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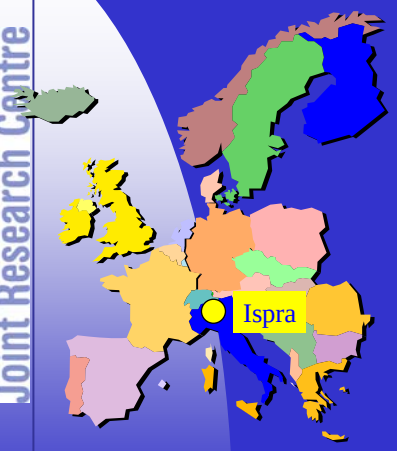

Indoor Air Quality in Europe: Policy-Science Interface

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- The Commission's Environment and Health Strategy and Action Plan
- Sources of indoor Air Pollutants
- Main objectives towards a European Indoor Air Policy
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Background

- No common regulations exist for exposure to indoor air pollutants at European level
- Ambient air monitoring does not include exposure to indoor originated sources
- People spend about 90% of their time indoors

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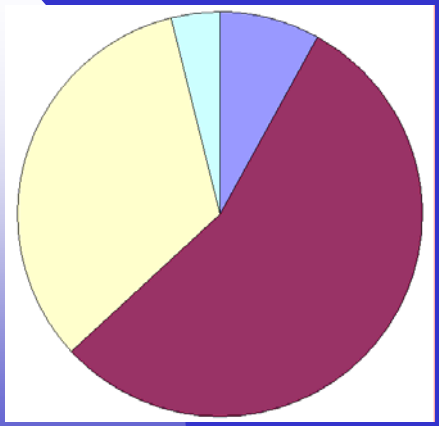
How much time do we in average stay indoors ?



Home Environment	55 %
Work Environment	33 %
Other Indoor Locations	4 %
Outdoors	8 %

Approximately 90% Indoors

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The Environment and Health Strategy/Action Plan

Ca. 90% of European citizens were concerned about the impact of the environment on their health.

- improving the information chain to understand the links between sources of pollution and health effects,
- filling the knowledge gap by strengthening research,
- reviewing policies and improving communication.

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Action 2: Develop integrated monitoring of the environment, including food to allow the determination of relevant human exposure

Action 3: Develop a coherent approach to biomonitoring in Europe

Action 4: Enhance coordination and joint activities on environment and health

Action 12: Improve indoor air quality

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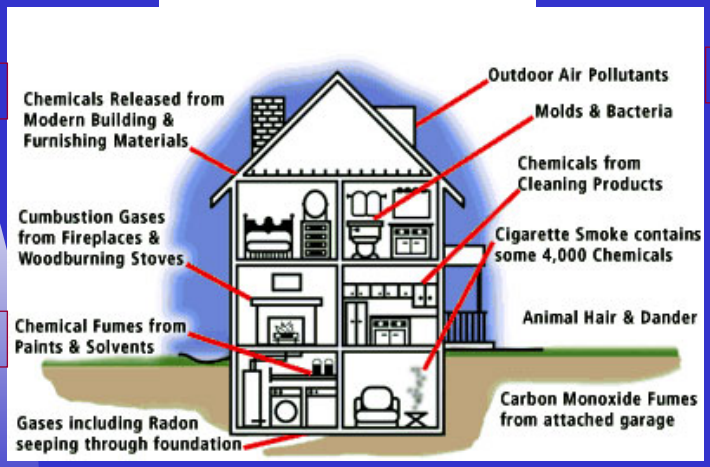
Sources of Indoor Pollutants

VOC, Formaldehyde

PM10, CO, PAH

VOC, Formaldehyde



PM_{10}, CO, NOx, VOC (Benzene)

VOC

PM10, CO, VOC

In offices photocopy machines, printers and other office specific equipment could act as VOC and PM emitters

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Reasons for Increased People's Exposure to Indoor Air Pollution

Construction of more tightly sealed buildings without sufficient air exchange

Reduced ventilation rates to save energy

The use of synthetic building materials and furnishings

The use of chemically formulated personal care products

Building deterioration due to age, improper maintenance or design

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Main objectives towards a European Indoor Air Policy

- to assess health risks of indoor originated chemical pollutants that could be regulated in the EU
- to provide suggestions and recommendations on potential exposure limits or other exposure control actions for the selected compounds

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The INDEX-Project

Project-leader: Dimitris Kotzias, EC-JRC, Ispra, Italy

The steering group and the members of the WGs:

- Carrer Paolo, University of Milan, Milan, ITALY
- Cochet Christian, CSTB, Paris, FRANCE
- Jantunen Matti, KTL-National Public Health Institute, Kuopio, FINLAND
- Kephalopoulos Stylianos, EC Joint Research Centre, Ispra, ITALY
- Koistinen Kimmo, EC Joint Research Centre, Ispra, ITALY
- Kirchner Séverine, CSTB, Paris, FRANCE
- Lindvall Thomas, Karolinska Institute, Stockholm, SWEDEN
- Maroni Marco, University of Milan, Milan, ITALY
- McLaughlin James, University College, Dublin, IRELAND
- Mølhave Lars, University of Århus , Århus , DENMARK
- Oliveira-Fernandez Eduardo de Oliveira, Universidade do Porto, Porto, PORTUGAL
- Schlitt Christian, University of Milan, Milan, ITALY
- Seifert Bernd, Federal Environmental Agency, Berlin, GERMANY

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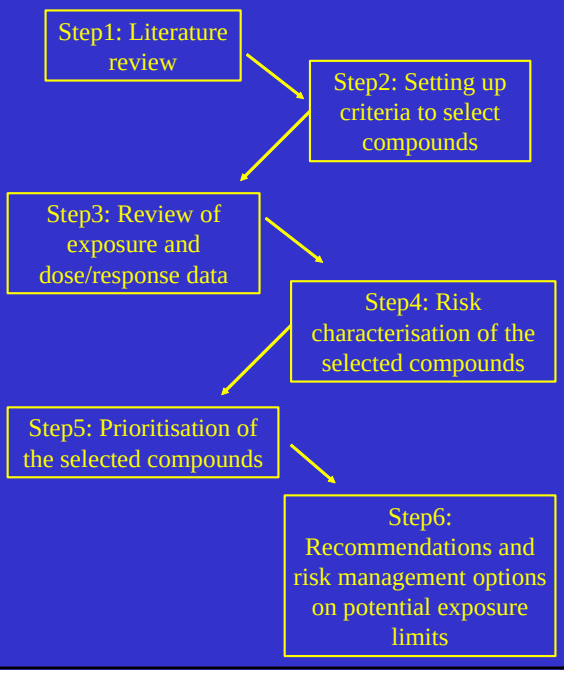
The main steps



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Criteria to select compounds to the process

- Only single compounds were considered
- The compound should have strong indoor sources
- The compound should have known health effects

- Compounds, which have been regulated by specific regulations would be excluded from the process
  - radon and tobacco smoke were excluded

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Criteria to exclude compounds

- no expressed concerns for health at present levels
- compounds already regulated by use restrictions for indoor materials
- incomplete or no dose-response data available at present levels
- the main route/media for the exposure to the compound is other than indoor air

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Process to select compounds

Round 1

2-Ethyl-1-hexanol
3-carene
Acetaldehyde
Acetone
alpha-pinene
benzaldehyde
Benzene
Cd
CO
Decane
Dichloromethane
Diisocyanate
d-Limonene
Ethylbenzene
Formaldehyde
hexanal
m&p-Xylene
Mercury
Methyl-ethyl-ketone
Naphtalene
n-butanol
NH3
NO2
Nonane
o-Xylene
Pb
Pentachlorophenol
Phenol
Propionaldehyde
Propylbenzene
Styrene
Tetrachloroethylene
Toluene
Trichloroethylene
Trimethylbenzenes
Tris-(2-chloroethyl) phosphate
Undecane

Round 2

2-Ethyl-1-hexanol
3-carene
Acetaldehyde
alpha-pinene
benzaldehyde
Benzene
Cd
CO
Dichloromethane
Diisocyanate
d-Limonene
Formaldehyde
hexanal
m&p-Xylene
Naphtalene
n-butanol
NH3
NO2
o-Xylene
Styrene
Tetrachloroethylene
Toluene
Trichloroethylene
Tris-(2-chloroethyl) phosphate

Round 3

Acetaldehyde
alpha-pinene
Benzene
CO
d-Limonene
Formaldehyde
m&p-Xylene
Naphtalene
NH3
NO2
o-Xylene
Styrene
Toluene

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Prioritisation based on risk characterisation

High priority chemicals

- Formaldehyde, Nitrogen Dioxide, Carbon Monoxide, Benzene, and Naphthalene

Second priority chemicals

- Acetaldehyde, Styrene, Toluene and Xylenes

Additional chemicals of interest

- Ammonia, delta-Limonene, and alpha-Pinene

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Individual recommendations- high priority chemicals:

1. Formaldehyde

• NOEL 30 µg/m3 (30-minute average).

• Pending the outcome of the current IARC revision of the carcinogenicity of formaldehyde, a guideline value should be *as low as reasonably achievable*.

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2. Nitrogen Dioxide

• long term guideline value of 40 µg/m^3 (1-week average) and

• short term guideline value of 200 µg/m^3

are recommended.

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3. Carbon Monoxide

• 1-hour average guideline value of 30 mg/m^3 and

• 8-hour average guideline value of 10 mg/m^3 are recommended.

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4. Benzene

- as benzene is a human carcinogen, its concentration in indoor air should be kept *as low as reasonably achievable*,

and

- indoor concentrations of benzene should not exceed outdoor concentrations.

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5. Naphthalene

- A long term guideline value of 10 µg/m^3 is recommended

Additional options – naphthalene:

- Restrict the use of naphthalene containing household products, particularly mothballs.
- Raise public awareness about the sources, risks, means of detecting and avoiding naphthalene in indoor air

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Second priority chemicals:

- Acetaldehyde
- Styrene
- Toluene
- o-, p- and m-Xylene

are not considered to urgently require regulatory risk management actions specifically in indoor air

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Additional chemicals of interest:

- ammonia,
- delta-Limonene,
- alpha-Pinene

are considered to require further research with regard to human exposure or dose response before recommendations can be made.

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AIRMEX

European Indoor Air Monitoring and Exposure Assessment Project

The aims of AIRMEX :

- Identify and quantify the main VOC pollutants in public buildings and schools
- Identify the sources of these pollutants
- Estimate of people's exposure to these pollutants while working/remaining in the monitored areas
- Investigate relationship between ambient backround concentrations and personal exposure
- Evaluate possible health risks due to (chronic) exposure to air pollutants, in particular, for children.

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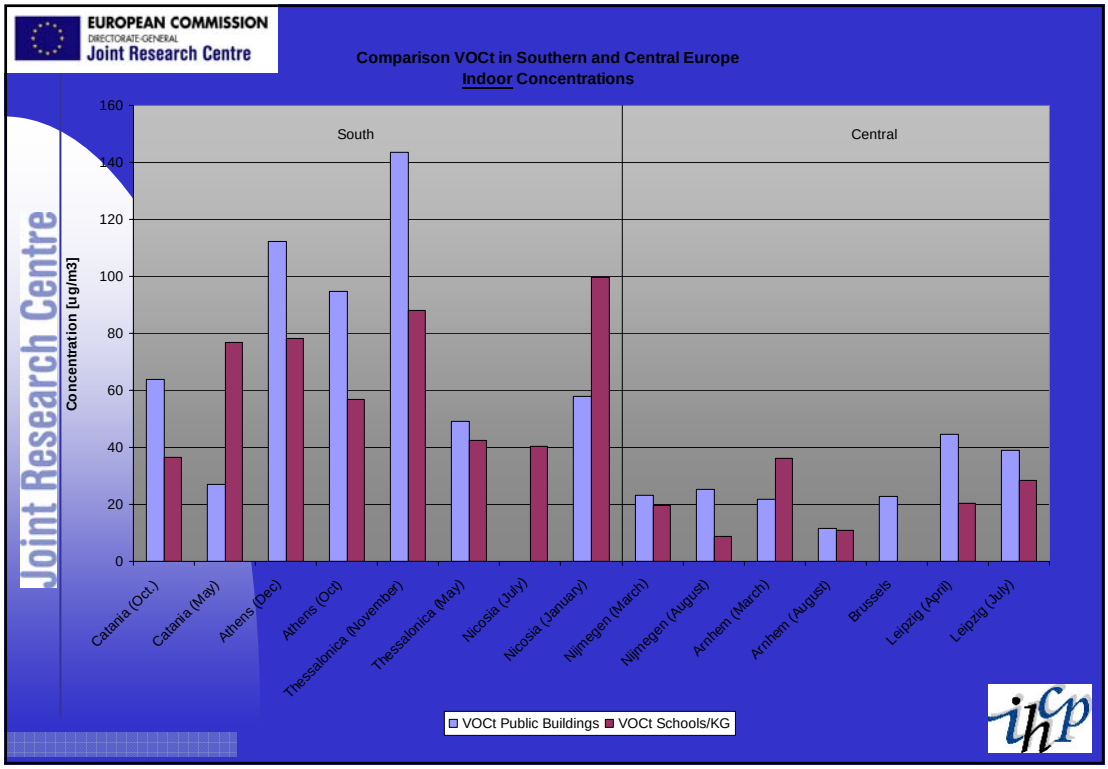

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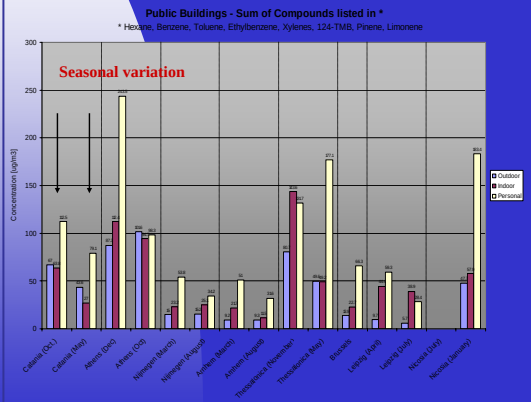
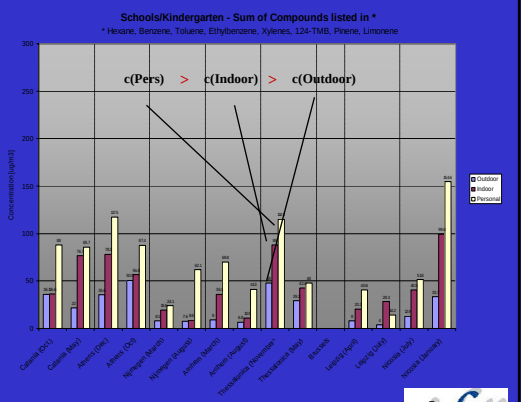
Sum of selected VOC in Public Buildings and Schools/Kindergartens





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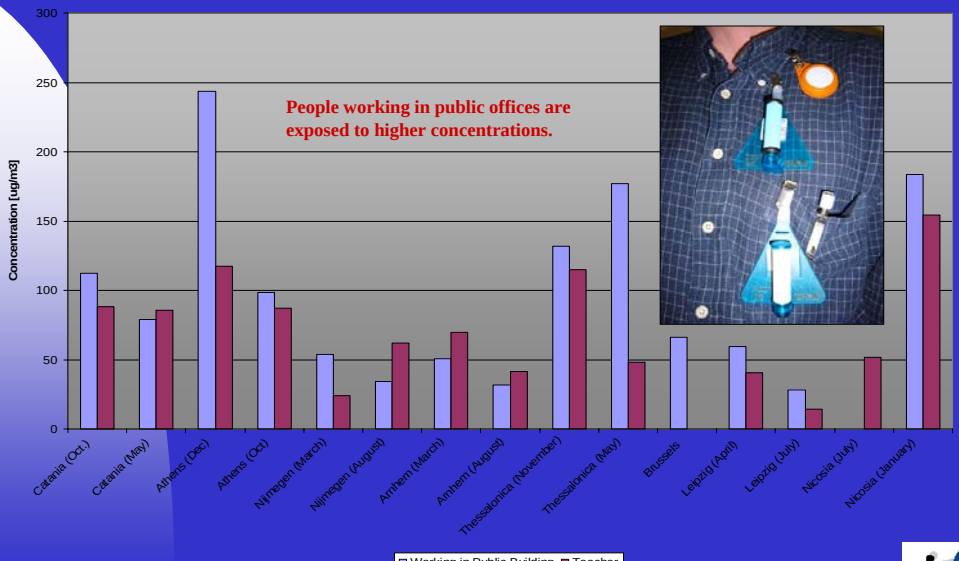
Comparison Sum of selected * VOC for People Working in Public Buildings and Teachers (Measured with Personal Sampler)



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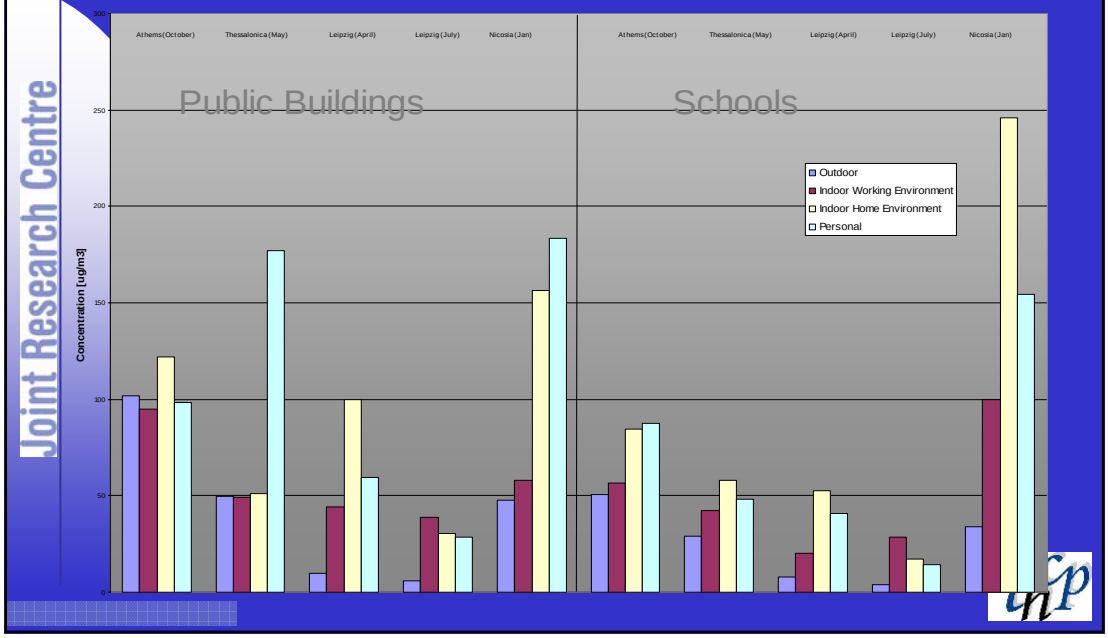
Comparison Sum of VOC (*) Outdoors, Indoors Working Environment, Indoors Home Environment (Home of Volunteer) and Personal
*** Hexane, Benzene, Toluene, Ethylbenzene, Xylenes, 1,2,4-TMB, alpha-Pinene, D-Limonene**



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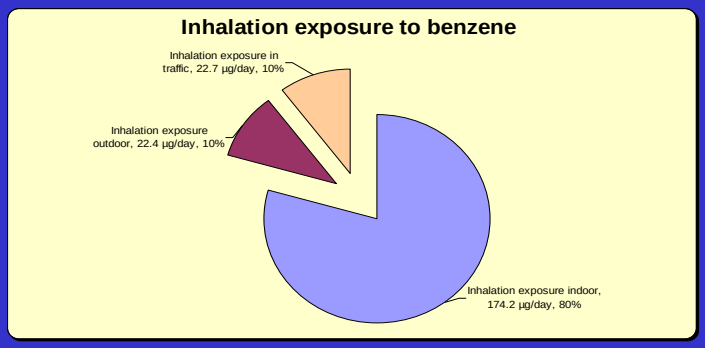

Contribution of indoor, outdoor, and motorized transportation microenvironments to the daily world's population *inhalation* exposure to benzene based on respective concentration and time-microenvironment-activity data.

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Benzene/AIRMEX

28% of the outdoor concentrations, **30%** of the indoor concentrations,
and **40.5%** of the personal exposure concentrations measured exceeded the limit value of 5 ug/m3.

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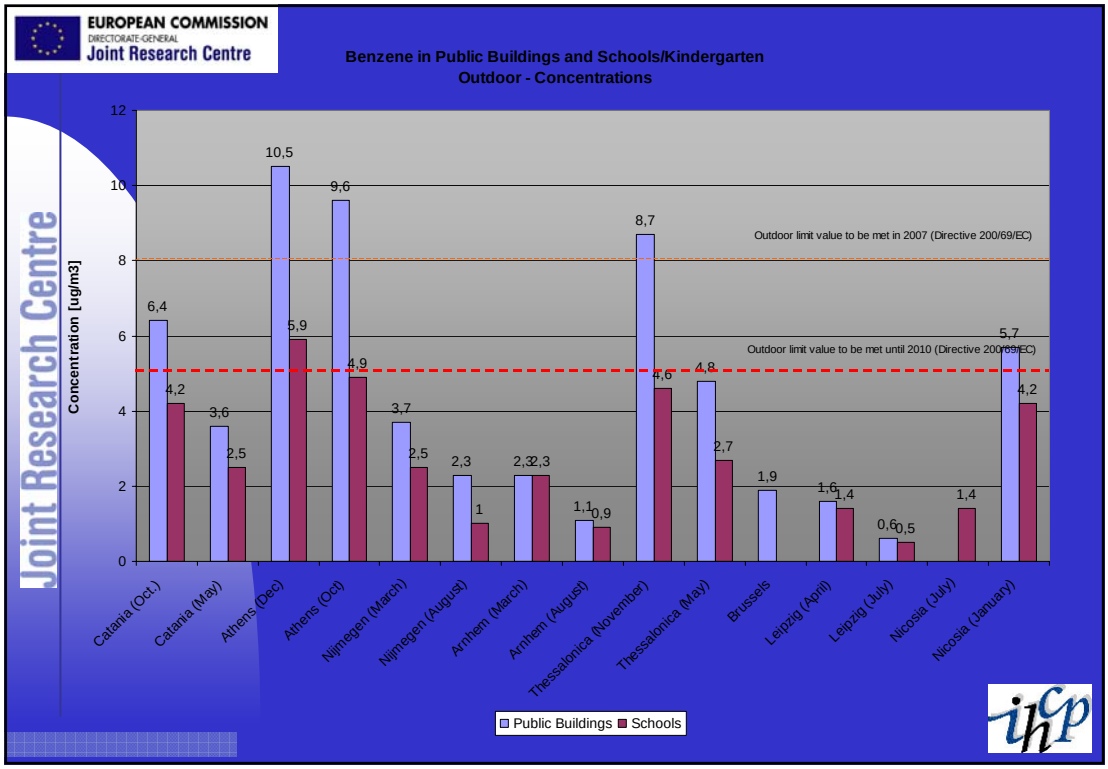

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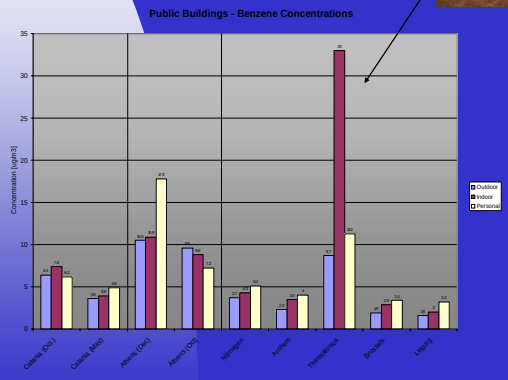
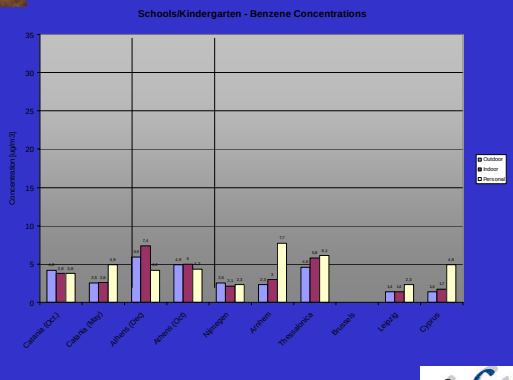
Benzene in Public Buildings and Schools/Kindergartens





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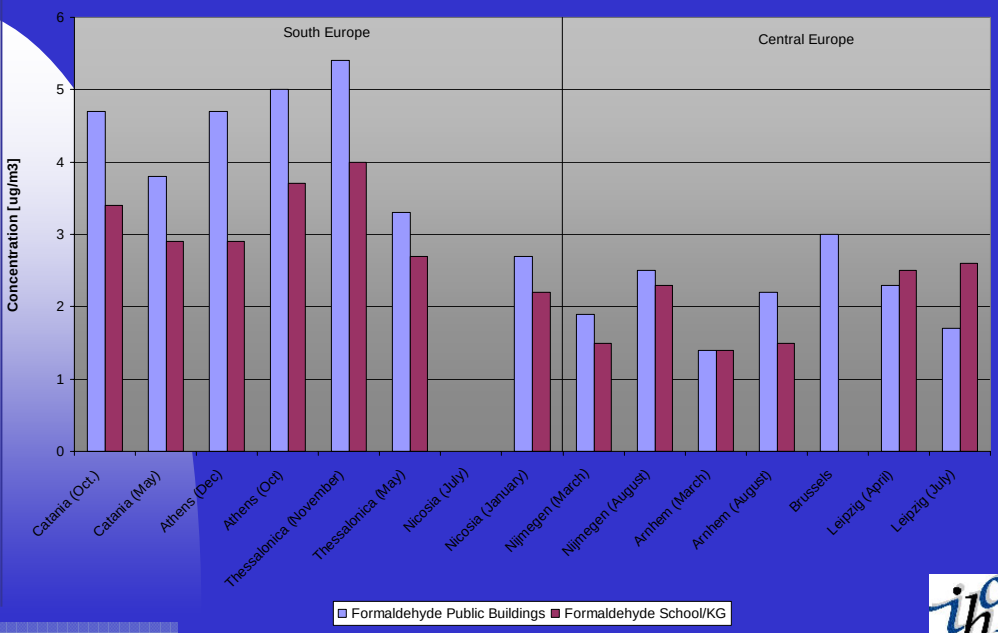
Comparison Formaldehyde in Southern and Central Europe
Outdoor Concentrations



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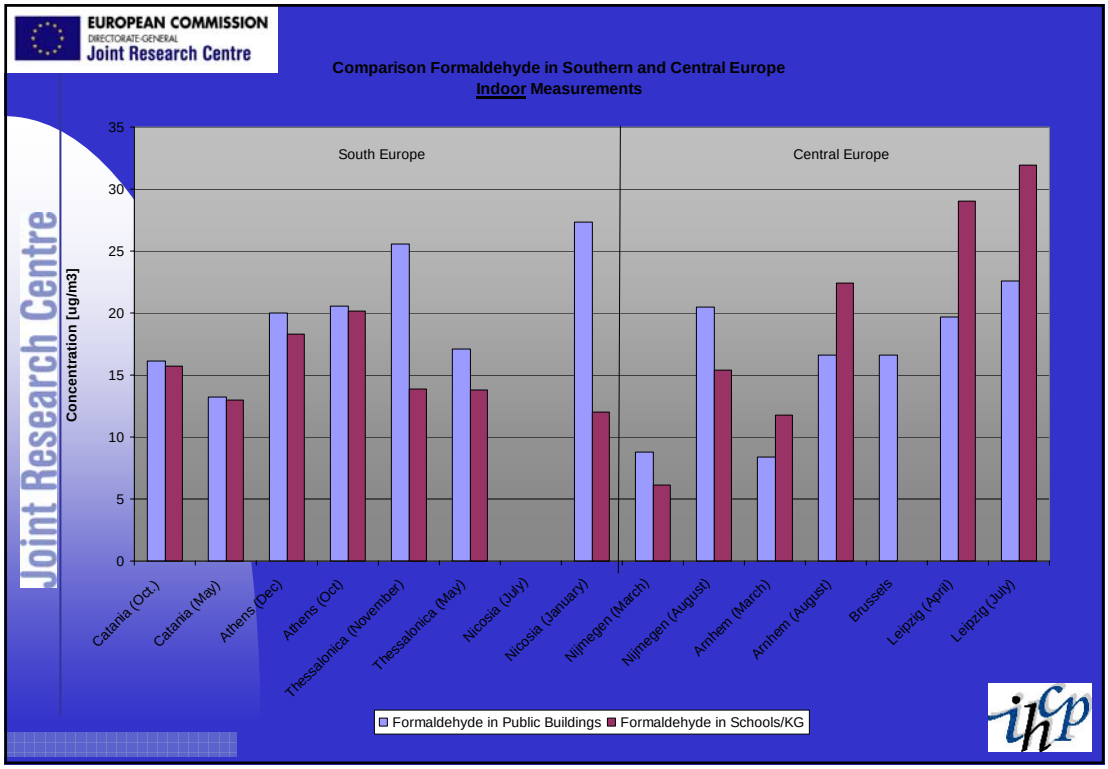
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Comparison Formaldehyde in Southern and Central Europe
Indoor Measurements
Joint Research Centre
Concentration [ug/m3]
South Europe
Central Europe
0
5
10
15
20
25
30
35
Catania (Oct.)
Catania (May)
Athens (Dec)
Athens (Oct)
Thessalonica (November)
Thessalonica (May)
Nicosia (July)
Nicosia (January)
Nijmegen (March)
Nijmegen (August)
Arnhem (March)
Arnhem (August)
Brussels
Leipzig (April)
Leipzig (July)
Formaldehyde in Public Buildings
Formaldehyde in Schools/KG
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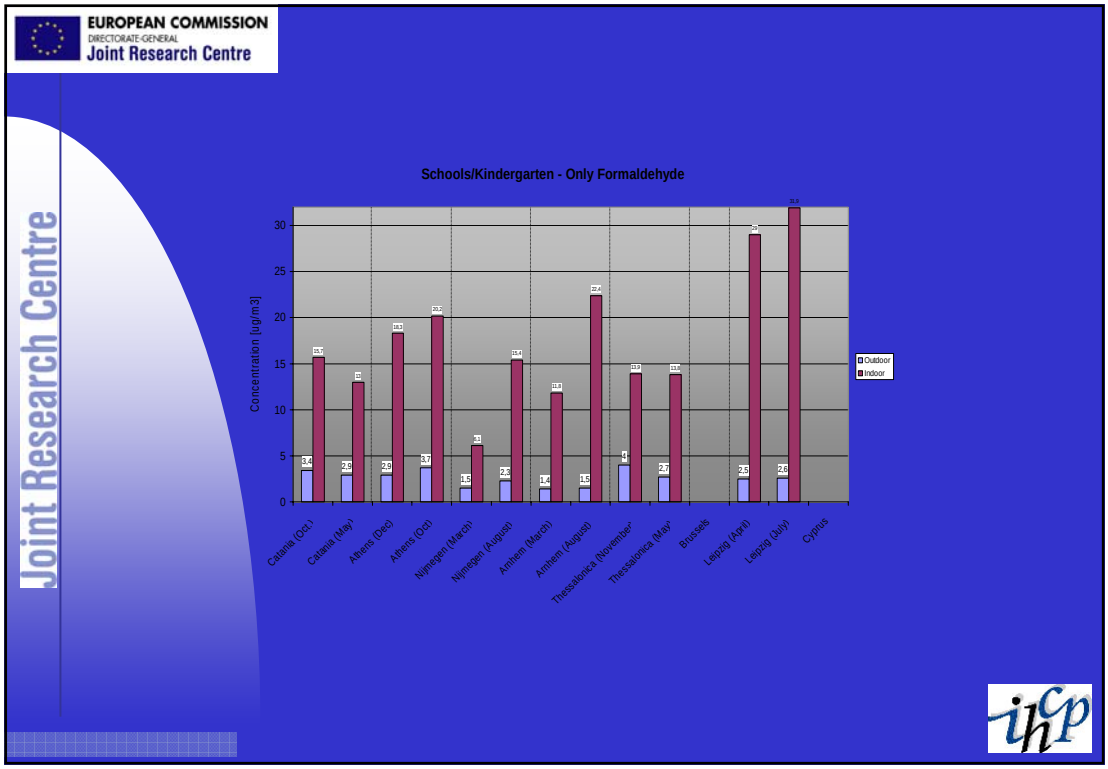
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Schools/Kindergarten - Only Formaldehyde
Joint Research Centre
Concentration [ug/m3]
0
5
10
15
20
25
30
Outdoor
Indoor
Catania (Oct.)
Catania (May)
Athens (Dec)
Athens (Oct)
Nijmegen (March)
Nijmegen (August)
Arnhem (March)
Arnhem (August)
Thessalonica (November)
Thessalonica (May)
Brussels
Leipzig (April)
Leipzig (July)
Cyprus
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Conclusions:

- Personal Conc. >/= Indoor Conc. >/= Outdoor Conc.
- Concentrations in southern cities always higher
- In south, indoor conc. more similar to outdoor conc. than in north
- Concentrations in schools lower than in public buildings
- True personal exposure cannot be determined directly from measurements pertaining from fixed ambient background monitoring stations.

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Outlook

- Green paper on environmental Tobacco Smoke (ETS)

- Completion of the database on indoor/outdoor relationships and personal exposure concentrations for priority pollutants at European level

- Epidemiological studies/biomonitoring

- Exposure to chemical mixtures/science and policy impact