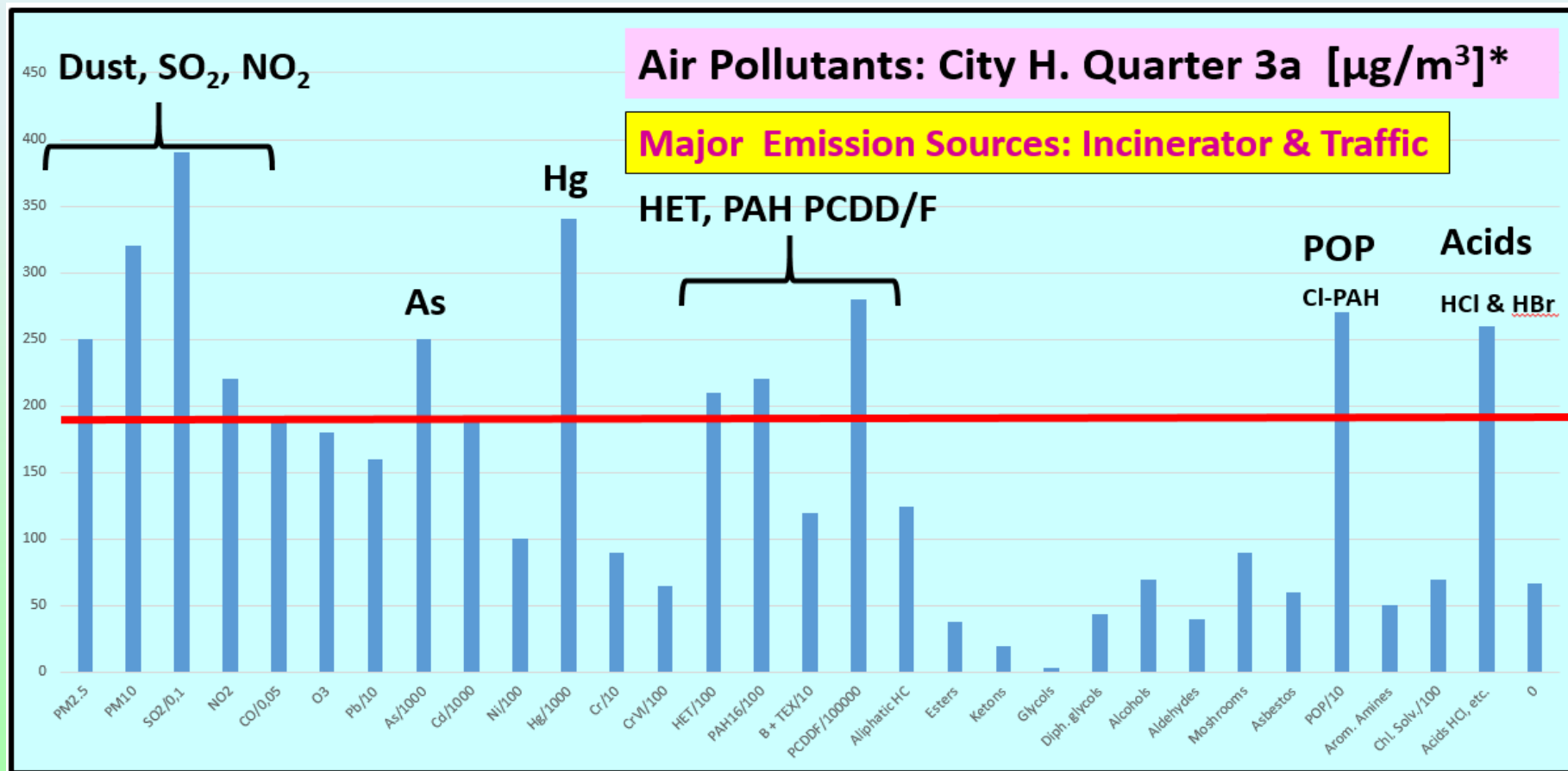
TERQ (MOA-HRA) Risk Assessment Monitoring on TEQ Base: ICR 10E-5 & ADI



Air Pollution Cocktail Spectrum, based principally on Solvent use and contaminated Site Emissions: BTEX, chlorinated and polar Solvents and Dust with Cadmium (Cd), Lead (Pb) and Mercury (Hg) (in Quarter 2d, City H.)

Case Studies from East Asia:

TERQ (MOA-HRA) Risk Assessment Monitoring on TEQ Base: ICR 10E-5 & ADI



Air Pollution Cocktail Spectrum, based principally on Household Waste Incineration: Dust, Arsenic (As), Mercury (Hg), HET, PAH, Acids (HCl, BrH) and POP (chlorinated PAH) (in Quarter 3a, City H.)

Results and Conclusions: 1/2

- The Results are showing, that the **Pollutant Screenings are absolutely necessary to quantify (by TERQ) the real toxic Risks of the identified Pollutant Exposure Cocktail** and
- to take the **right Decisions** concerning Emission Reducing Corrective Actions.
- This should mandatory, because Air Investigations shows, that in dependence of urban Activities the Air Pollution Spectrum and Pollutant Cocktails could be very variable, as also their toxic Impact !
- **It's not at all sufficient to limit Monitoring on PM2.5, PM10, SO₂, CO and NO₂ !!!**





Results and Conclusions: 2/2



- Via the TERQ Risk Assessment (MOA – HRA), **City (and City Quarter) specific ATL: Air Threshold Levels** for different Air Quality Levels can be defined and implemented “on-line” for best Public **Health Protection. Even sensitive groups, as Children** (concerning Pollutants which are at the same Time Carcinogen and Mutagen) **can be better protected** by these **Pollutant Screenings and specific TERQ (MOA – HRA) Approach and based on TEQ-Factors & Pollutant Cocktail related Thresholds.**
- **This Systematic Pollutant Screening + TERQ (MOA – HRA) Approach should become Standard for better Public Health Protection and especially for sensitive Groups, as Children, Asthmatics, etc.** After receiving the Pollutant Screening results a restricted Parameter Monitoring can be decided.



Serenity ?

