Umwelt Bundes Amt
Für Mensch und Umwelt

Action Programme
Environment and Health

*Oakland, CA, 9th June 2008*

# German Environmental Survey (GerES)

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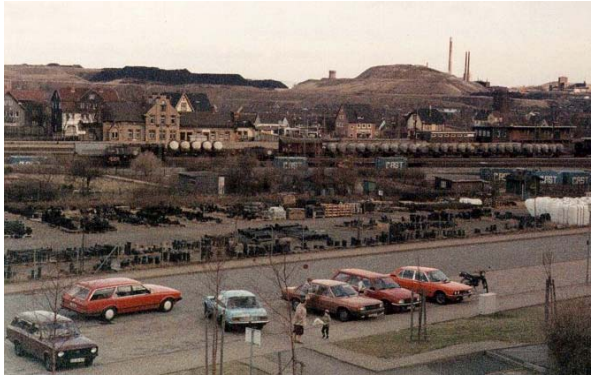
Marike Kolossa-Gehring
Federal Environment Agency

# About 30 years ago...



## Starting:

- more than 100 cows died after exposure to heavy metals close to a lead works
- lead in children living near a battery production plant
- lead in blood of children near a smelting works

## Challenge:

- scientific basis for protection of the environment and health
- internal and external exposure
- exposure sources
- health impacts
- policy measures

# GerES: study design

Cross-sectional population study

Background level of exposure for a defined group of the general population: Reference values

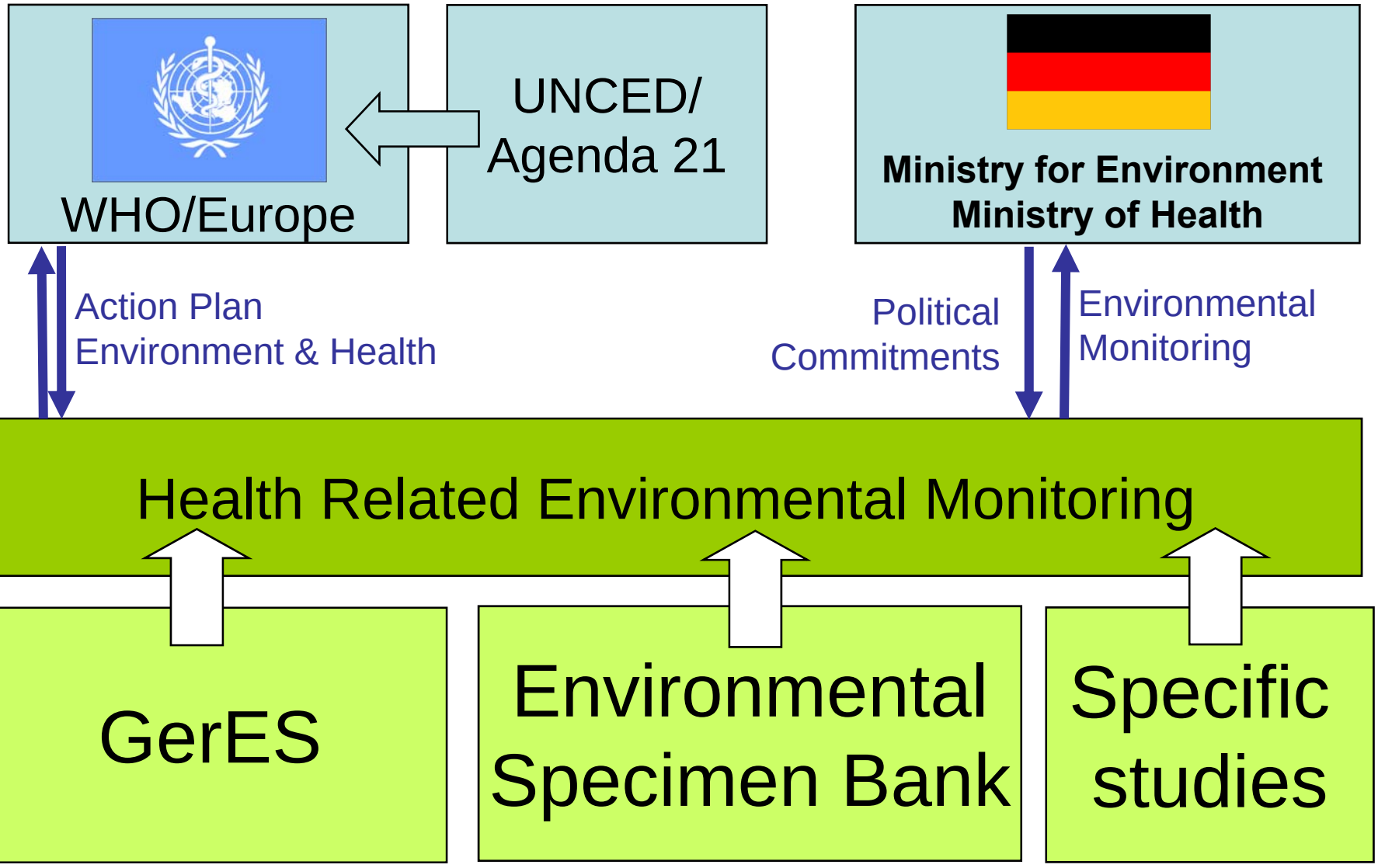
Inclusion of several media and parameters

Identification/quantification of pathways and sources

# 20 years of GerES

| *Survey* | *Period* | *Population sample* |
|---|---|---|
| GerES I | 1985 - 1986 | 2,700 adults |
| GerES II | 1990 - 1992 | 4,000 adults<br>730 children |
| GerES III | 1997 - 1999 | 4,800 adults |
| GerES IV | 2003 - 2006 | 1,790 children |

# Today

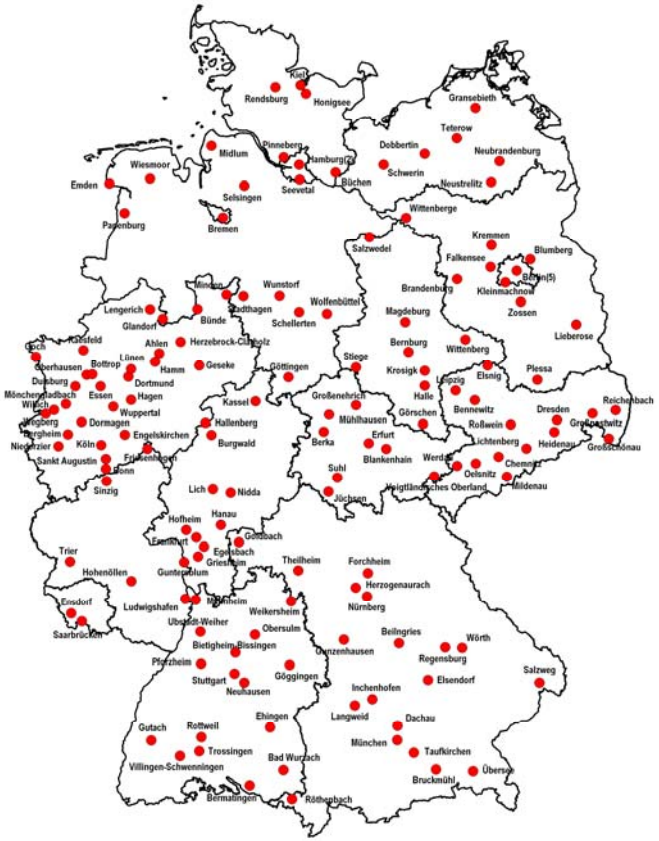

WHO/Europe
UNCED/
Agenda 21
Ministry for Environment
Ministry of Health
Action Plan
Environment & Health
Political
Commitments
Environmental
Monitoring
Health Related Environmental Monitoring
GerES
Environmental
Specimen Bank
Specific
studies

# GerES IV: Population sample

**1,790 children ( 3 to 14 years)**

representative with regard to **age, gender, community size and region**

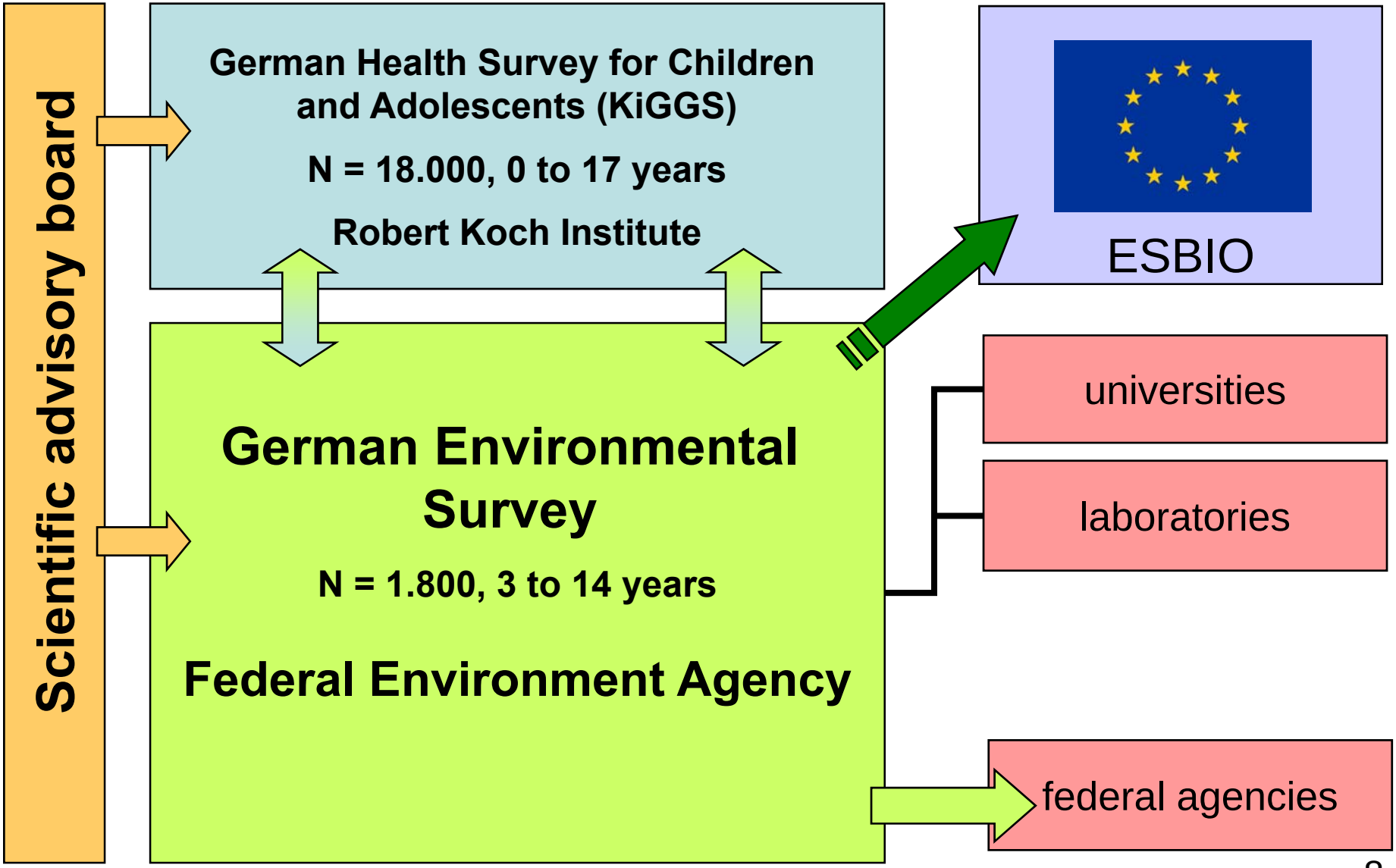
**150 sampling locations**



# GerES IV: time frame

| | |
|---|---|
| 9/1999-3/2001 | Planning phase |
| 3/2001-3/2002 | Pilot study |
| 5/2003-5/2006 | Field work |
| 5/2003-4/2008 | Chemical analyses |
| 5/2006-9/2008 | Basic evaluation |
| 9/2008 | Public use file |

# GerES: partners involved



# Instruments and factors

**Main Instruments**

- Human biomonitoring
- Ambient monitoring
- Questionnaires

**Environmental factors**

- biological (mould and fungi)
- physical (noise)
- chemical (pollutants)

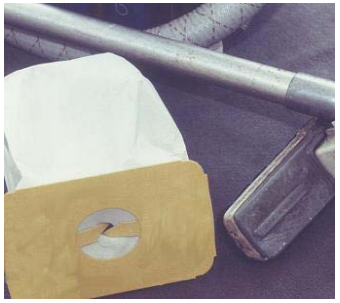
# Instruments: HBM

**Blood:** Cd, Pb, Hg
persistent organochlorines
mould specific IgE

**Urine**: As, Cd, Hg, Ni, U
nicotine, cotinine
PCP and other chlorophenols
PAH metabolites
pyrethroid metabolites
metabolites of phthalates
bisphenol A
trialkylphosphates
creatinine
stress hormones

# Instruments: ambient monitoring

**House dust:** DDT, HCH, HCB, PCBs; PCP, chlorpyrifos (vacuum cleaner bags)



**Drinking water:** Pb, Cd, Cu, Ni, U

**Indoor air:** VOC and formaldehyde (passive sampling)

# Instruments: questionnaires

Stand 1.06.03

UMWELTBUNDESAMT
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ROBERT KOCH INSTITUT

Studie zur Umweltweltbelastung von Kindern in Deutschland

**Interviewgesteuerter Fragebogen an die Eltern**

| | |
|---|---|
| ID-Nr. Kind/Jugendliche(r) | |
| Datum der Erhebung | .200 |
| Begaher-Nr | |

*Interviewer: Die folgenden Fragen werden allen Eltern gestellt. Die letzten Fragen sollen nur an die Eltern der 3- bis 10-Jährigen gestellt werden und sind als solche gekennzeichnet.*

| Wohnumfeld und Wohnung |
|---|
| Wir möchten uns zunächst mit dem Wohnumfeld Ihres Kindes beschäftigen. |
| 1. Seit wann wohnt Ihr Kind in _____? |
| *Interviewer: Gemeinde / Stadt eintragen und vorlesen!* |
| seit seiner Geburt..... ☐ |
| seit ☐☐ Monat ☐☐☐☐ Jahr |
| 2. **Seit wann bewohnt** Ihr Kind diese Wohnung/dieses Haus ? |
| seit seiner Geburt..... ☐ |
| seit ☐☐ Monat ☐☐☐☐ Jahr |

- 1 -

- indoor and outdoor environment
- health information
- socio-economic status
- food consumption
- exposure relevant habits

……

# Field work

- Cooperation with the National Health Survey (KiGGS)
- 3 field teams (trained medical personnel and interviewers)
- Randomised sequence of sampling location visits to avoid regional or seasonal effects
- Visit of participants in an examination center (blood samples)
- Visit at home by interviewers to collect samples of the indoor environment and to perform the interviews
- Internal and external quality control

# Budget and resources

**Field work** (recruitment, sampling, questionning, qualtiy control):

**1.2 mill. Euro**

**Chemical analysis** (blood, urine, house dust, indoor air)

**2.0 mill. Euro**

**Management and evaluation**

(design, supervision, sample management, qualtiy control of field work and chemical analysis, development of hypotheses, evaluation, reporting to the government and the public, scientific publications)

**Staff of the Federal Environment Agency**

# General objectives

1. **Comparable data** concerning external and internal exposure to environmental pollutants and contaminants

2. Identification and quantification of (primary-) **exposure pathways**

3. Evaluation of the impact of environmental factors on **children‘s health**

# Comparable data

DDE in blood (µg/l)

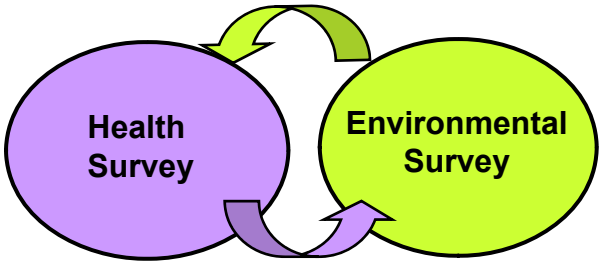
| | N | n<LOQ | P10 | P50 | P90 | P95 | P98 | MAX | AM | GM | CI GM | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **total** | 587 | 2 | 0.09 | 0.22 | 0.83 | 1.11 | 1.93 | 5.05 | 0.370 | 0.241 | 0.224 | 0.259 |
| **region** *** | | | | | | | | | | | | |
| west | 405 | 1 | 0.08 | 0.17 | 0.52 | 0.82 | 1.90 | 2.86 | 0.277 | 0.191 | 0.177 | 0.207 |
| east | 182 | 1 | 0.16 | 0.38 | 1.12 | 1.42 | 2.51 | 5.05 | 0.575 | 0.406 | 0.357 | 0.462 |
| **age** *** | | | | | | | | | | | | |
| < 6 years | 11 | 0 | 0.13 | 0.38 | 2.20 | | | 2.56 | 0.585 | 0.398 | 0.238 | 0.665 |
| 6 - 8 years | 143 | 1 | 0.11 | 0.25 | 1.02 | 1.27 | 2.91 | 5.05 | 0.474 | 0.290 | 0.246 | 0.341 |
| 9 - 11 years | 219 | 0 | 0.09 | 0.21 | 0.73 | 1.05 | 1.74 | 3.78 | 0.339 | 0.231 | 0.207 | 0.258 |
| 12 -14 years | 214 | 1 | 0.08 | 0.20 | 0.66 | 1.03 | 1.81 | 2.30 | 0.320 | 0.217 | 0.193 | 0.244 |

# Exposure pathways

Factors influencing 1-OH-Pyr levels in urine, multiple regression model (GerES IV-Pilot-study)

| Variable | p |
|---|---|
| creatinine in urine | < 0.001 |
| age | < 0.001 |
| grilled food consumption | < 0.001 |
| East vs. West Germany | 0.002 |
| ETS exposure at home | 0.012 |
| exposure to traffic | 0.044 |
| chocolate consumption | 0.047 |

# Links between environment and health




Allergic sensitisation against indoor specific mould spores (N=600)

Irritation of eyes and respiratory system due to formaldehyde, other aldehydes and VOC in indoor air (N=600)

Allergies due to nickel, chromium or scents (N=1800)

Noise, hearing and stress (N= 1050, aged 8 to 14)

# Criteria for selection of pollutants

**General criteria**

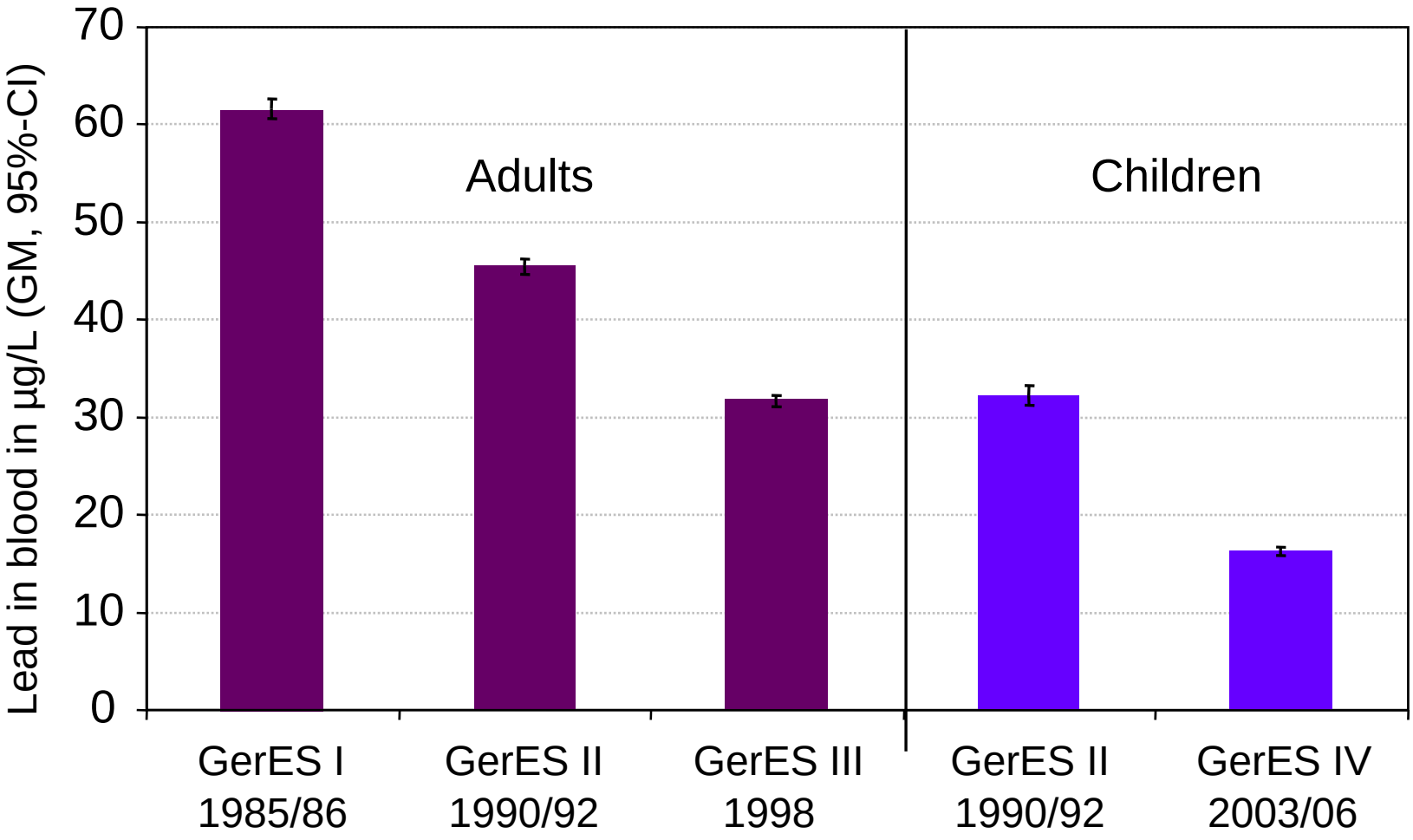
- toxicological properties of concern
- potential influence on children‘s health
- relevance for environmental policy
- widespread exposure of the general population
- reliable sampling procedures
- analytical methods available
- costs

**Discussion in expert groups / the scientific advisory board**

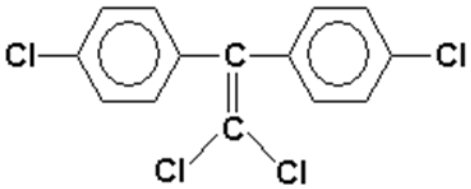
# Pollutants selected

- **Metals** (Pb, Cd, Hg, As, Ni, U)
- **Organochlorine compounds** (DDT/DDE, HCH, HCB)
- **PCB** (28, 52, 101, 138, 153, 180)
- **Pyrethroids** (Cis-$Cl_2$-CA, trans-$Cl_2$-CA, $Br_2$CA, 3-PBA, F-PBA)
- **Organophosphates** (DMP, DMTP, DMDTP, DEP, DETP, DEDTP )
- **Phthalates** (metabolites of DEHP, DiNP, DnBP, DIBP, DBzP)
- **PAH** (1OH-Pyr, 1OH-Phen, 2/9OH-Phen, 3OH-Phen, 4OH-Phen)
- **PCP** and other **chlorphenols** (2-MCP, 4-MCP, 2,4-DCP, ….)
- **Bisphenol A**
- **Nicotine, cotinine**
- **IgE** (mould fungi), **stress hormones**

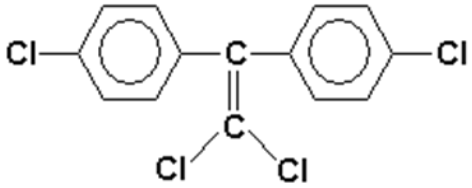
# Lead: Success of political measures



# DDE



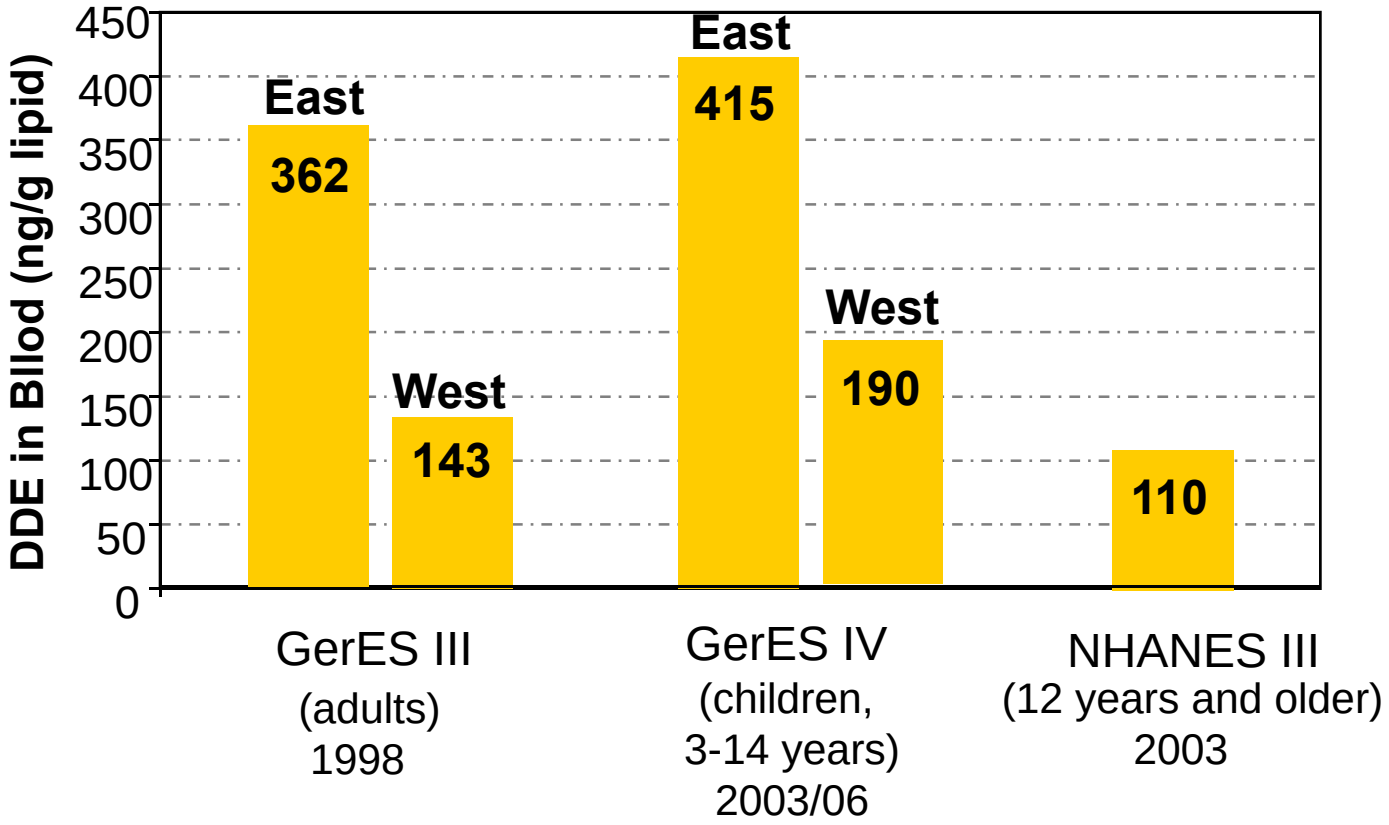

Dichlordiphenyltrichlorethan




Dichlordiphenyltrichlorethylen

| | |
|---|---|
| **Exposure sources:** | fatty foodstuff from animals |
| **Chronic toxicity:** | neurotoxic, hepatotoxic, endocrine disruptor |
| **Carcinogenicity:** | Group 2B: might be carcinogenic in humans |
| **Legal status:** | banned since 1972 (in East-Germany some applications until 1989) |

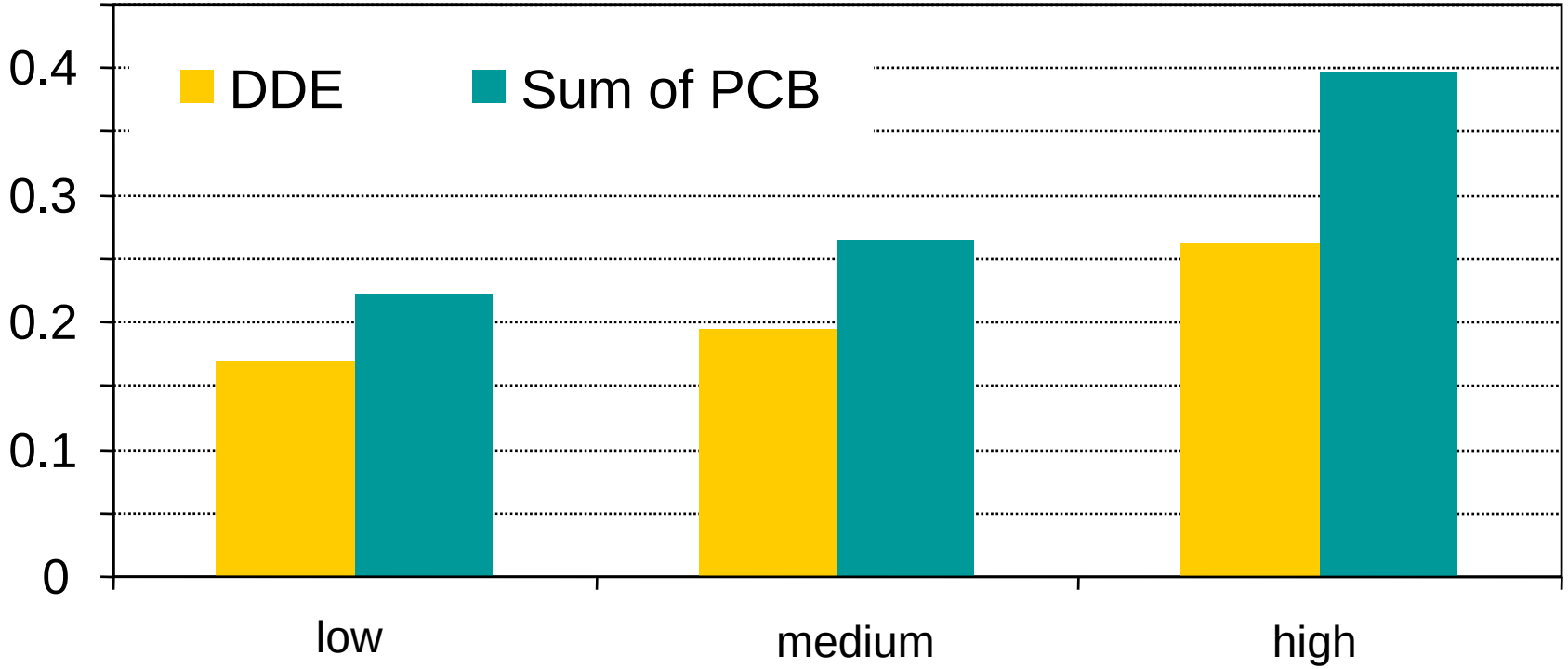
# DDE: East and West Germany



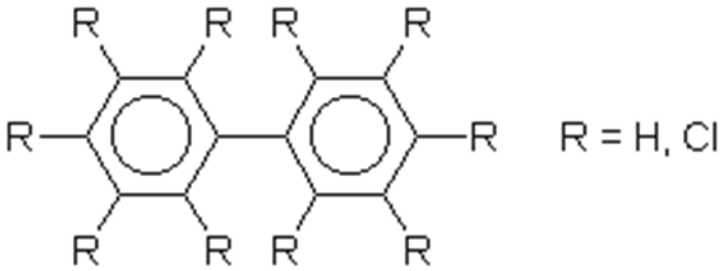
# DDE and Σ PCB in blood and socio-economic status

(GM in µg/l, 7 to 14 years)

*p < 0,001*



# Polychlorinated biphenyles (PCB)




**Exposure sources:** indoor (sealing compounds), fatty foodstuff from animals

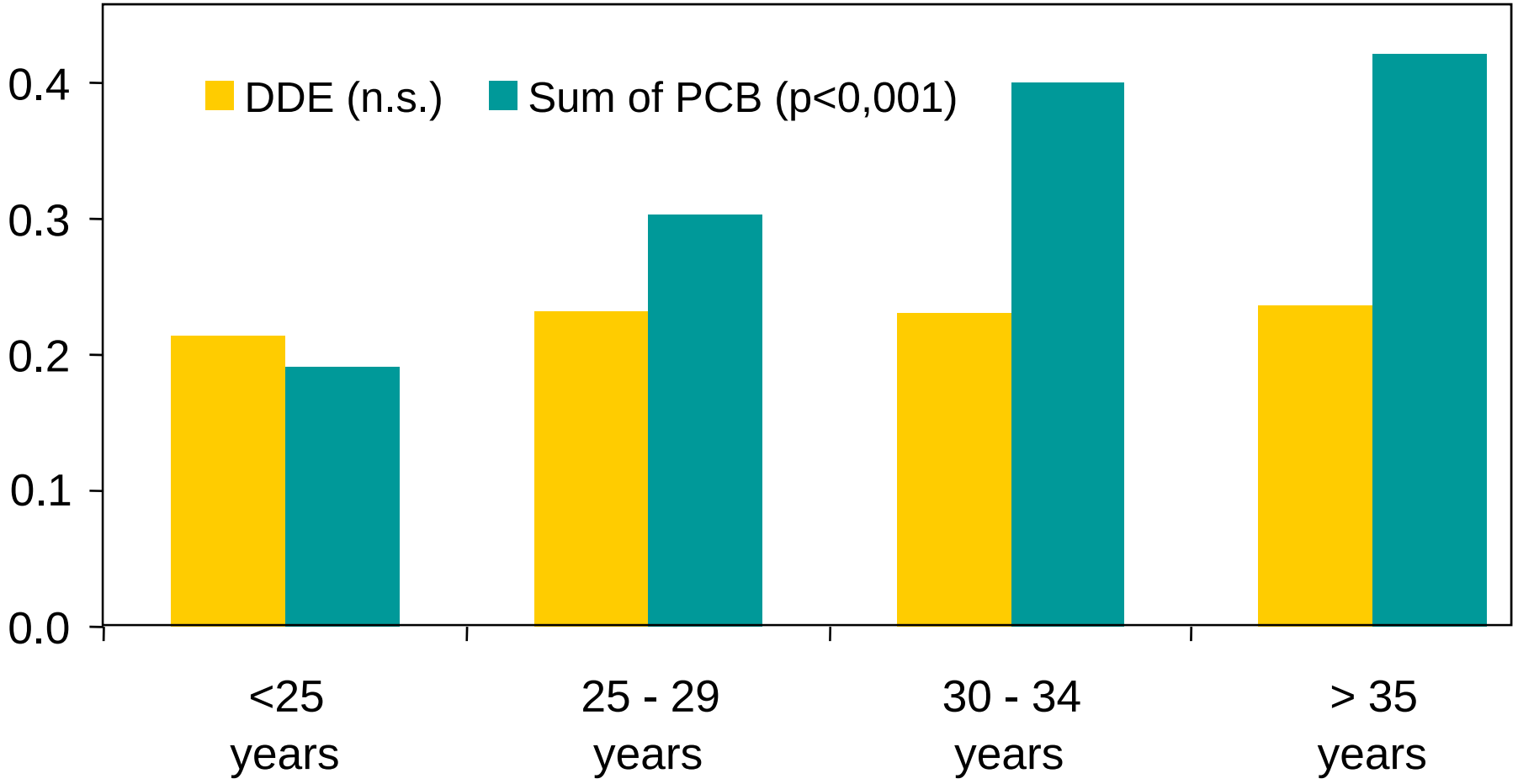
**Chronic toxicity**: neuro-, immuno- and reprotoxic

**Carcinogenicity**: Group 2A probably carcinogenic in humans

**Legal status:** banned for use in open systems since 1978, completely banned since 1989

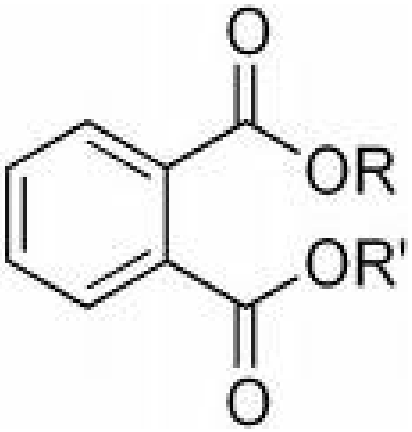
# PCB: age of the mother

(GM in µg/l, 7 to 14 years)




Age of the mother at time of birth and DDE and sum of PCB in blood of children

# Phthalates



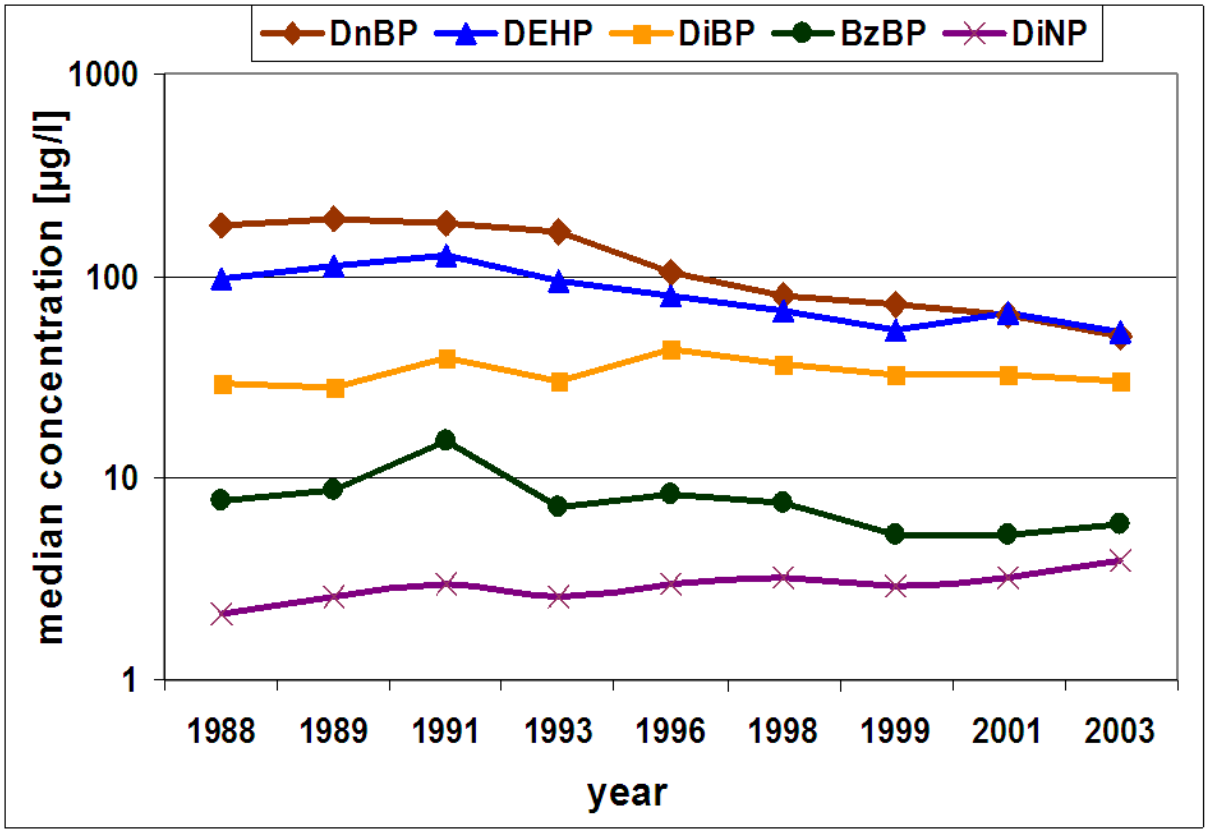

**Exposure sources:** nutrition (food contact materials), consumer products (plasticiser in PVC, cosmetics/personal care products), pharmaceuticals, medical devices, house dust

**Chronic toxicity**: endocrine and reprotoxic

**Legal status:** in use in a wide range of products, the EU prohibited the marketing of toys and childcare articles

# Environmental Specimen Bank

- **DnBP**: di-n-butyl phthalate
- **DEHP**: di(2-ethyl-hexyl)phthalate
- **DiBP**: di-iso-butyl phthalate
- **BzBP**: butylbenzyl phthalate
- **DiNP**: di-iso-nonyl phthalate




DnBP: 14% intakes above the TDI value (EFSA)

Wittasek et al.: Int. J. Hyg. Environ. Health 210 (3-4) (2007) 319-33

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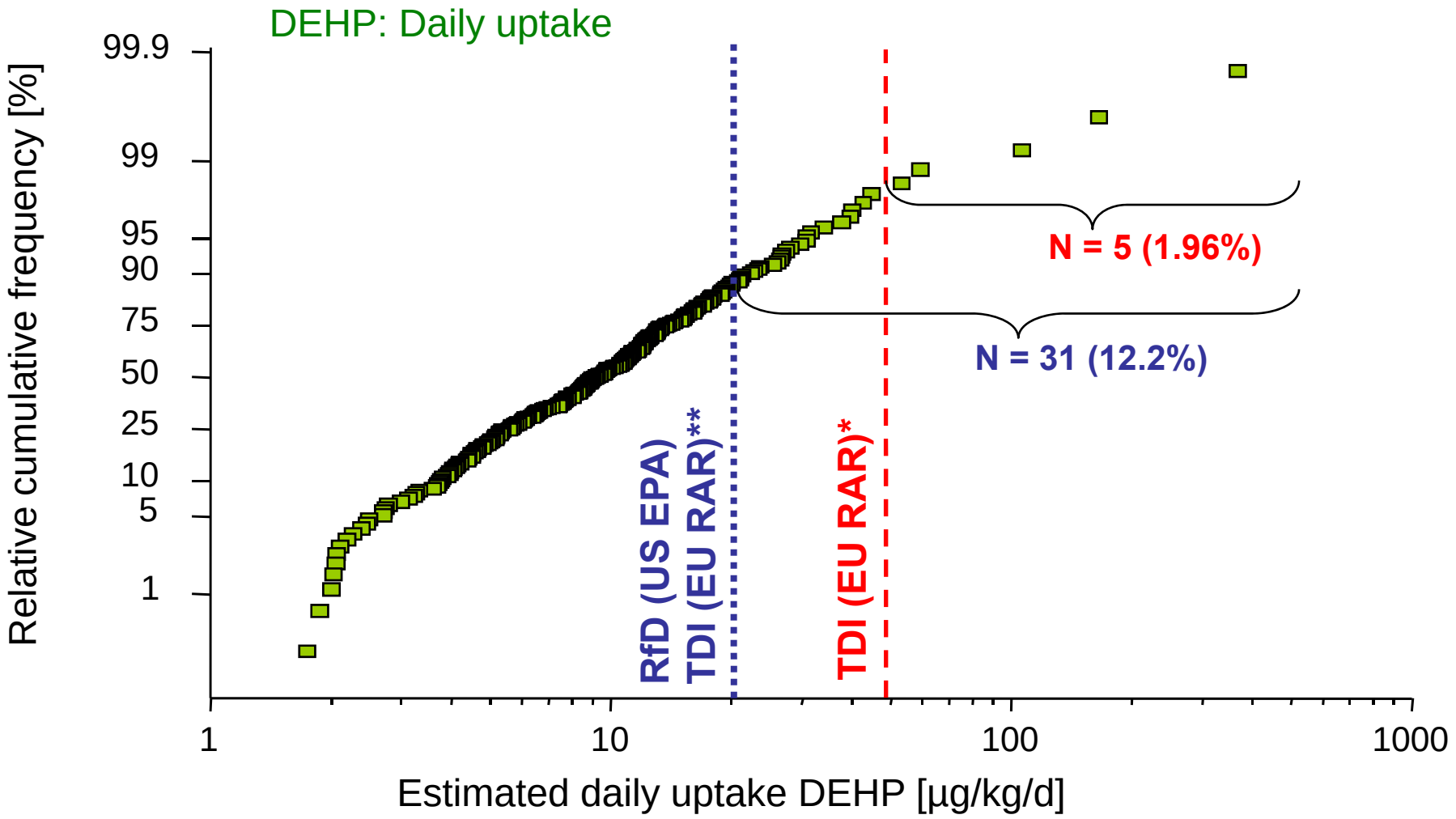
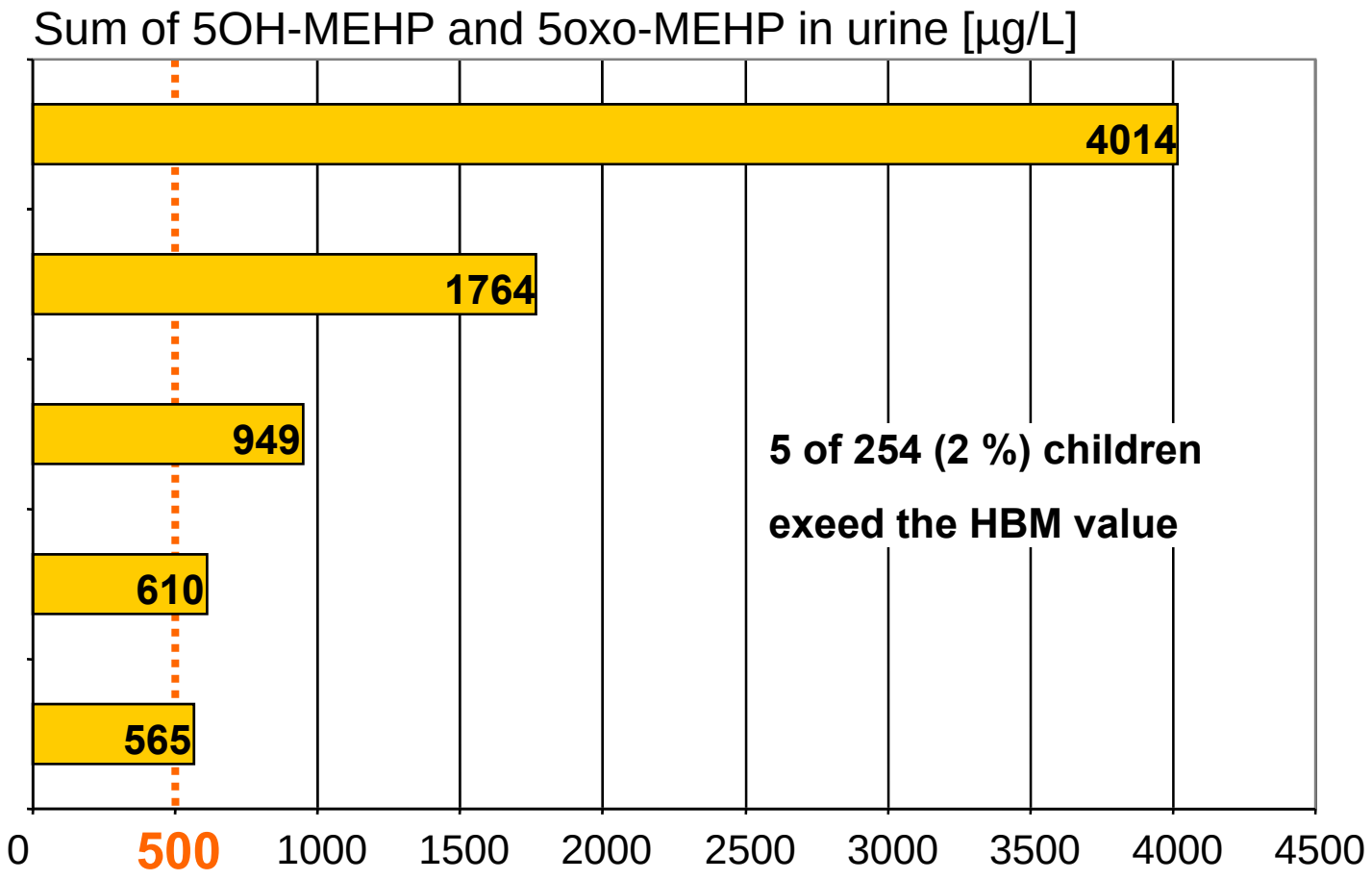
# DEHP: identification of Need for Action




**Tolerable daily intake (TDI)** ····· **20µg/(kg·d)** – – – **48µg/(kg·d)**

**:new borns *:adults

# Exceedance of the HBM value for DEHP (500 µg/L)



# Human Biomonitoring Value, DEHP

- ADI/ TDI: 4 - 66 µg/kg bw/d
- NOAEL: 2,9 - 20 mg/kg bw/d
- derived in: 1994 - 2005

- Human-Biomonitoring-Kommission:

  NOAEL 4,8 mg/kg bw/d, Wolfe and Layton (2003): testicular effects, developmental toxicity

<u>Human Biomonitoring Value I</u>

- children (6-13 years) 500 µg/l
- women of childbearing age 300 µg/l
- rest of population 750 µg/l

„Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz, 2007“

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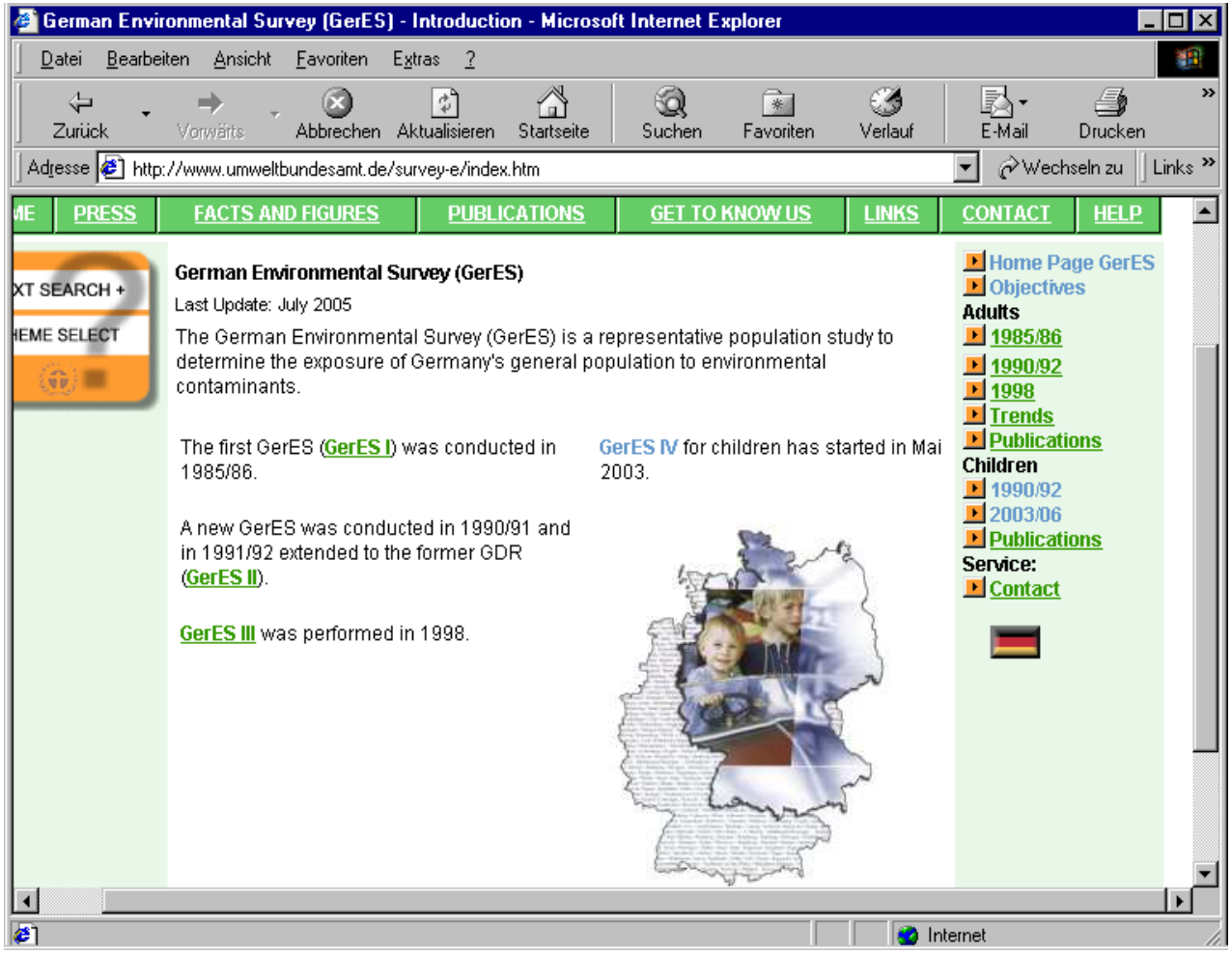
# HBM-Values

***http://www.umweltbundesamt.de/gesundheit-e/monitor/index.htm***

| Parameter and Matrix [bibliographical data] | Population group | HBM I Value | HBM II Value |
|---|---|---|---|
| **Lead** in **blood** [6,34] | Children ≤ 12 years and females of a reproductive age | 100 µg/l | 150 µg/l |
| | other persons | 150 µg/l | 250 µg/l |
| **Cadmium** in **urine** [11] | Children, adolescence and adults ≤ 25 years | 1 µg/g Crea. | 3 µg/g Crea. |
| | Adults > 25 years | 2 µg/g Crea. | 5 µg/g Crea. |
| **Mercury** in **urine** [13] | Children and adults | 5 µg/g Crea.<br>7 µg/l | 20 µg/g Crea.<br>25 µg/l |
| **Mercury** in **blood** [13] | Children and adults*<br>* derived from females in reproductive age. The use is recommended for other groups. | 5 µg/l | 15 µg/l |
| **Pentachlorphenol** in **serum** [9] | General population | 40 µg/l | 70 µg/l |
| **Pentachloro-phenol** in **urine** [9] | General population | 20 µg/g Crea.<br>25 µg/l | 30 µg/g Crea.<br>40 µg/l |
| **Sum of the DEHP metabolites 5oxo- and 5OH-MEHP** in **urine** [55] | Children aged 6 to 13 | 500 µg/l | / |
| | Women of childbearing age | 300 µg/l | / |
| | Males 14 years of age and older and remaining general population | 750 µg/l | / |

# GerES, website

***http://www.umweltbundesamt.de/survey-e***



# Reglementation of PBT/vPvB in the EU

Anlage3-MinutesNov2006.doc

**EUROPEAN COMMISSION**
DIRECTORATE GENERAL JRC
JOINT RESEARCH CENTRE
Institute for Health and Consumer Protection
**Unit: Toxicology and Chemical Substances**
***European Chemicals Bureau***

November 2006

## ANNEX I: Actions arising from 9th TC NES Subgroup Meeting on Identification of PBT and vPvB Substances - Existing Substances Session (14.-15.11.2006)

| No. | MS Rapporteur | CAS | Name | Description of the Action | Time Scale |
|---|---|---|---|---|---|
| 5 | AT | 118-82-1 | 2,2',6,6'-tetra-tert-butyl-4,4'-methylenediphenol | IND to perform a test on water solubility and a BCF study (if practical feasible OECD 305 otherwise dietary study). Substance is included in the 12(2) Regulation. Labelled substance is available now. Ind to perform the test on water solubility. Depending on WS the appropriate method for BCF testing has to be decided. | BCF study to be started if WS is available. |
| 15 | UK | 15571-58-1 | 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate | Relevant for 15, 16 and 99. After 3 year the water chemistry is still unknown. UK and IND will have a meeting in 12/2006 to decide on the further steps and if some of the achievements of ICCA program are useful for PBT assessment. If no progress to include the substance into Art 12.2 list. | December 2006 |
| 16 | UK | 3542-36-7 | Dichlorodioctylstannane | | |
| 22 | NL | 50849-47-3 | 5-Nonylsalicylaldehyde oxime | No progress since the last meeting. NL to discuss with IND the proposed testing program. | As soon as possible |

# PBT/vPvB

- Dodecylphenol (CAS 27193-86-8)
- Octamethylcyclotetrasiloxan (CAS 556-67-2)
- 2,2',6,6'-Tetra-tert-butyl-4,4'-methylenediphenol (CAS 118-82-1)
- Hexabromocyclododecan (CAS 25637-99-4)

# Towards HBM in Europe

## Starting position

- different chemicals
- different methods
- different objectives
- different population samples
- different study designs
- different questionnaires

→

- no comparable data
- insufficient knowledge

ESBIO
Expert team to Support
BIO monitoring in Europe


map: wikimedia commons

# ESBIO: proposed biomarkers

Szenario 1
"Basic"

- Lead in blood
- Cadmium in urine
- Mercury in hair
- Cotinine in urine

ESBIO
Expert team to Support BIO monitoring in Europe

Szenario 2
"Shopping list"

1. Metabolites of PAHs in urine
2. Phthalate metabolites in urine
3. Perfluorinated und polybrominated chemicals in blood
4. Polybrominated flame retardents in blood
5. Organochlorine compounds in blood
6. Metabolites of organophosphates in urine
7. Metabolites of pyrethroids in urine

# ESBIO: results

**Basic documents:**

- Proposals for objectives of EU HBM approach and for pilot project including a justification of recommended priorities
- **Proposal for pollutants and biomarkers including a justification of recommendations**
- Protocol for population sampling, recruitment and biological monitoring
- Questionnaires for the Pilot Project
- Protocol for harmonised way of collecting and analysing selected pollutants and for data management

ESBIO
Expert team to Support BIO monitoring in Europe

# ESBIO, internet

***http://www.eu-humanbiomonitoring.org***

# Thank you for your attention!

Special thanks to our team members

André Conrad
Andreas Hünken
Margarete Seiwert
Christine Schulz

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