What is the extent of release of pollutants from articles?

ChEmiTecs
(Organic Chemicals Emitted from Technosphere articles)

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www.chemitecs.se

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Outline

- **Overview and general information of ChEmiTecs**
  - aims and questions raised
- **Case studies: products and chemicals**
- **Emissions from other sources**
  - substance flow analyses
  - environmental pathways
  - concentrations in the environment
  - indoor-outdoor
- **Emissions from usage of articles**
  - experimental and models

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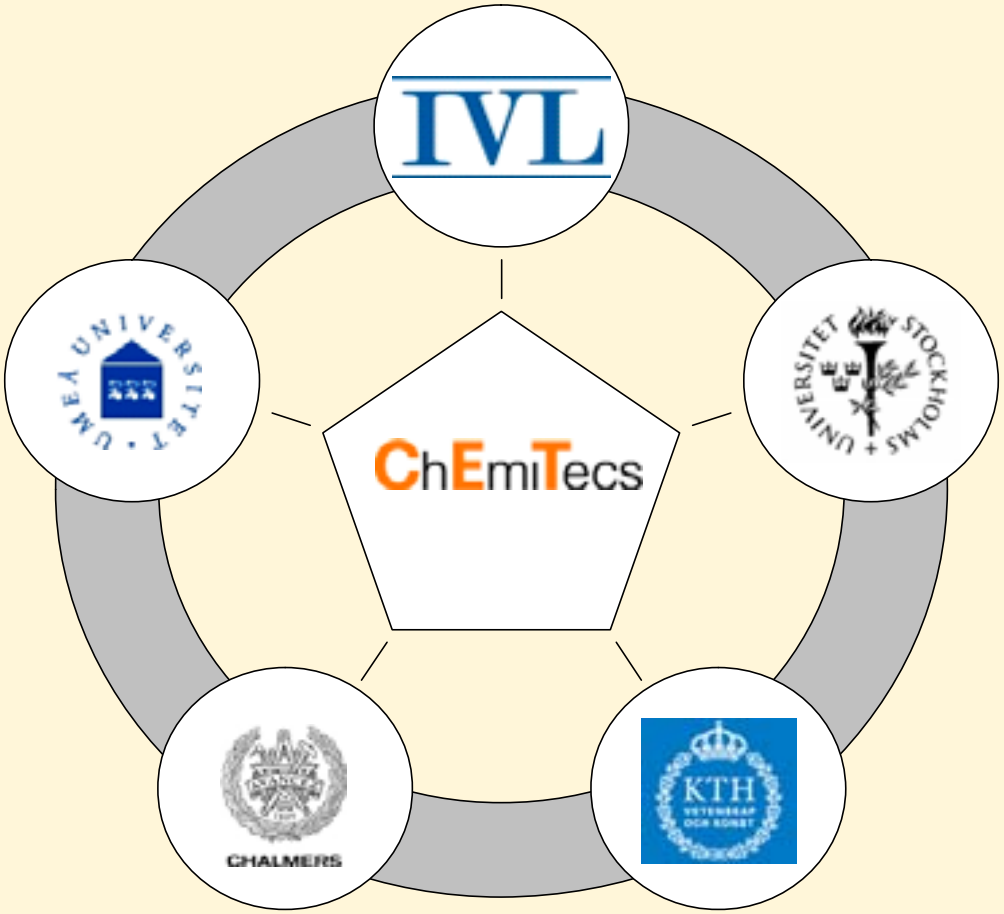
Research programme financed by the Swedish EPA 2008-2012



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Organic Chemicals Emitted from Technosphere articles: ChEmiTecs

Overall aim

To increase the scientific understanding of the magnitude of the problem regarding emissions from articles

Questions raised

How big is the problem?
How dangerous is it?
What can we do about it?

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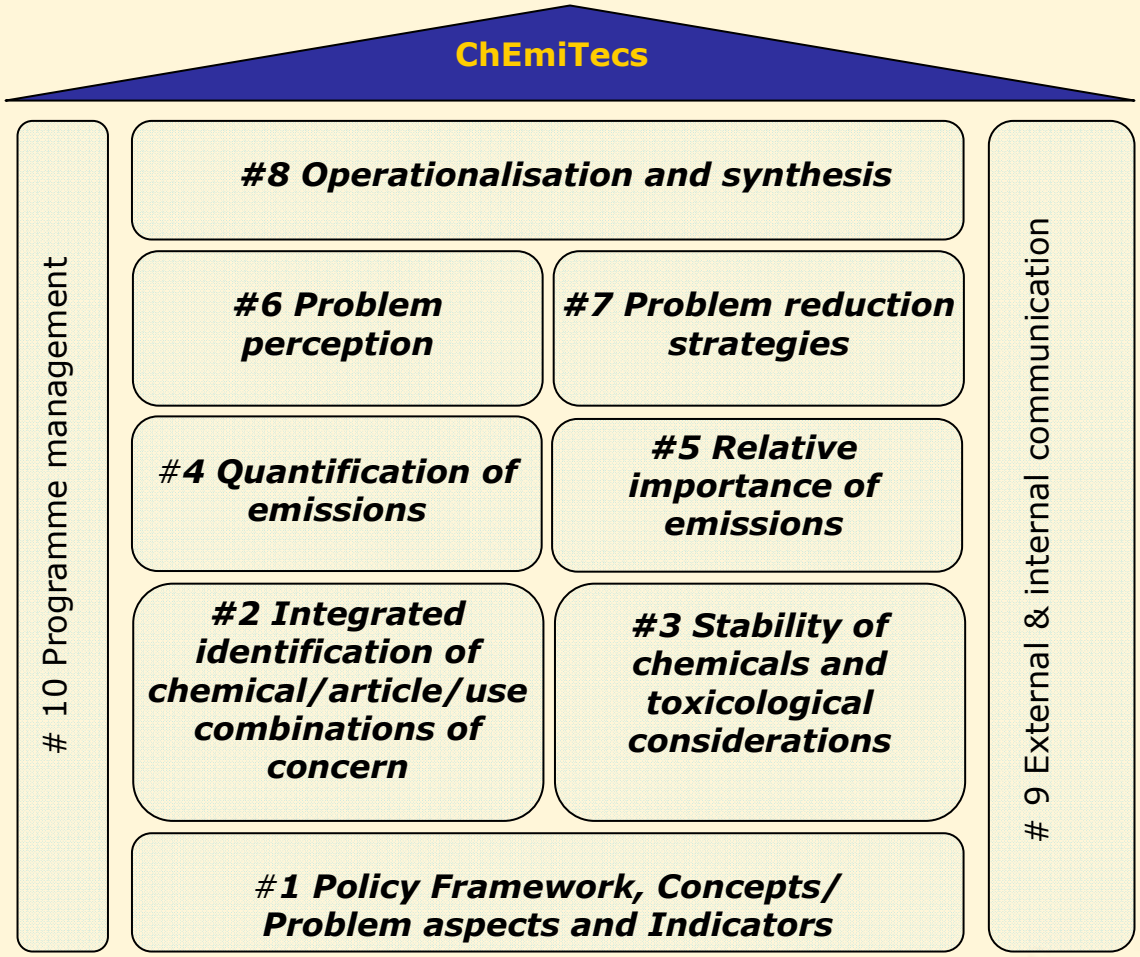
An integrated approach



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Integrating domains

Chemicals

- Chemical Policy - REACH
- Environmental Chemistry & Toxicology
- Analysis in Nature

Goods

- Product policy - SCP
- Environmental Systems Analysis & Engineering
- Technical System Modeling

- ”Risk assessment”

- ”Life cycle assessment”

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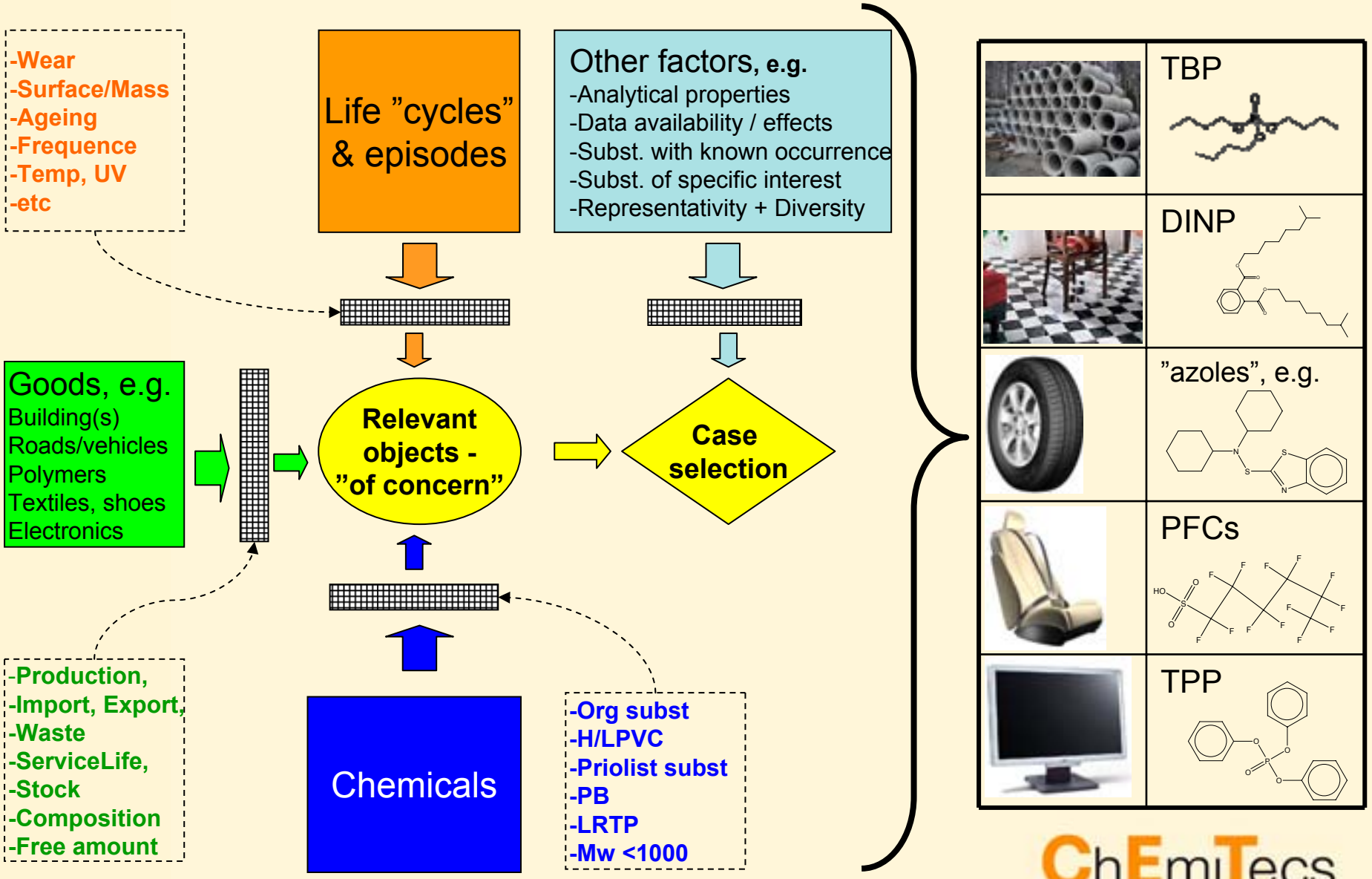
Case studies selection



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How big is the problem with emissions from articles relation to other sources and pathways ?

Screening studies

- Concentrations in the environment, fill data gaps
- Estimation of pathways and sources
- Selection of case studies

Substance flow analysis (SFA)

- Dimensioning of sources, sinks and flows – what is big and what is small
- Allows for source tracking
- Important information when suggesting management strategies

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Screening of benzothiazoles and benzenediamines

Detection frequency (%) of the individual benzothiazoles and benzenediamines

Matrix	Air	Atm. Dep.	Surface water	Sed.	Crops	Soil	Biota	Storm water	Effluent, landfill	Effluent, WWTP	Sludge, WWTP
No of samples:	*8*	*4*	*11*	*6*	*4*	*6*	*19*	*4*	*2*	*5*	*5*
	%	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*
Benzothiazoles											
MBT, Benzothiazole-2-thiol	0	0	36	0	0	0	74	50	100	80	100
CBS, N-cyclohexyl-benz 2-sulphenamic										0	0
DBS, N,N-dicyclohexyl-benzo-th sulphenamid,										0	0
DBD, Di(benzothiazo disulphide,										0	0
Benzenediamines											
DPP, N-1,3-dimethylbutyl-N'-phenyl-p-phenylenediamine,	0	25	27	0	-	0	-	25	0	0	20

Case Study: Benzothiazole-2-thiole (2-Mercaptobenzothiazole), MTB

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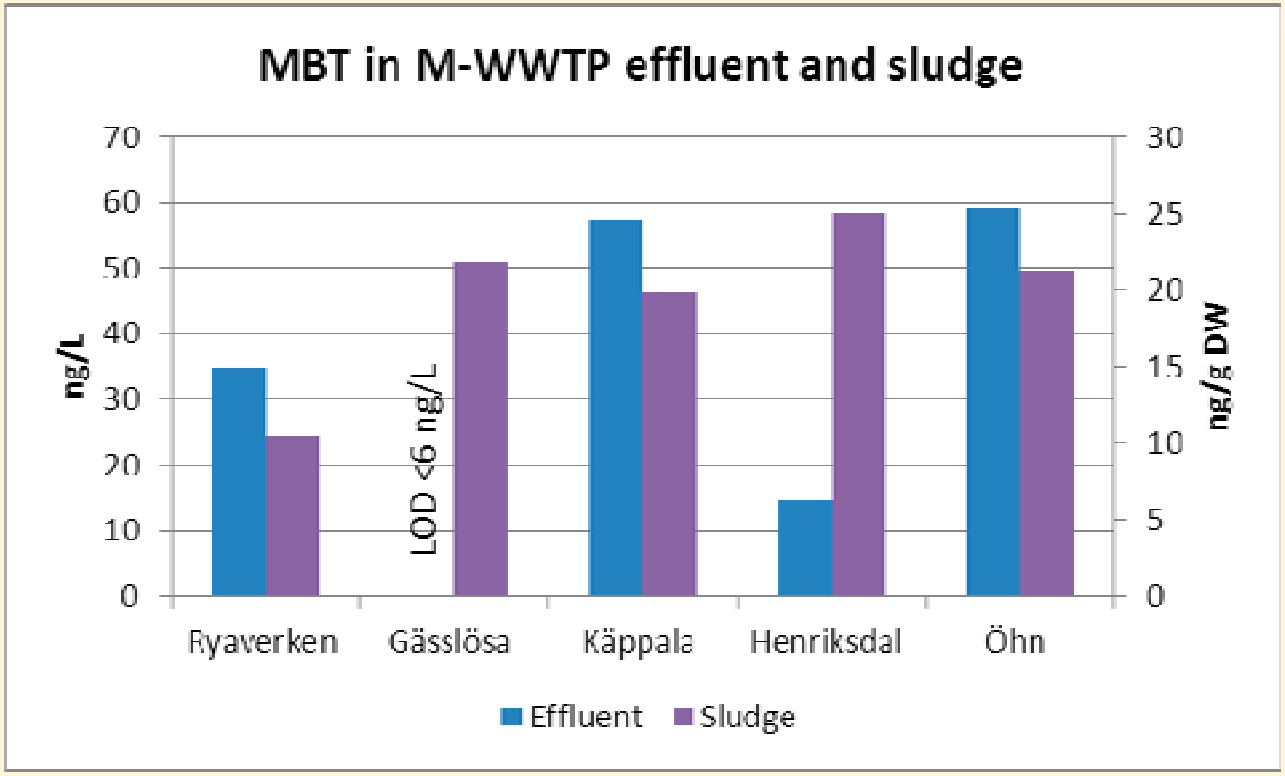
Screening of Benzothiazole-2-thiole, MTB



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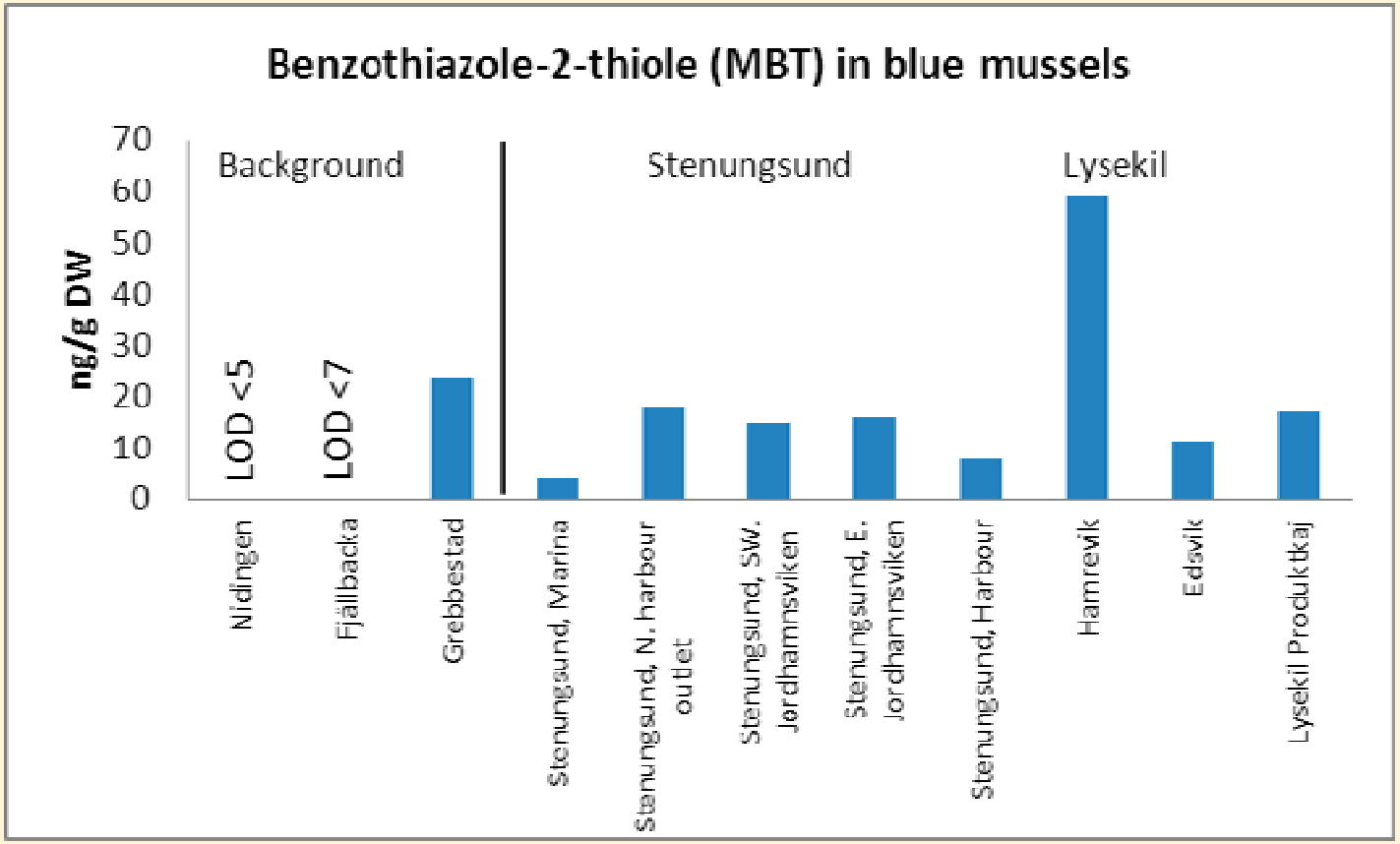
Screening of Benzothiazole-2-thiole, MTB



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Summary of the Benzothiazole-2-thiole (MBT) screening

•An important pathway to the environment is via M-WWTPs; An indication that the occurrence is due to diffuse emission from e.g. consumer products.

•The occurrence in storm water indicated traffic related emissions.

•MBT and the other benzothiazoles did mainly occur in the aquatic environment.

•Air transport seems to be of minor importance

•MTB was found in aquatic biota

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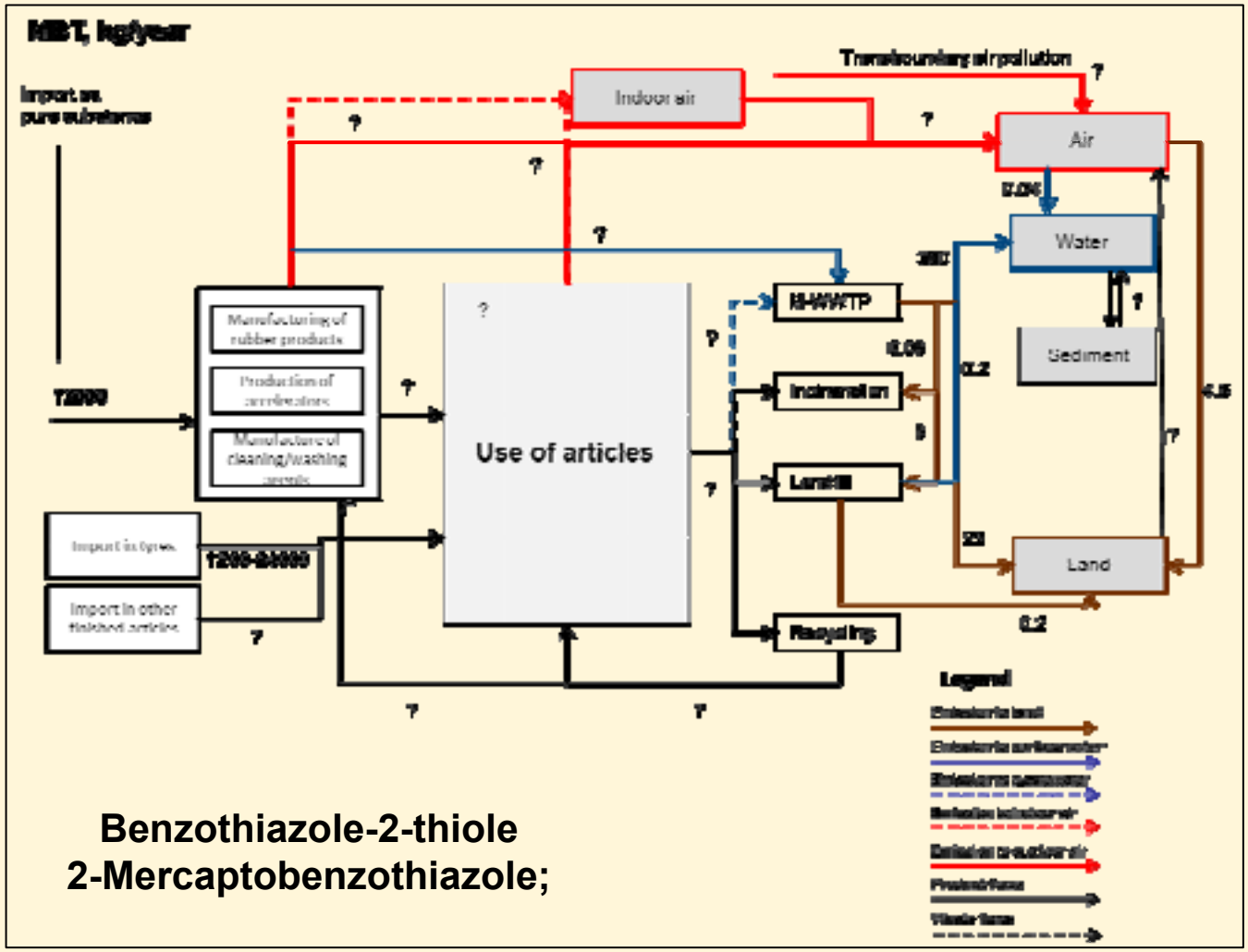
SFA for MBT in Sweden



Benzothiazole-2-thiole
2-Mercaptobenzothiazole;

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Summary
Benzonzothiazole-2-thiole (MBT) SFA for Sweden

•MBT is widely used in industry and in household articles, e.g. as rubber vulcanization accelerator, fungicide and as a chemical intermediate.

Approximately 4 tonnes MBT is annually imported to Sweden as pure substance. The imported amounts of MBT in products are unknown.

•An important emission source of MBT to the environment is diffuse releases from the M-WWTPs.

Approximately 400 kg MBT may enter the environment via effluent water from M-WWTP. 40 kg will end up in the sludge from M-WWTP.

•There was several data gaps identified in this SFA
Emissions from production
Emissions of from use of articles

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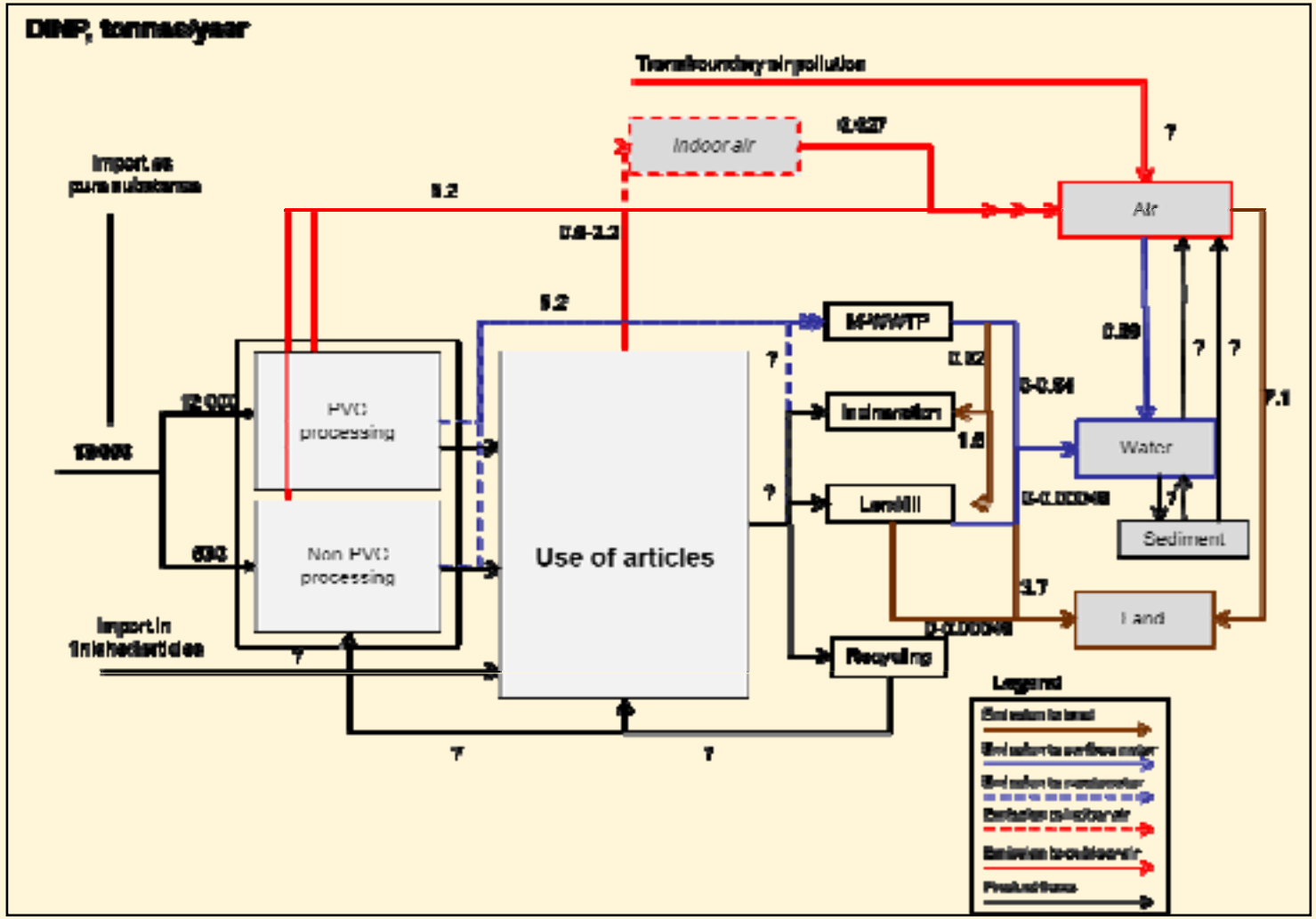
SFA for diisononylphthalate (DINP) in Sweden



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Summary of the SFA for diisononylphthalate in Sweden (tonnes DINP/year)

DINP has a wide range of indoor and outdoor applications.

DINP will be released to the water and air during the processing of PVC and non-PVC products. The yearly release of DINP from the manufacture steps in Sweden has been estimated to 16 tonnes

DINP is released via M-WWTP (0-0.5 tonnes/year) Sludge from M-WWTP will contribute to environmental concentrations of DINP when the sludge is used as filling material, or disposed to agriculture land (4 tonnes/year).

DINP is emitted to the surrounding environment during the use phase of DINP containing products,

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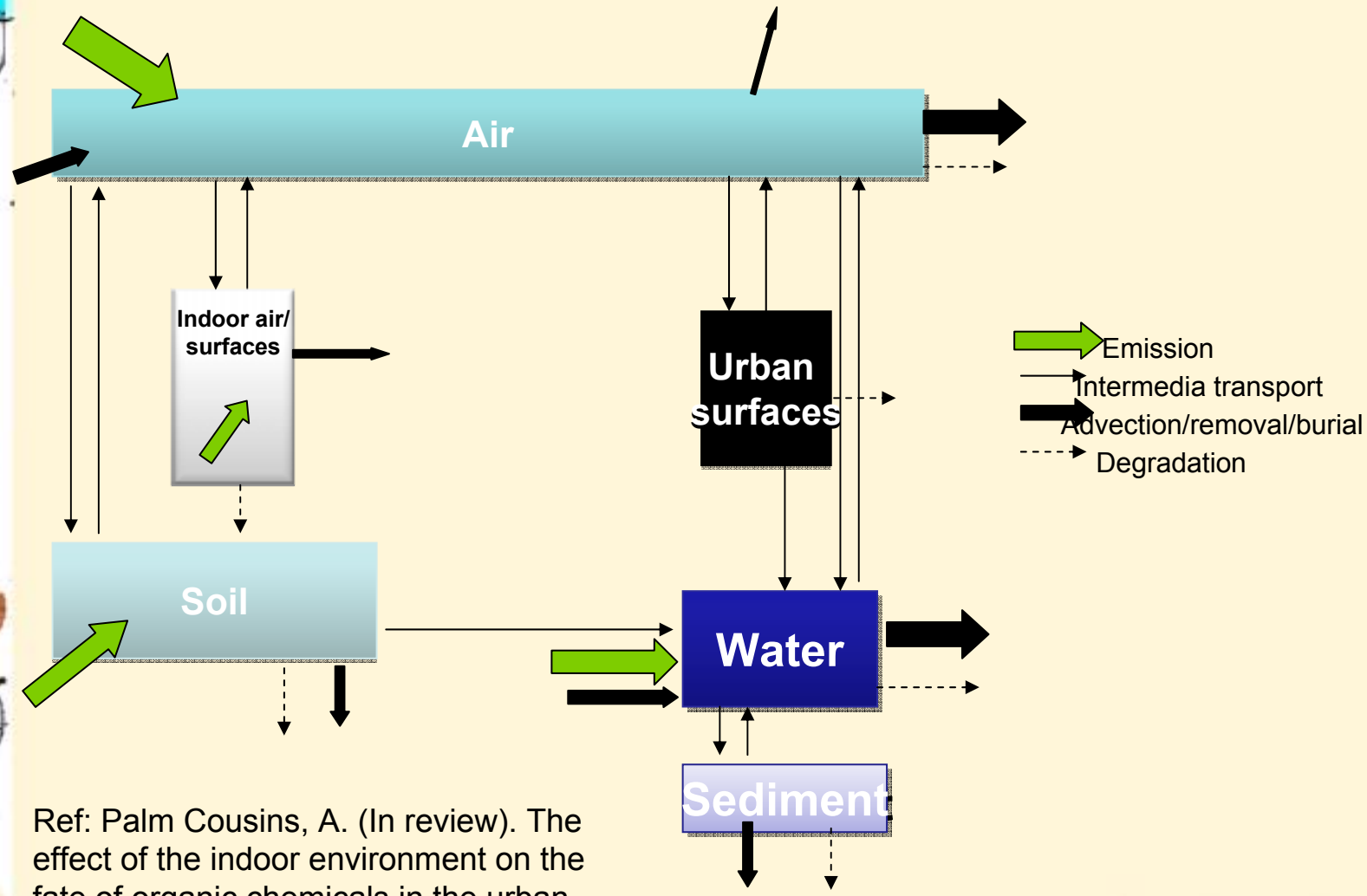
Stockholm **M**ultimedia **UR**ban **F**ate model (SMURF)



Ref: Palm Cousins, A. (In review). The effect of the indoor environment on the fate of organic chemicals in the urban landscape. Science of the Total Environment, 2012

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Organic substances in the indoor environment

The first results of modeling of a flame retardant and plasticizers (DEHP DINP) in SMURF shows that:

The indoor environment can act as both source and sinks for

Source - Transport from indoor air to outdoor air. The dominant via the ventilation air

Sink – Chemicals end up in dust and not further disseminated to the outdoor environment

Palm Cousins A., Holmgren T., Remberger M., Brorström-Lundén E. *Emissions of organic chemicals to indoor air and their impact on urban air quality – evaluation of an urban environmental fate model* In prep.

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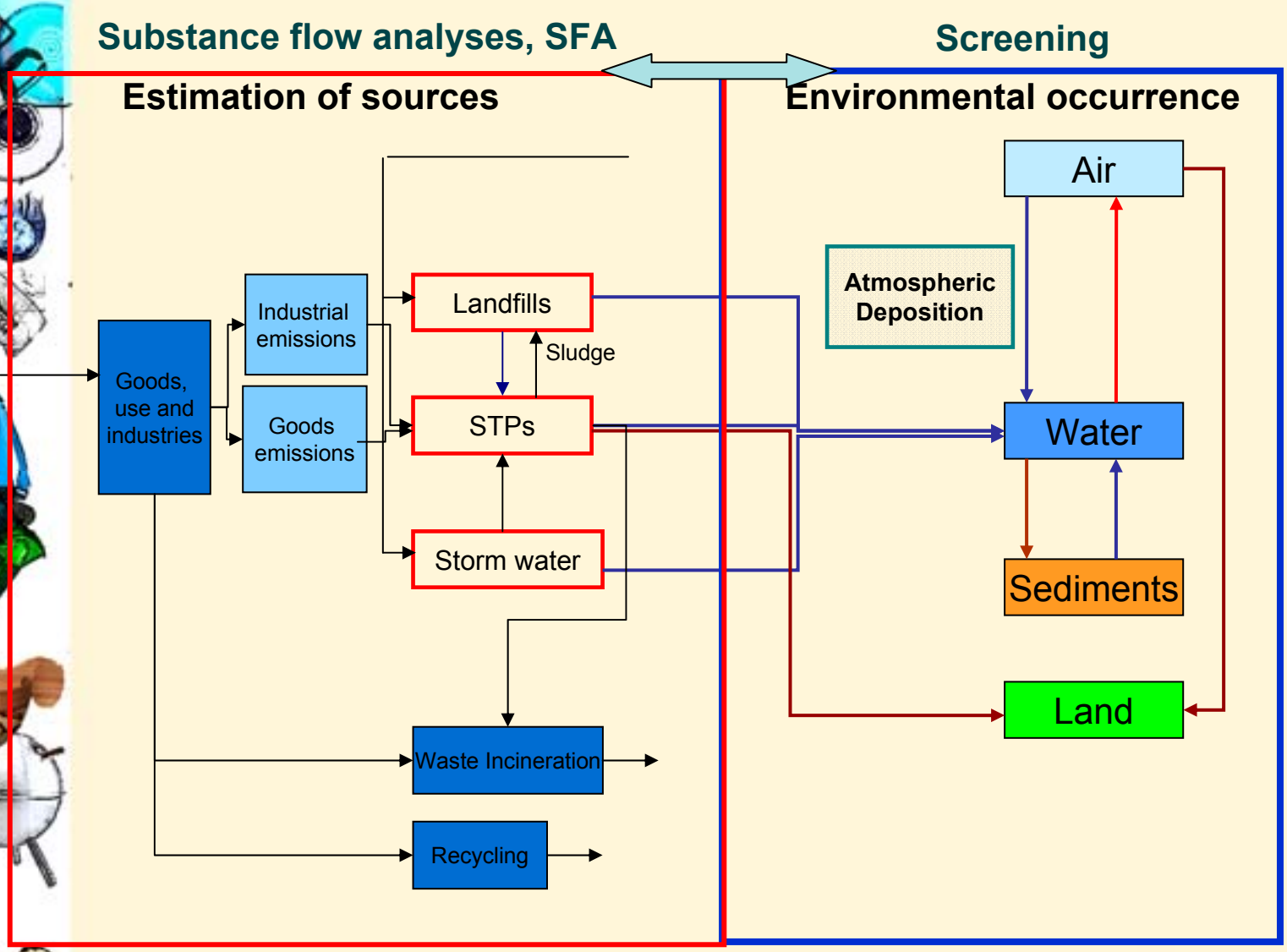
Estimation of sources, pathways and concentrations



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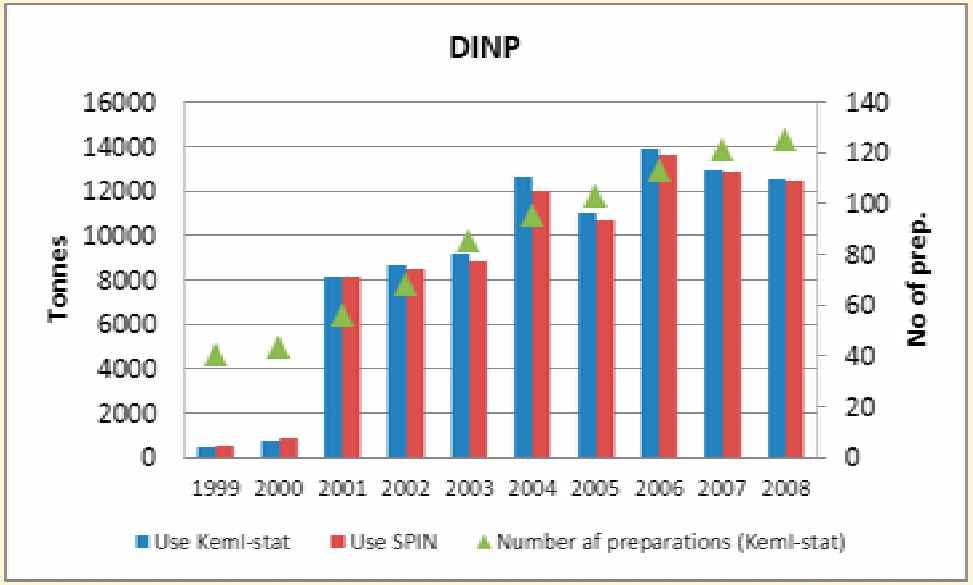
The use of DINP in Sweden (Keml-stat, 2011; SPIN, 2011).



The data from SPIN and Keml-stat differs slightly.
SPIN present manufacture – export, while in Keml-stat, the exported amounts are included.

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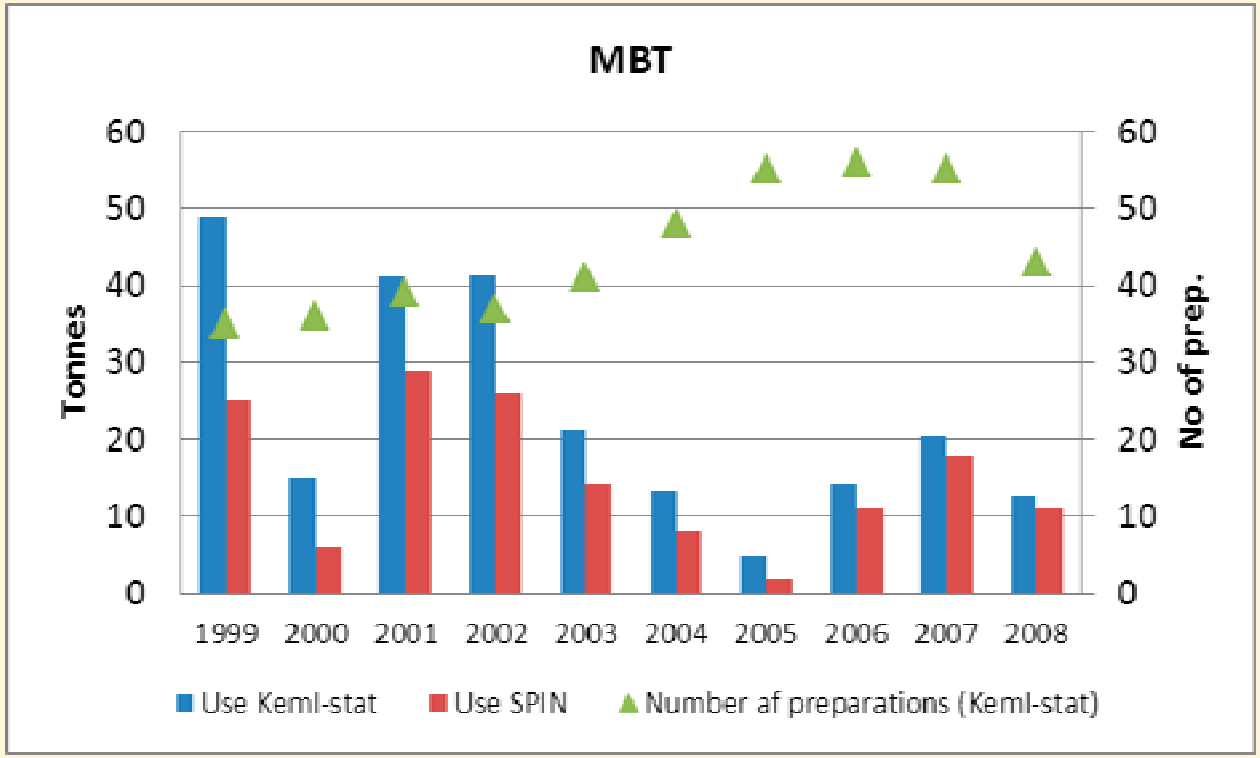
The use of MBT in Sweden between 1999 and 2009 (SPIN, 2011; Keml-stat, 2011)



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