



CHEMICAL POLLUTIONS OF THE INDOOR AIR

Barbara Kolařík

Danish Building Research Institute
Aalborg University



Content of the presentation

- Importance of indoor air quality
- Sources of indoor pollutants
- Changes in indoor pollutants in the last 50 years

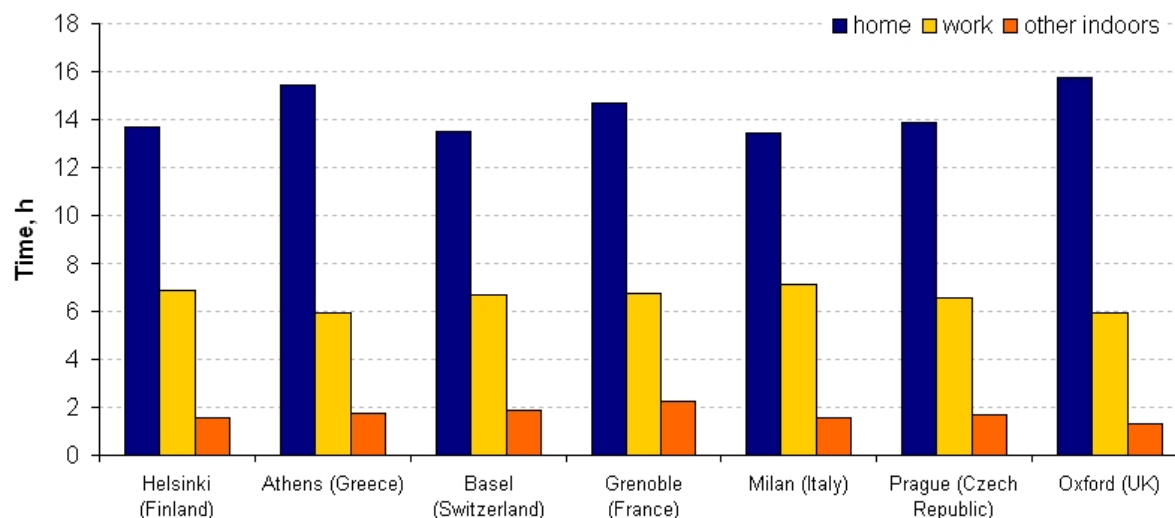


- Focus on particular pollutants
 - Formaldehyde
 - Phthalates
 - Polychlorinated biphenyls



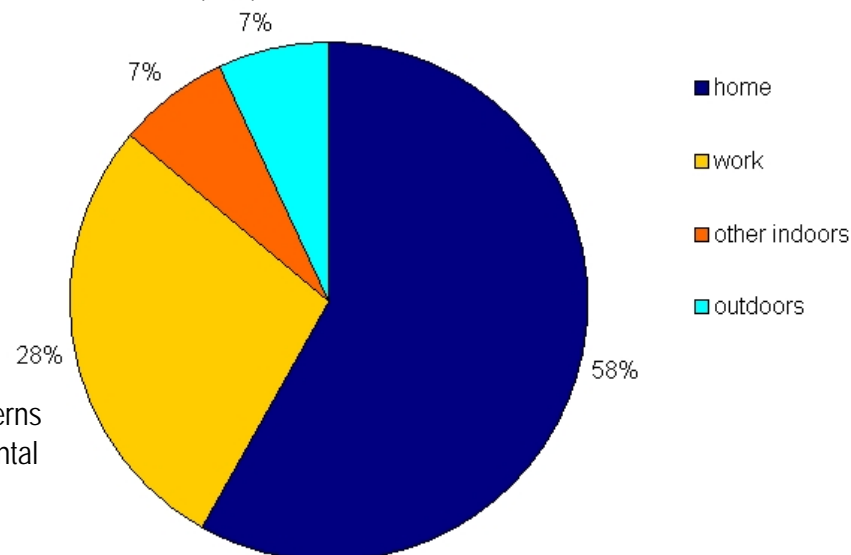


Importance of indoor air – time spent indoors



- 1427 subjects
- age 19-60
- 2 working days

Schweizer et al. "Indoor time – microenvironment – activity patterns in seven regions of Europe". Journal of Science and Environmental Epidemiology. 2007.17:170-181



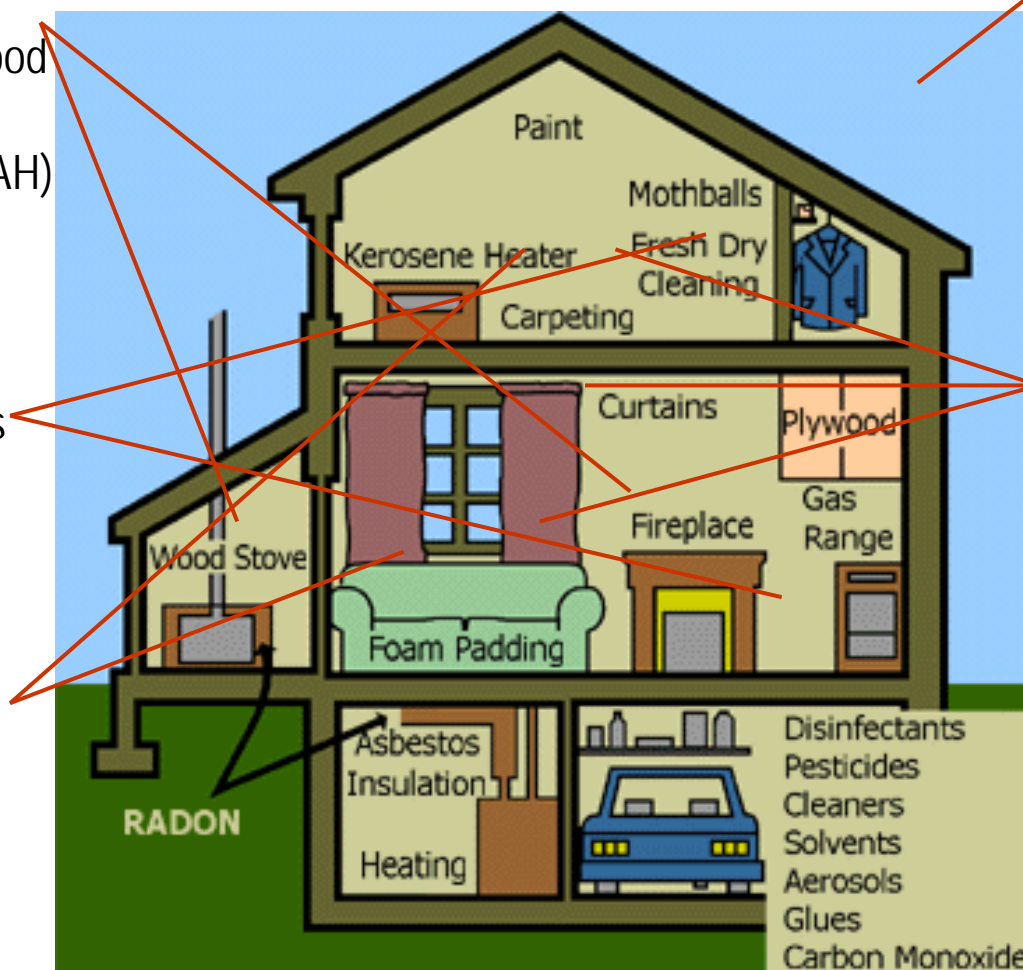


Sources of indoor air pollutants

Products of combustion from fireplaces and wood burning stoves (particles, CO, PAH)

Chemicals from cleaning products (VOCs)

Tobacco smoke (particles, CO, VOCs, SVOCs)



Outdoor air pollutants (particles, CO, NOx, VOC (e.g. BTEX), ozone)

Chemicals released from buildings and finishing materials (VOCs (e.g. benzene, formaldehyde), SVOCs (e.g. phthalates, flame retardants, PCB)



Negative effect of poor indoor air quality

autism

?

asthma/allergy

?

obesity

?

reproduction

?

diabetes

?

cardiovascular
diseases

?

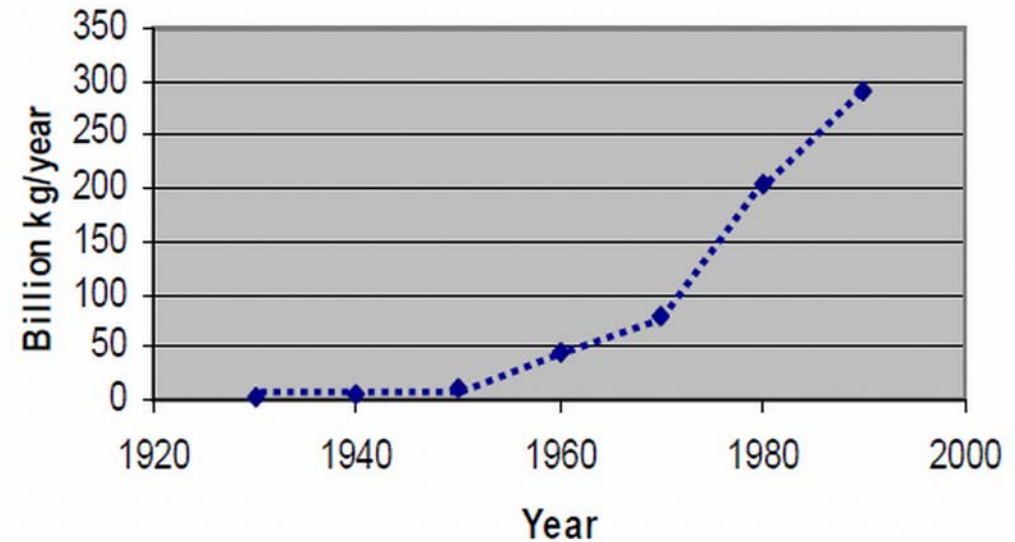


Changes in indoor pollutants in the last 50 years – more pollutants



Source: Gudrun Bremle, Länsstyrelsen i Jönköpings län

Synthetic organic chemical production



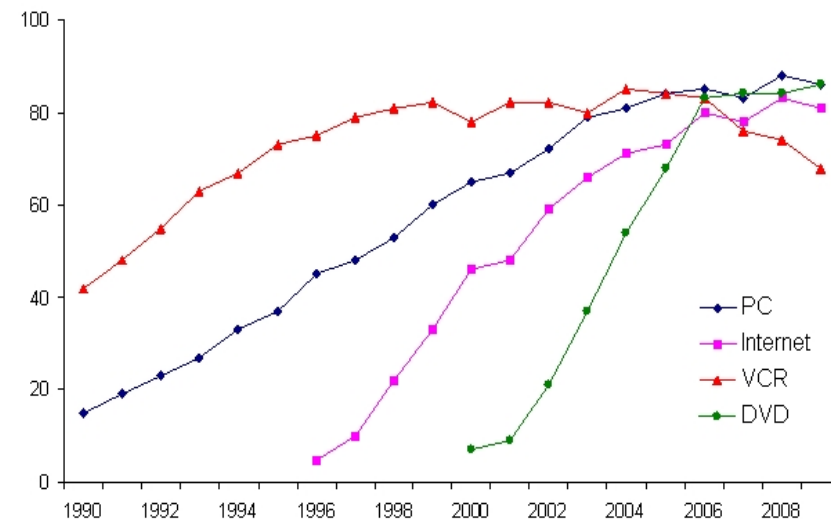
Source: Dr. Richard Corsi, based on U.S. Intern. Trade Commission

Changes in indoor pollutants in the last 50 years – more pollutants



Following World War II

- Plywood and other wooden products began to replace solid wood in home constructions (formaldehyde)
- Veneer on composite-wood has replaced solid-wood in many furnishings (formaldehyde)
- Flexible PVC insulation began to replace rubber and textile insulation on wiring and cable; PVC surface covering began to replace linoleum (phthalates)
- Most synthetic foams used in furnishings have been treated with flame-retardants
- Increased use of air fresheners (CFCs gases were later eliminated; emission of unsaturated organic compounds which can react with ozone)
- Increased use of electronic equipment in offices and homes (ozone, particles, flame retardants, phthalates)



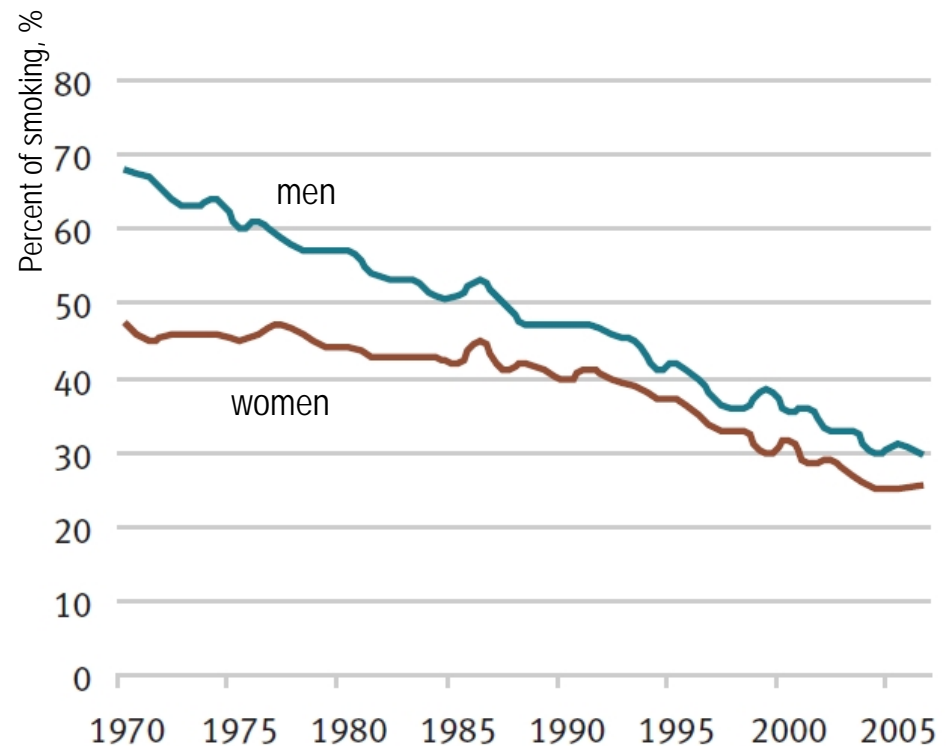
Weschler "Changes in indoor pollutants since the 1950s" Atmospheric Environment 2009, 43:156-172

Source:www.dst.dk

Changes in indoor pollutants in the last 50 years – good news



- Lead and mercury have been removed from interior paints
- Benzene disappeared from indoor cleaning products
- Concentrations of CO, NO_x and SO₂ decreased due to decrease in outdoor concentrations (low sulphur fossil fuels, catalytic converters, less smoking)
- Radon concentrations has been downward due to development of different standards and regulations
- Percent of people smoking indoors has decreased



Source: Folkesundhedsreporten, Danmark 2007

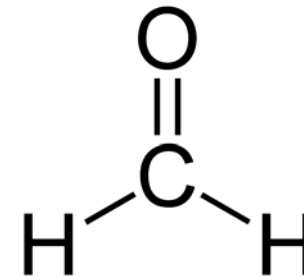
Focus on particular pollutants



- Formaldehyde
- Phthalates
- Polychlorinated biphenyls



Formaldehyde



- Causes irritation in eyes and nose
- 2006 – IARC - carcinogenic to humans
- Requirements
 - WHO – maximum guideline value for 30-minute average exposure – 0.1 mg/m³
 - DK - emission from wooden products - 0.124 mg/m³





Formaldehyde - concentrations

	Number	Mean mg/m ³	Range mg/m ³
Denmark, (SBI 2007), Kolarik 2010	20	0.050	0.018-0.110
Denmark, Raaschou-Nielsen 2010	378	0.020	NA-0.226
Denmark, Andersen 1975	25	0.620	0.080-2.240



Formaldehyde - sources

	mg/m ³		mg/m ³
Plywood 1	<0.01	Insulation 1	0.01
Plywood 2	<0.01	Insulation 2	<0.01
Plywood 3	<0.01	Paint 1	0.01
Chipboard 1	0.10	Paint 2	<0.01
Chipboard 2	0.04	Cleaner 1	<0.01
MDF 1	0.10	Cleaner 2	<0.01
MDF 2	<0.01	Cleaner 3	<0.01
OSB 1	<0.01	Carpet 1	<0.01
OSB 2	0.04	Carpet 2	<0.01
Bookcase	0.03	Roller blind	0.05
Drawer	0.05	Curtain	<0.01

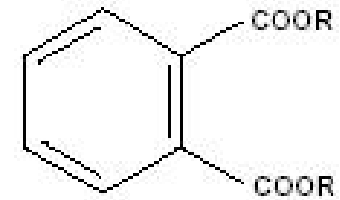
			mg/m ² h	mg/m ³
I	Wall	Paint 1	0.01	0.12
	Floor	MDF 1	0.1	
	Ceiling	Paint 1	0.01	
II	Wall	Max	0.124	0.54
	Floor	Max	0.124	
	Ceiling	max	0.124	



Formaldehyd – new regulation

“Ved omfattende brug af de nævnte typer træplader er funktionskravet opfyldt, når den samlede overflade af synlige og ikke-indkapslede plader maksimalt svarer til 90 % af det enkelte lokales nettogulvareal. Alternativt er funktionskravet opfyldt, hvis den samlede afgasning fra de anvendte træplader ikke overstiger WHO´s anbefaling på højst 0,1 mg/m³”.

Phthalates



- Widely used in many different materials
- Added to make PVC material soft
- Not chemically bound to the materials
- They migrate to the surrounding environment

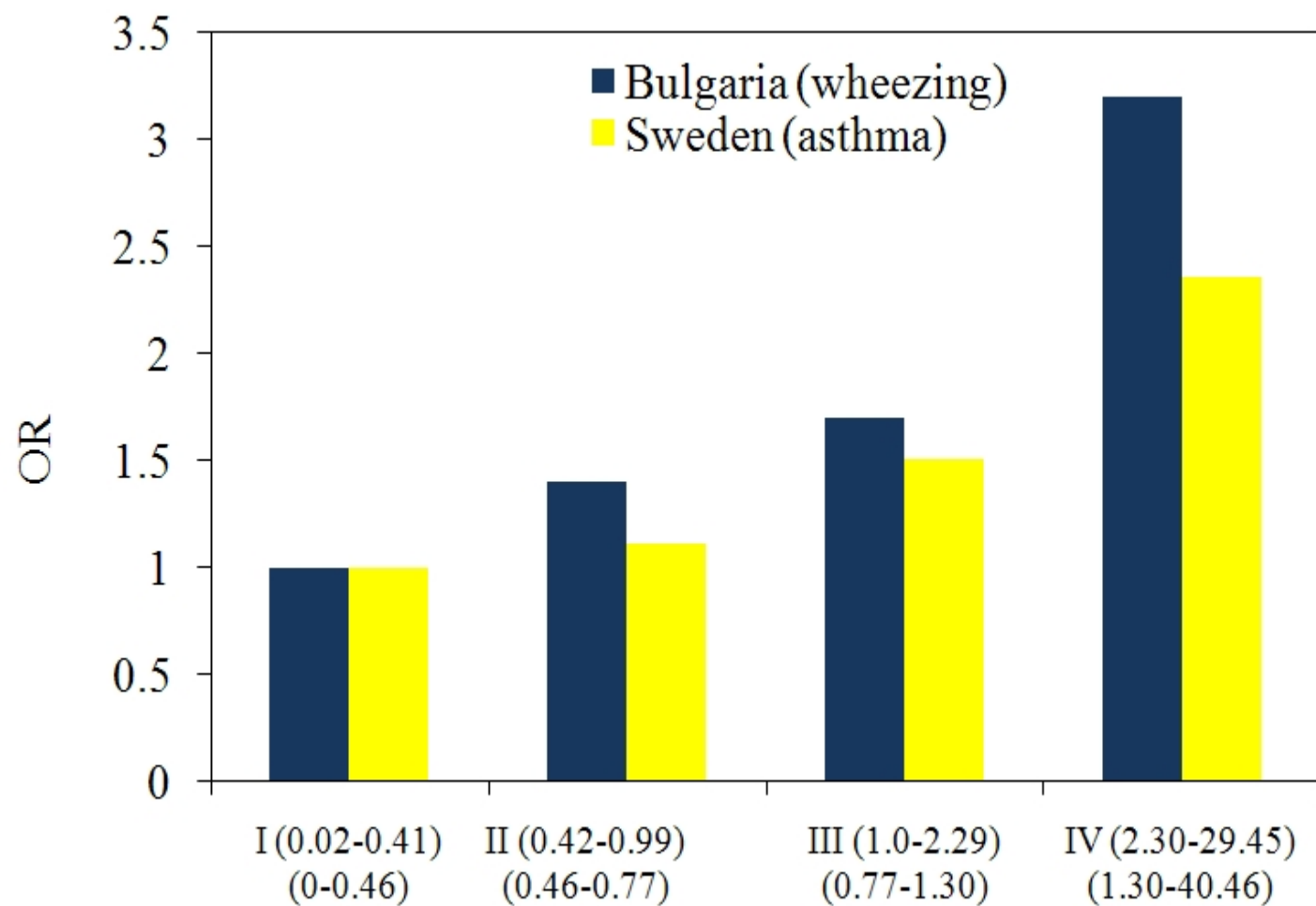




Phthalates - concentrations

Dust	DIBP $\mu\text{g}/\text{m}^3$	DnBP $\mu\text{g}/\text{m}^3$	BBzP $\mu\text{g}/\text{m}^3$	DEHP $\mu\text{g}/\text{m}^3$
DBH, Sweden, 2001/2002	45	150	135	770
ALLHOME, Bulgaria, 2005	9850		330	990

Phthalates – health effects





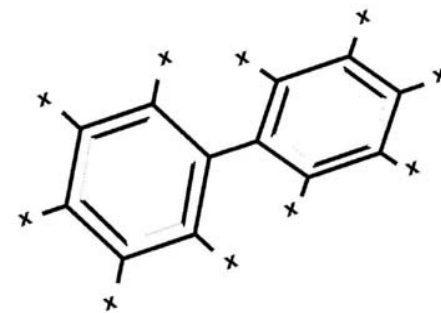
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ALLHOME, Bulgaria, 2005	9850		330	990
IECH, Denmark, 2008	27	15	3.7	210



Polychlorinated biphenyl -PCB

- Commercially produced since 1929
- Properties:
 - Good electrical insulation
 - High thermal stability
 - Fire resistance
- Use:
 - Plasticizer in building sealants
 - Heat transfer fluids
 - Dielectric fluids in transformers and capacitors
 - Electrical insulating
 - Flame retardants
- Health effects:
 - Skin
 - Liver
 - Thyroid gland
 - Reproductive organs
 - Central nervous system
 - Immune system.
 - PCB may cause cancer and reduce fertility.
- 1976 (1986) - prohibited in Denmark



Summary

- Indoor air is very important issue - affects everyone almost all the time
- Chemicals in indoor environments change from month-to-month, year-to-year, decade-to-decade
 - Good direction – smoking, lead, mercury, benzene ...
 - But also new chemicals / new sources
- Most “indoor chemicals” are also in our bodies – some for years
- Some groups are more exposed – exposure starts already in prenatal stage!
- Some of the restricted chemicals are still causing a lot of problems
- The long term effects of many chemicals are still unknown – more research is needed!

