

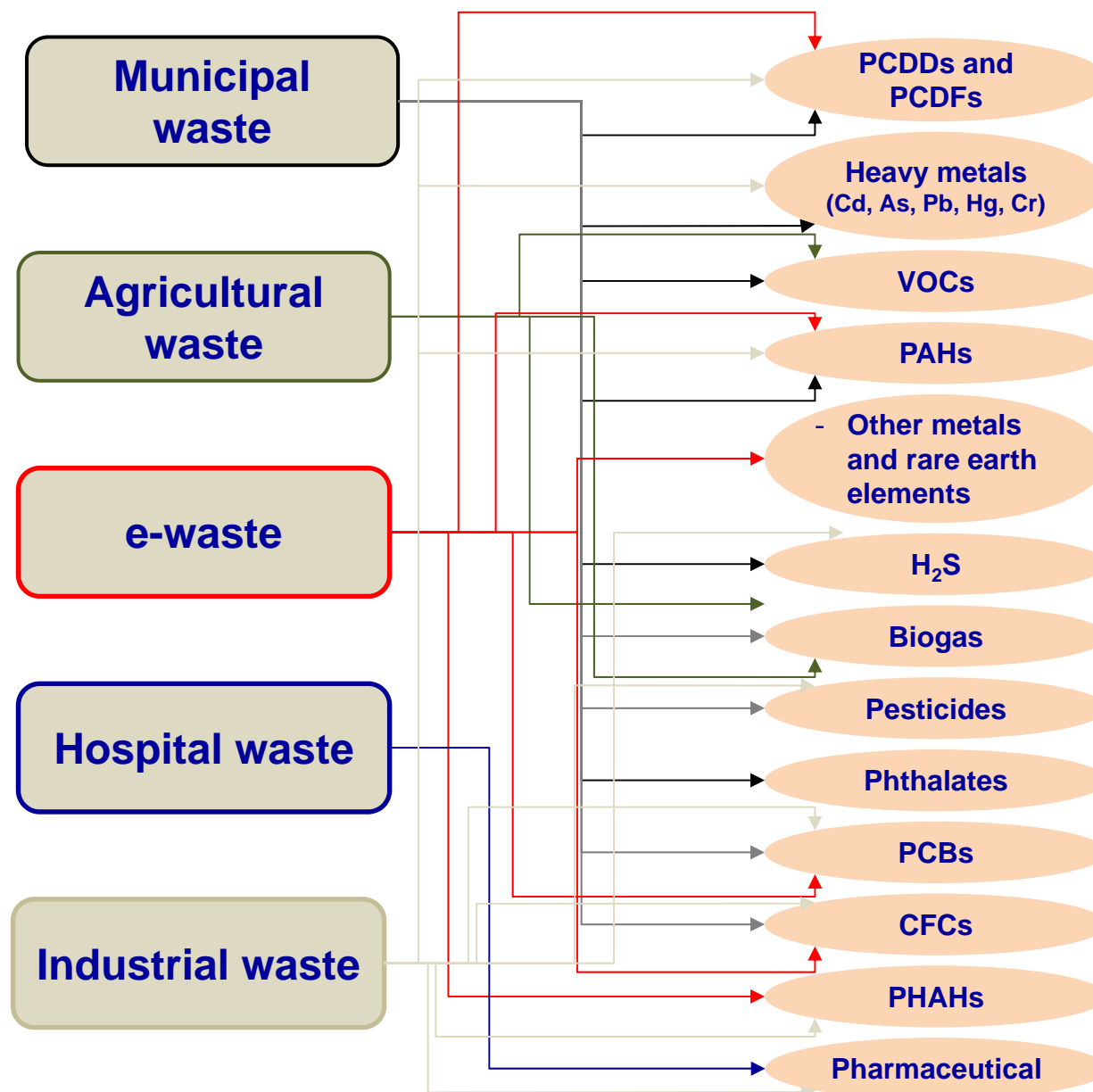
Life cycle-based health risk assessment of plastic waste

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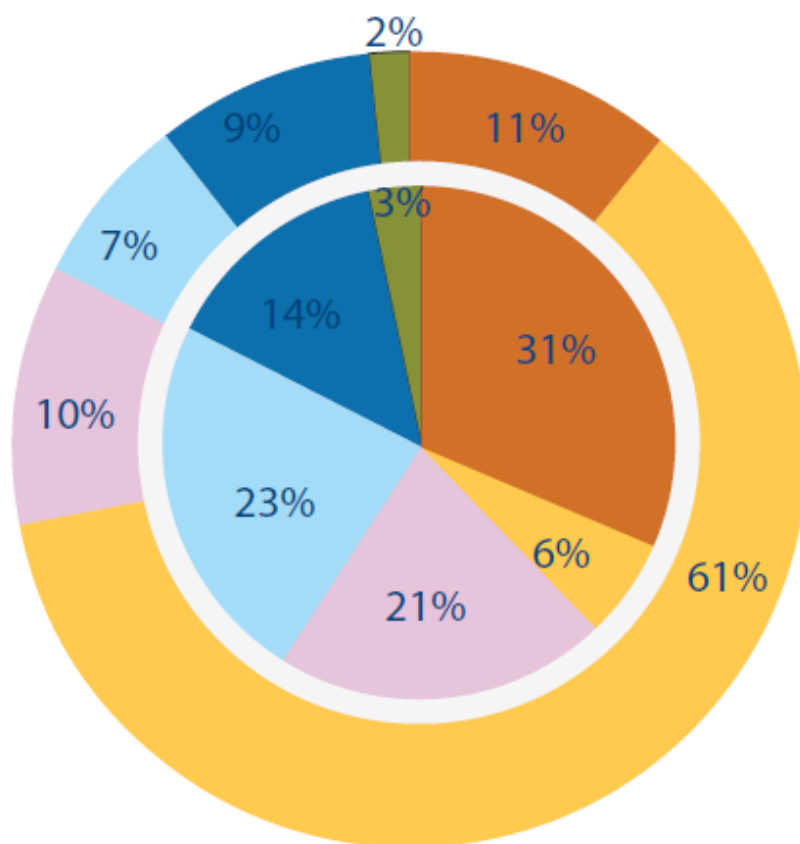
*² Chair of Environmental Health Engineering,
Institute of Advanced Study, Pavia 27100, Italy*

<http://www.enve-lab.eu>





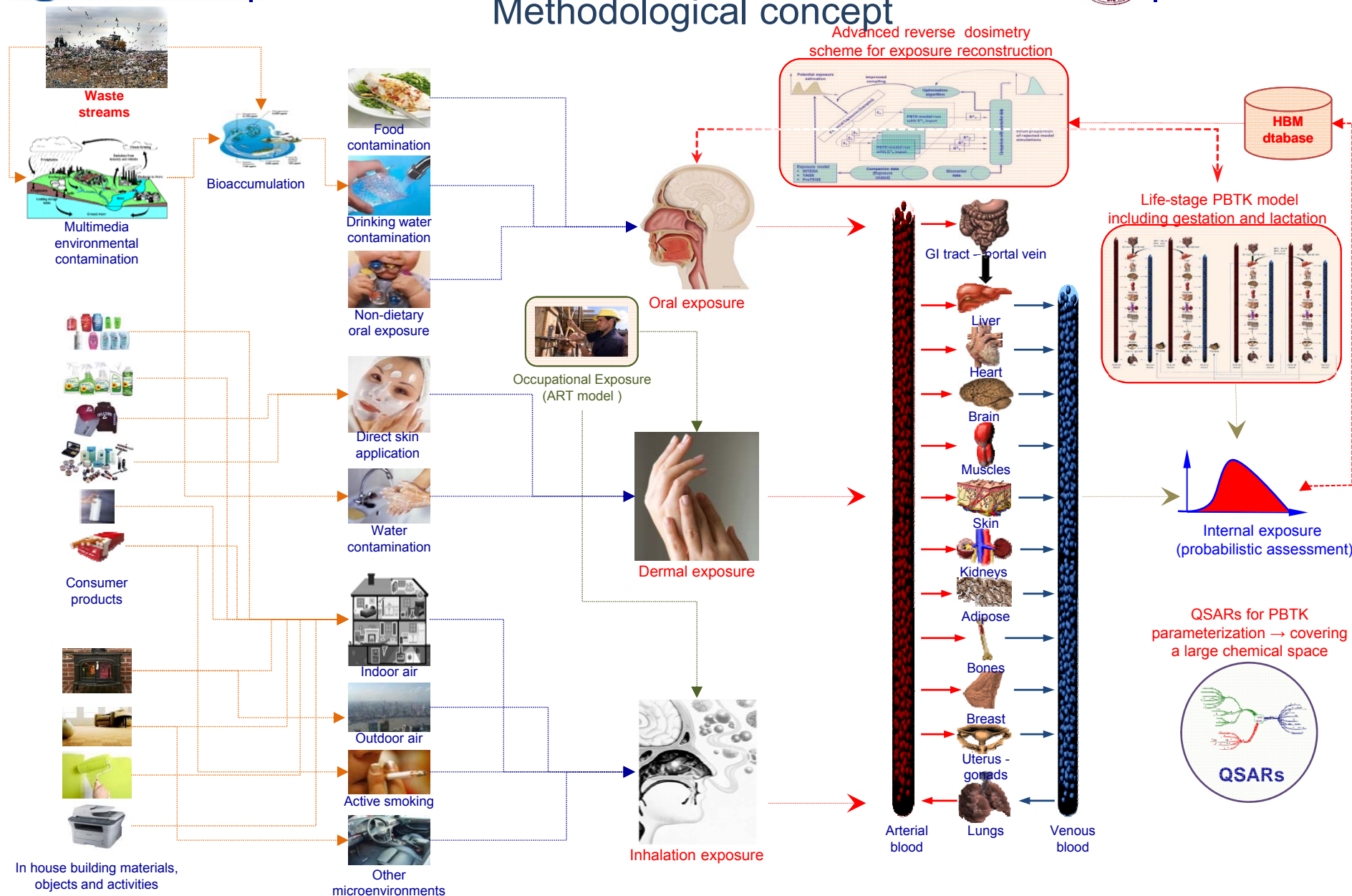
Total waste and plastic waste



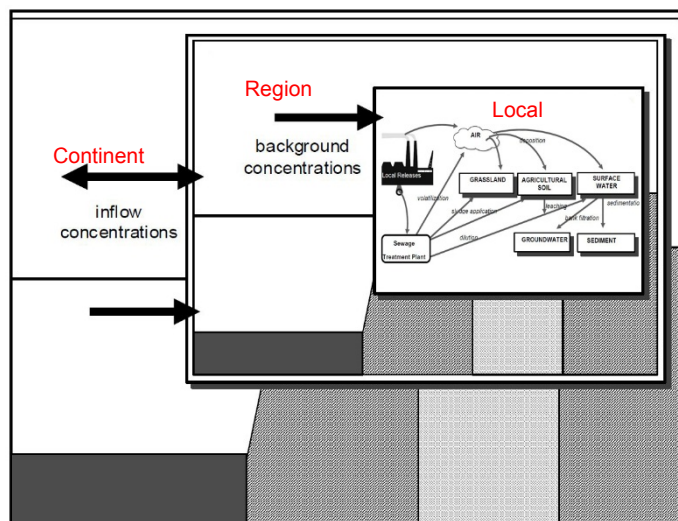
- Manufacturing
- Mining & construction
- Gas, electricity & water supply, sewage & waste
- Services
- Households
- Agriculture, forestry & fishing

INTEGRA LCA

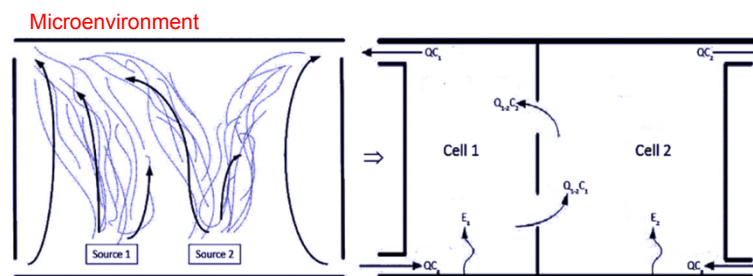
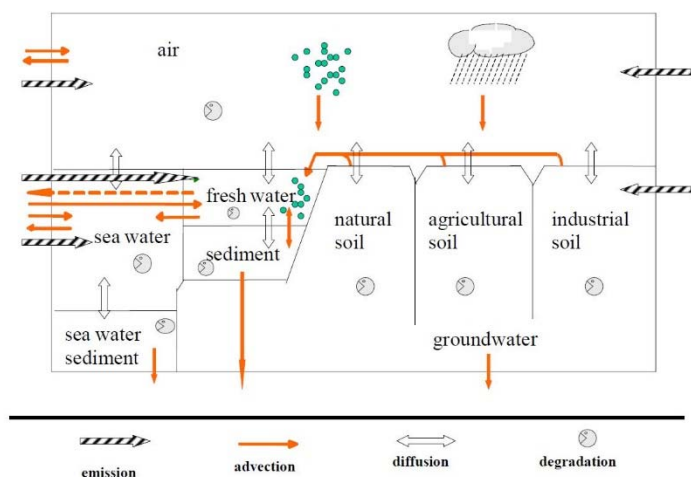
Methodological concept



Multi-scale environmental modelling

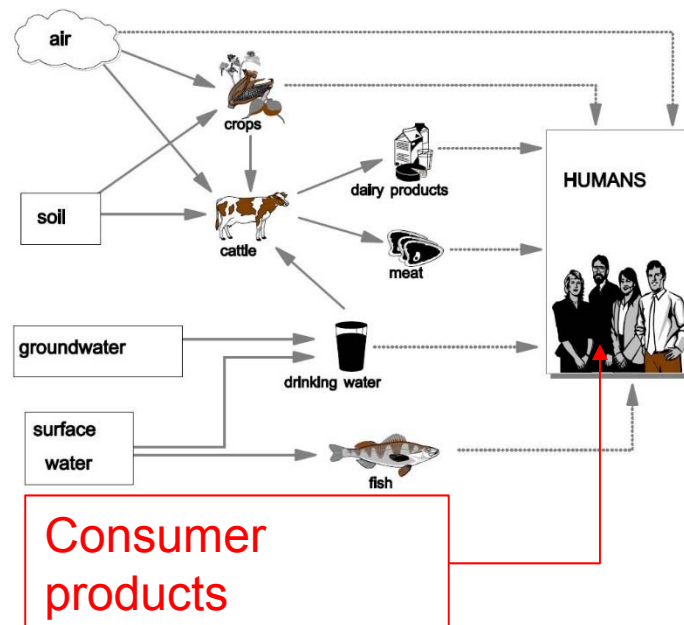


Multimedia environmental modelling, taking into account mass transfer and transformation across different scales and media, following ECHA recommendations



Detailed micro-environmental concentrations taking into account interactions among different media (gas, particles and dust)

Detailed exposure modelling taking into account multiple pathways and routes of exposure



Oral exposure – Non Dietary



Object to mouth



Hand to mouth



Soil and dust ingestion



Personal care
products ingestion

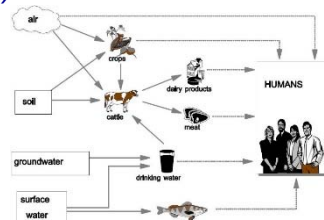
Oral exposure – Dietary

Dietary ingestion takes into account

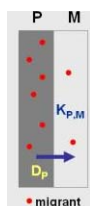
- The chemical concentration of food category i in $\mu\text{g/g}$
- The daily average consumption in g/d of food category i , age category j and gender category k

Food residues are estimated

- Through the food web (multimedia model)



- Accounting also for migration through food contact materials



Skin exposure



Instant
application



Migration from
skin contact



Rubbing off



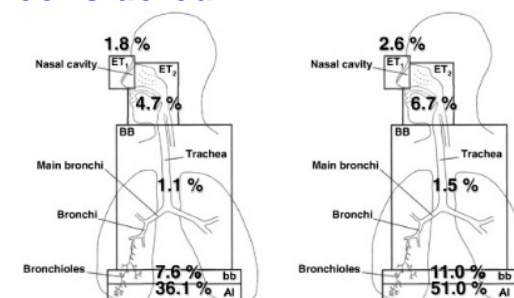
Constant rate

Inhalation exposure

Inhalation takes into account

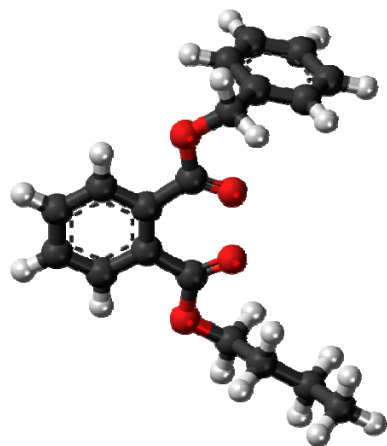
- The concentration from the several locations encountered during the exposure regimes
- The intensity of activity, gender and age dependent inhalation rate

For particles and the compounds adsorbed, deposition across the HRT is considered

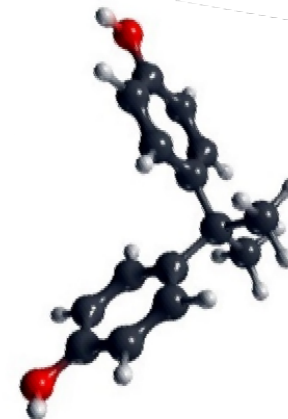




Exposure to plastic waste in the European Union



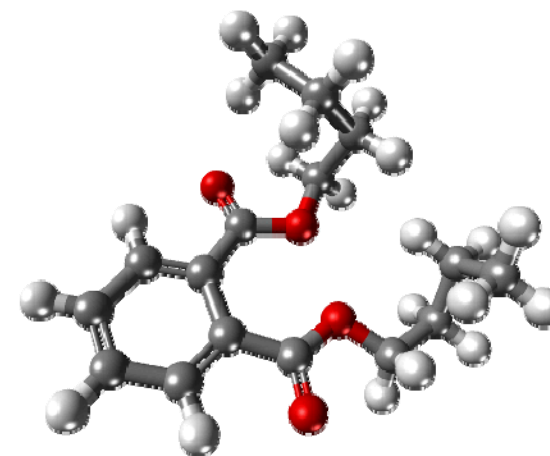
DEHP
Bis(2-ethylhexyl) phthalate



BPA
Bisphenol - A



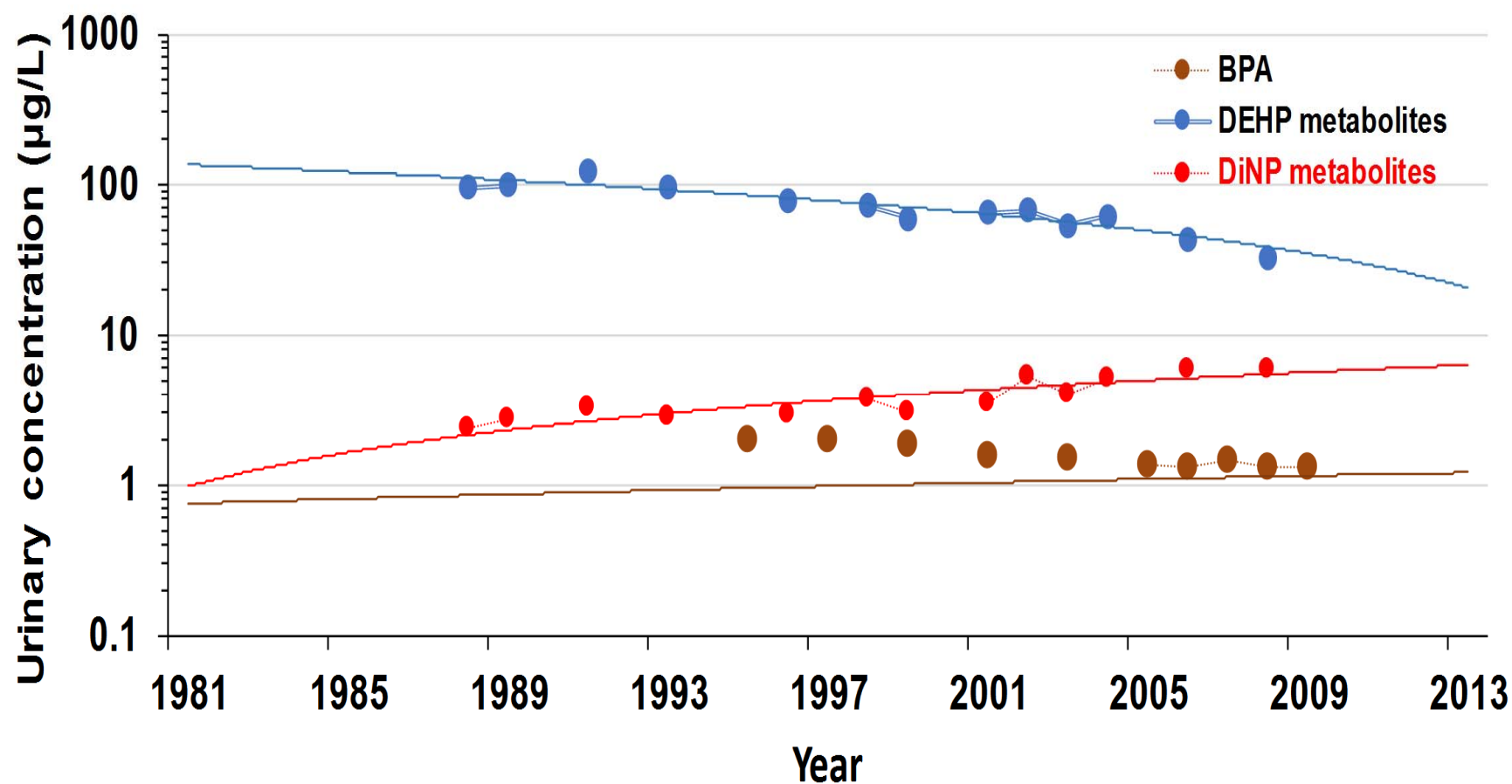
DINCH
1,2-Cyclohexane dicarboxylic acid diisononyl ester



DEHA
Bis(2-ethylhexyl) adipate

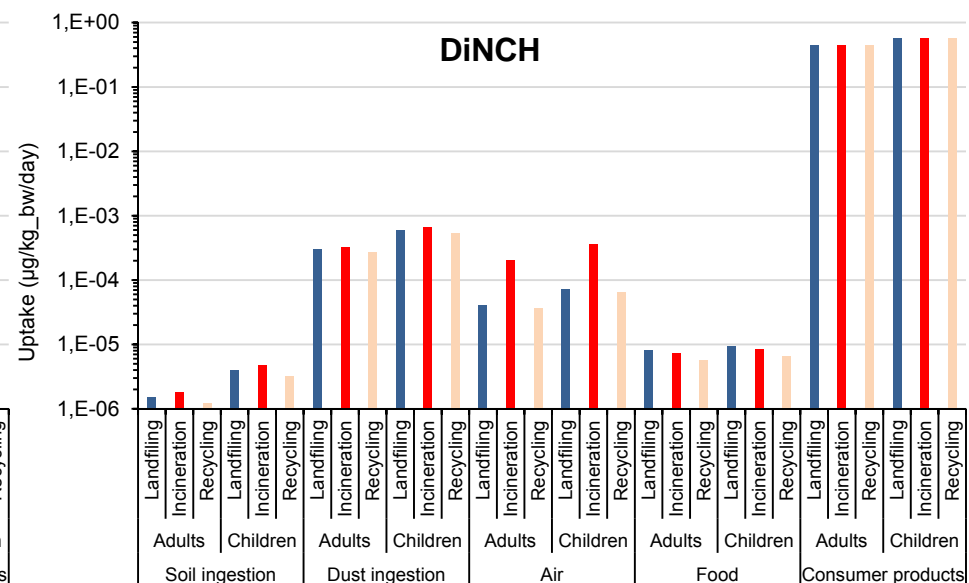
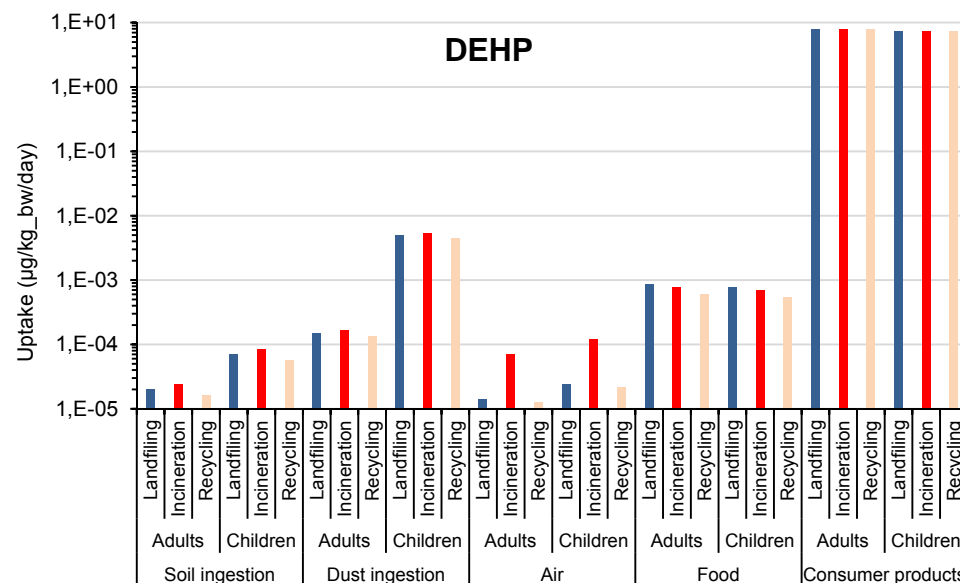
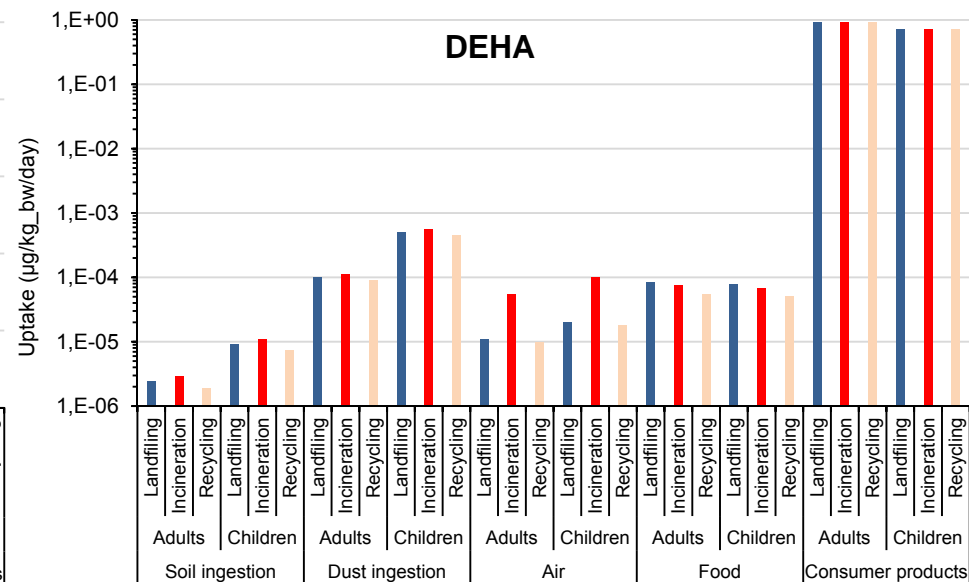
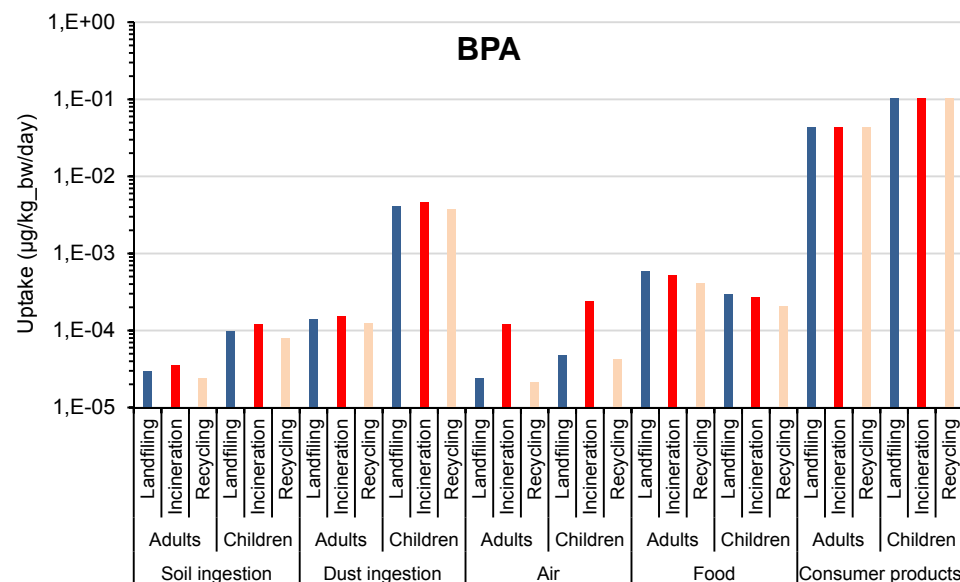
Temporal trends of characteristic plasticisers

Human Biomonitoring: Urinary concentrations in the EU



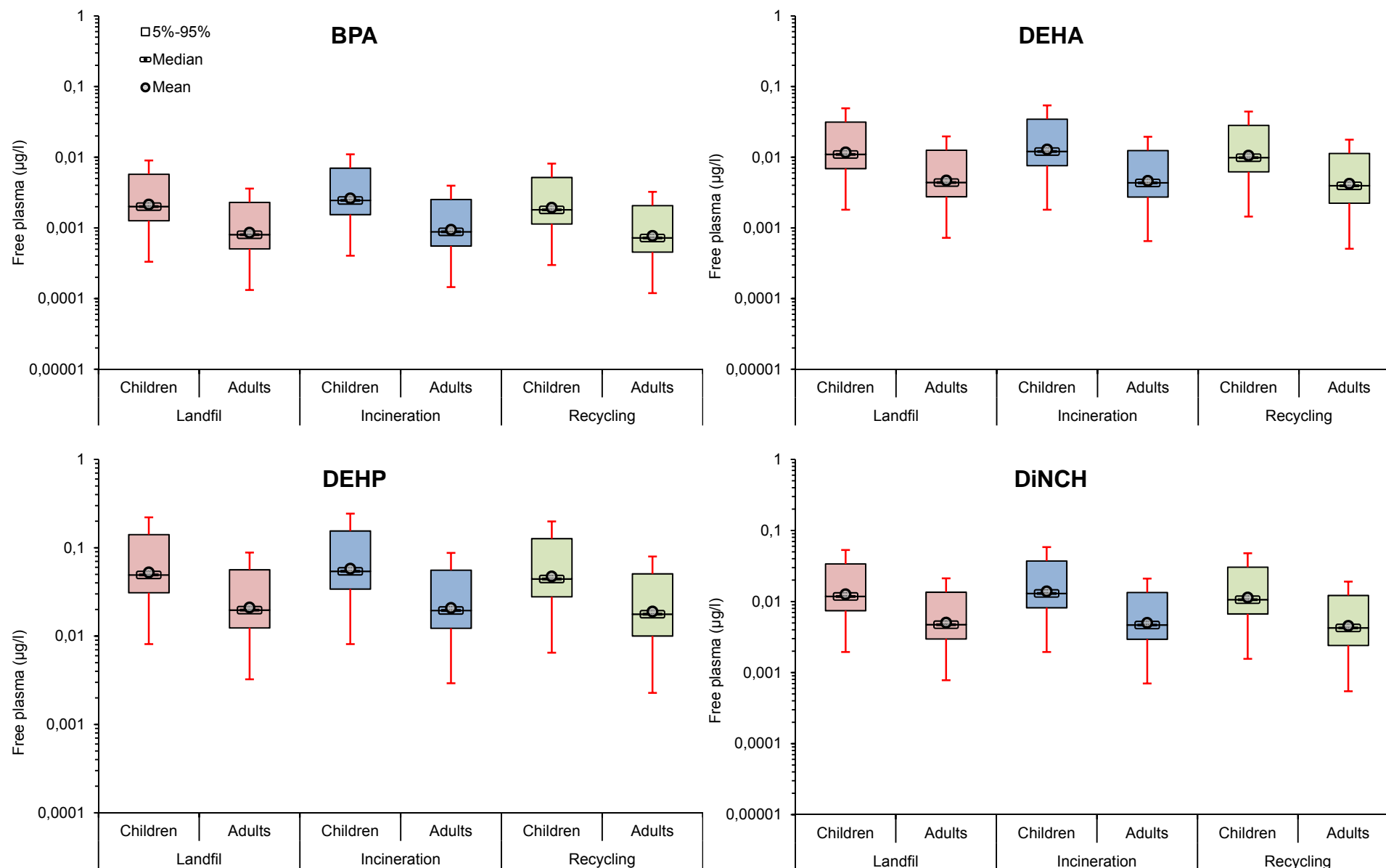


Plasticizer exposure under various waste management options





Internal exposure under various waste management options

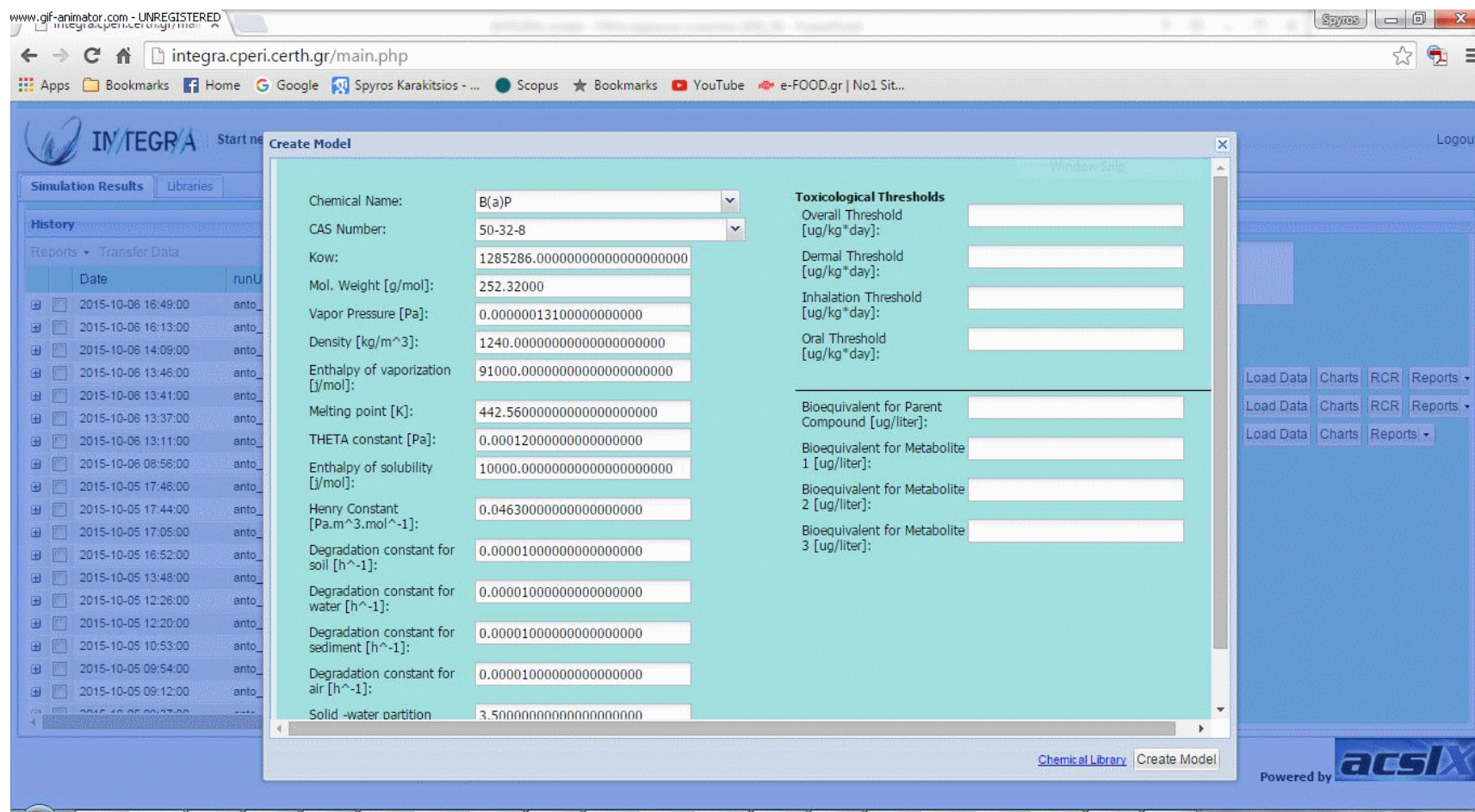


Health Risk assessment

Compound	Hazard Quotient
BPA	0.05
DEHP	1.00
DEHA	0.03
DINCH	0.70

- Risk of plasticizers: relatively low – except for DEHP; need to account for cumulative effects
- Most persistent component: particles/fragments abraded during service life of products and disposal of waste
- With regard to waste management options:
 - Incineration contributes significantly to exposure through inhalation for population living close by
 - Recycling results in lower exposure considering all environmental pathways
- INTEGRA-LCA: a comprehensive tool for life cycle-based exposure assessment to chemicals in products / waste

Thank you for your kind attention

The screenshot displays the INTEGRA web application interface. The main window is titled 'Create Model' and contains several input fields for chemical and toxicological data. The left sidebar shows a 'History' table with columns for Date, runU, and anto. The right sidebar has buttons for 'Load Data', 'Charts', 'RCR', and 'Reports'. The bottom right corner indicates 'Powered by acslX'.

Parameter	Value
Chemical Name:	B(a)P
CAS Number:	50-32-8
Kow:	1285286.00000000000000000000000000
Mol. Weight [g/mol]:	252.32000
Vapor Pressure [Pa]:	0.000000131000000000000000000000
Density [kg/m ³]:	1240.000000000000000000000000000000
Enthalpy of vaporization [J/mol]:	91000.0000000000000000000000000000
Melting point [K]:	442.560000000000000000000000000000
THETA constant [Pa]:	0.00012000000000000000000000000000
Enthalpy of solubility [J/mol]:	10000.0000000000000000000000000000
Henry Constant [Pa.m ³ .mol ⁻¹]:	0.04630000000000000000000000000000
Degradation constant for soil [h ⁻¹]:	0.00001000000000000000000000000000
Degradation constant for water [h ⁻¹]:	0.00001000000000000000000000000000
Degradation constant for sediment [h ⁻¹]:	0.00001000000000000000000000000000
Degradation constant for air [h ⁻¹]:	0.00001000000000000000000000000000
Solid-water partition	3.50000000000000000000000000000000

Toxicological Thresholds

Threshold	Value
Overall Threshold [ug/kg*day]:	
Dermal Threshold [ug/kg*day]:	
Inhalation Threshold [ug/kg*day]:	
Oral Threshold [ug/kg*day]:	

Bioequivalent for Parent Compound [ug/liter]:

Compound	Value
Bioequivalent for Parent Compound [ug/liter]:	
Bioequivalent for Metabolite 1 [ug/liter]:	
Bioequivalent for Metabolite 2 [ug/liter]:	
Bioequivalent for Metabolite 3 [ug/liter]:	