



# Indoor air quality Sensors

Atmos'Fair, Lyon  
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# Is that the air is breathable?

**ASBESTOS**

**ENVIRONNEMENTAL TOBACCO SMOKE**

**LEGIONELLA**

**RADON**

**CARBON MONOXYDE**

**FORMALDEHYDE**

**PARTICULATE MATTERS**

...

Discomfort, odor stuffy air, SBS, infection, poisoning, respiratory diseases, cancer, etc.



- 100 deaths and 3000 annual poisonings related to carbon monoxide

- Doubling of the prevalence of allergic respiratory diseases in 20 years. 10% of adolescents have a **chronic asthma**



- Environmental tobacco smoke, radon, benzene, asbestos and formaldehyde could contribute substantially to the increased incidence of **cancers**.

- 1044 cases of **legionellosis** (fatal in 14% of cases) reported in 2003.

etc...



Fœtus 9 SG (5cm)

# Economic impacts

(ex : estimation of direct medical cost due to IAQ in Italy  
source, Maroni et al., 2000)

POLLUANTS	MALADIE	IMPACT	COUTS MEDICAUX DIRECTS (€)
<b>Allergènes (acariens, moisissures, animaux domestiques)</b>	Asthme bronchique chez les enfants et les adolescents	> 160 000 cas /an	> 80 Millions
<b>Radon</b>	Cancer du poumon	1 500-6 000 morts/an	26-105 millions
<b>Tabagisme passif</b>	Asthme bronchique chez les enfants et les adolescents	> 30 000 cas /an	> 15 millions
	Infection des voies respiratoires	> 50 000 nouveau cas /an	> 12 millions
	Cancer du poumon	> 500 morts / an	> 9 millions
	Maladies cardiovasculaires	> 900 morts / an	> 8 millions
<b>Benzène</b>	Leucémie	36 - 190 cas / an	0.5 - 4 millions
<b>Monoxyde de carbone</b>	Intoxication	> 200 morts / an	1 million
<b>TOTAL</b>			<b>152 – 234 M €</b>

# Indoor environments



**90% indoor**

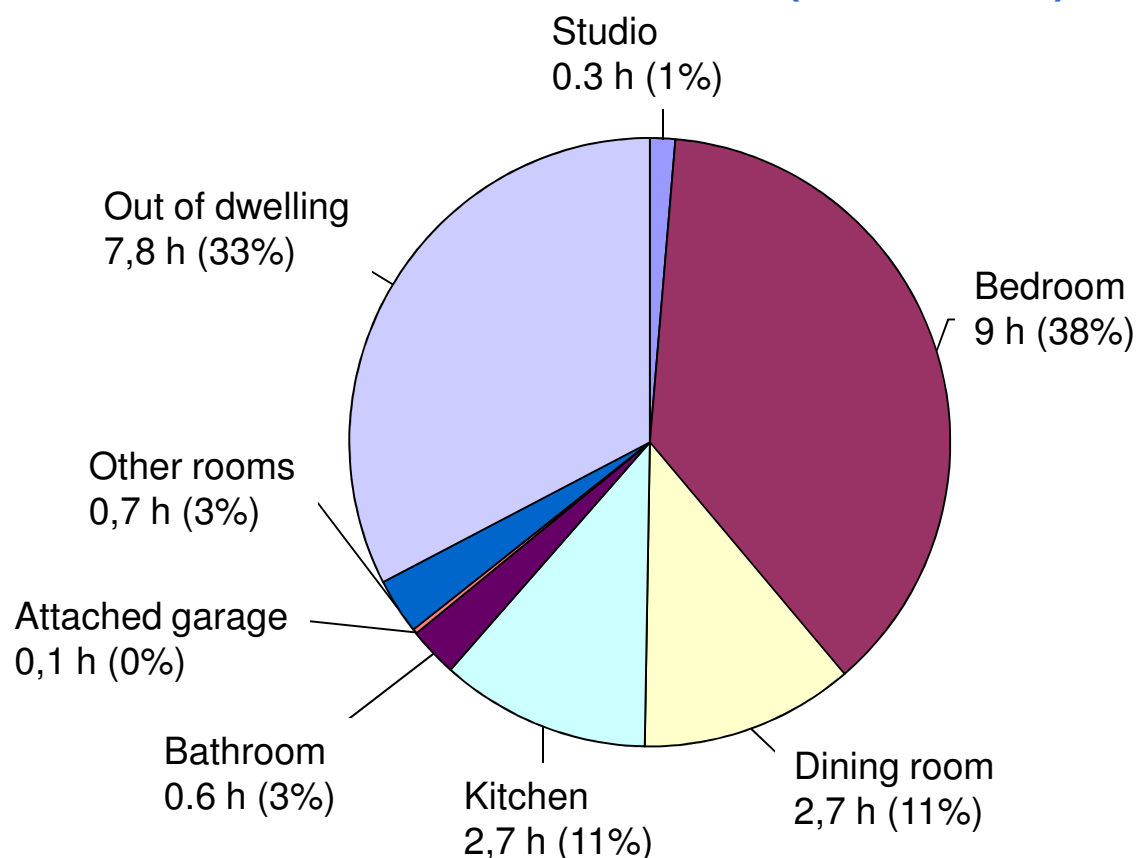
**10% outdoor**



# Time spent in dwellings

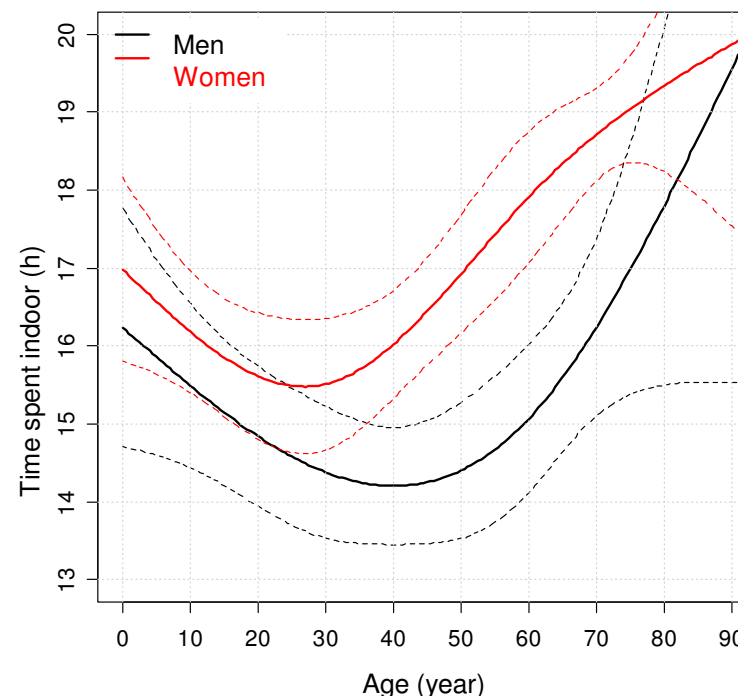
Source : OQAI – National survey on IAQ in dwellings 2003-2005

**Average time spent in dwelling : 16h10mn**  
(67% of time)

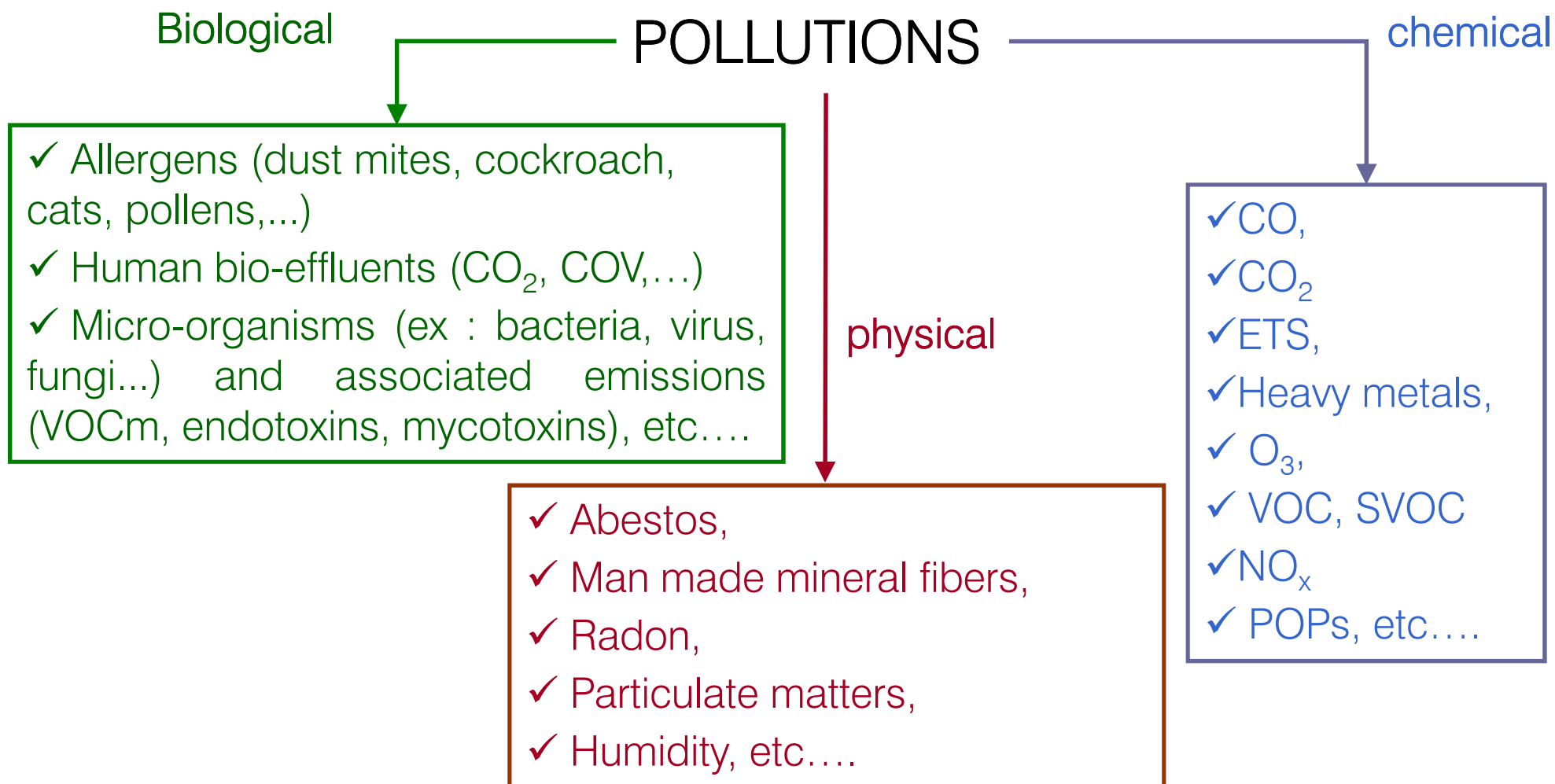


**Women=17h00 ; Men=15h14**

**1/4 of the population spend more than 20h**  
**Children under 5 years old and elderly**  
**> 60 ans stay indoor most of their time**







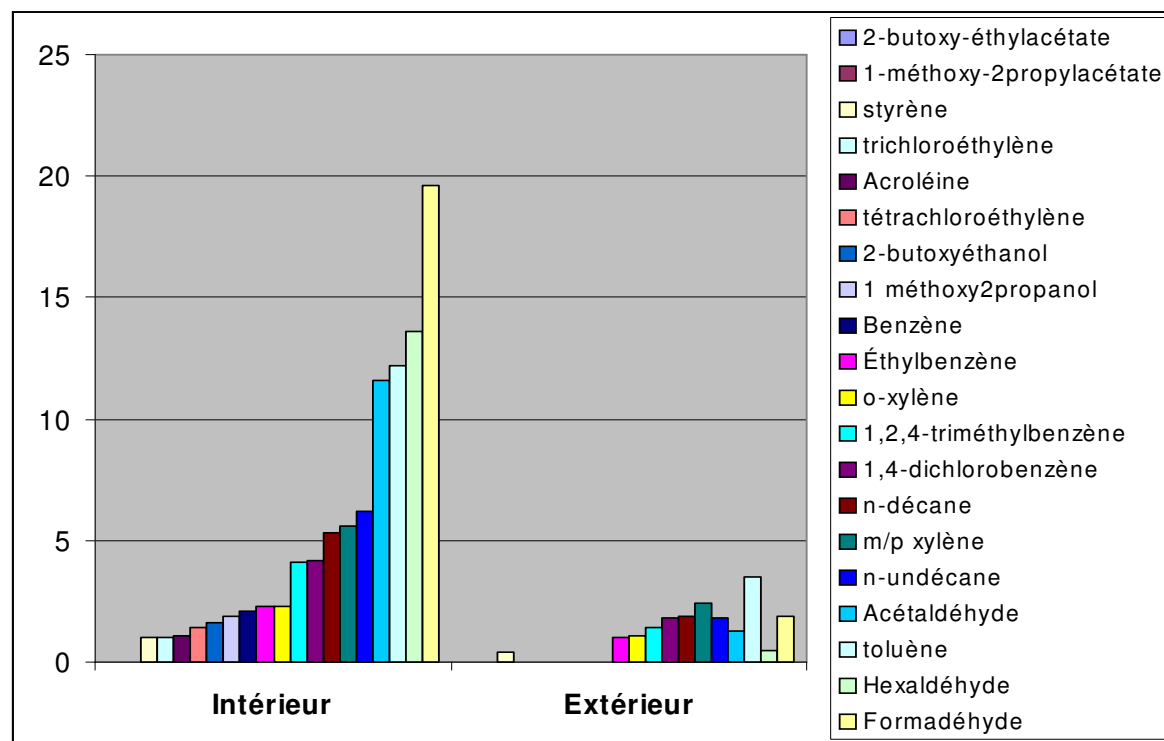
# French national survey OQAI (2003-2005)

## Indoor pollution in housing

Various pollutants (chemical, physical, microbiological) present in most of the dwellings

Indoor pollution higher than outdoor

Inequality in pollution exposure : about 10 % of dwellings are multi polluted

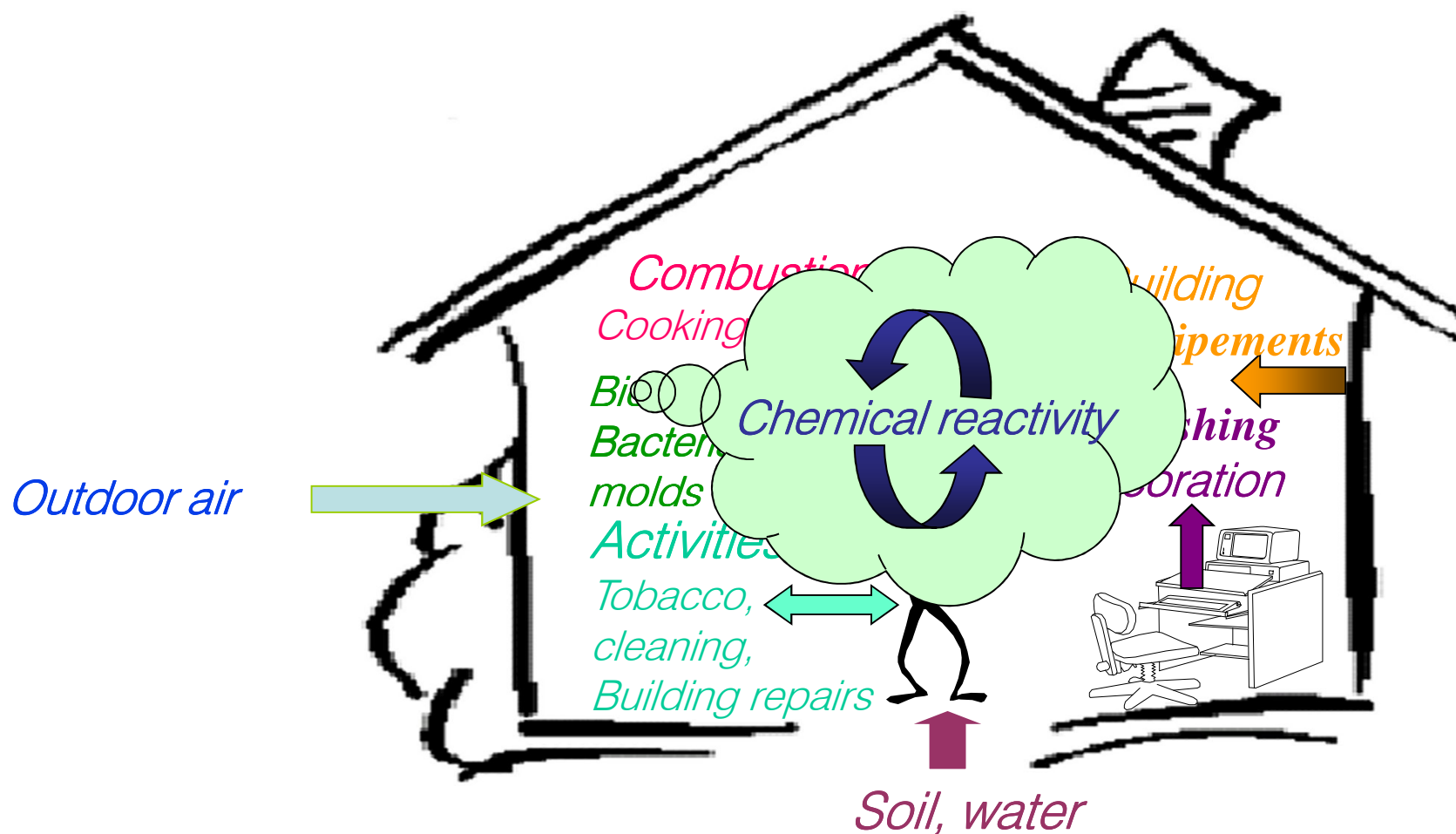


Volatile organic compounds

Report available on [www.air-interieur.org](http://www.air-interieur.org)



# Pollution sources ?



## Energy consumption / climate change : major changes coming

- architectural design
- thermal insulation and building airtightness
- efficient HVAC systems
- new energy source like biomass

# How to improve IAQ ?

Health based guidelines on key pollutants:  
chemicals, moisture and dampness – WHO)

**Prioritise pollutants**  
Vs. health effects



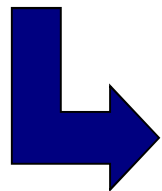
Establish **guideline value** for priority pollutants



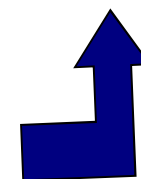
**Identify sources**



**Monitor concentrations**  
Vs health effects



**Reduce emission/concentration**  
**Air quality monitoring**

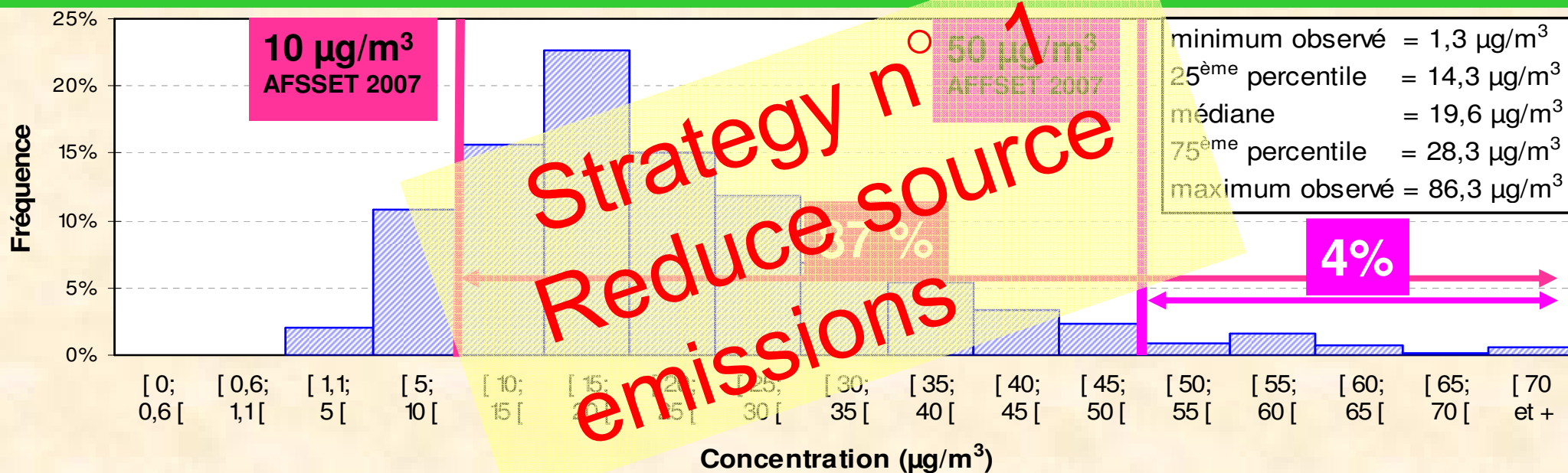


- **7 substances « very high priority » (Groupe A)** : formaldéhyde, benzène, acétaldéhyde, particules, radon, ester de phtalate (DeHP) et dichlorvos
- **12 substances « high priority » (Groupe B)** : dioxyde d'azote, allergènes de chien, d'acariens, toluène, trichloréthylène, plomb, tétrachloréthylène, dieldrine, allergène de chat, aldrine et monoxyde de carbone, paraffines chlorées à chaîne courte
- **32 substances « priority » (Groupe C) among them** biocides, low frequency electromagnetic Fields, VOCs, glycol ethers, endotoxines and MMMF, phthalate esters (DEP, DnBP), organoétains (MBT, DBT, TBT, MOT, DOT), flamme retardants
- **22 substances « unclassified » (Groupe D) among them** biocides and glycol ethers, phthalate esters (DMP, DPP), organoétains (TeBT, TCHT, TPT), alkyl phénols.

# FORMALDEHYDE

OQAI, French national survey on IAQ in dwellings

## Formaldéhyde example



More than 80 % of dwellings have concentrations  
from 5 to 50 times higher than outdoors



# Chemical emissions labelling systems...

Harmonisation framework for indoor material labelling schemes in the EU  
ECA Report n° 27

Comparison of the different emission labelling systems (for detailed information Annexes need to be consulted).

	AgBB	CESAT	M1	ICL	LQAI scheme	Natureplus, examples: Linoleum + carpets	Blue Angel, example: RAL UZ 120 floor coverings	Austrian Ecolabel, example: Ö UZ 42 resilient floor coverings	GUT	EMICODE EC1, example: adhesives	Scandinavian Trade Standards
General											
Origin	Germany	France	Finland	Denmark	Portugal	Germany	Germany	Austria	Germany	Germany	Sweden
Source for more information	<a href="http://www.umweltbundesamt.de/building-products/agbb.htm">http://www.umweltbundesamt.de/building-products/agbb.htm</a>	<a href="http://www.cstb.fr">www.cstb.fr</a>	<a href="http://www.rts.fi">www.rts.fi</a>	<a href="http://www.indeklima.org">www.indeklima.org</a>	<a href="http://www.markelink.com/directorios/ct2004/lab-qual-ar-int.htm">www.markelink.com/directorios/ct2004/lab-qual-ar-int.htm</a>	<a href="http://www.natureplus.org">www.natureplus.org</a>	<a href="http://www.blauer-engel.de">www.blauer-engel.de</a>	<a href="http://www.umweltzeichen.at">www.umweltzeichen.at</a>	<a href="http://www.gut-ev.de">www.gut-ev.de</a>	<a href="http://www.emicode.com">www.emicode.com</a>	<a href="http://www.golybransch.se">www.golybransch.se</a>
Legal status	basic concept for Germany	voluntary, complement to French technical Agreement	voluntary (private), promoted by government	voluntary (private), promoted by government	voluntary (association between private organization and public institution)	voluntary (private), promoted by several retailer chains	voluntary (private), promoted by government	voluntary (private), promoted by government	voluntary (private)	voluntary (private)	trade agreement
Scheme/label is based on	ECA report 18	ECA report 18	-	-	ECA report 18	AgBB	AgBB	ECA report 18	AgBB	-	-
Product types covered	meant for all types of construction products relevant to indoor air	several types of construction products	all type of construction products	open to all types of products relevant to indoor air	several types of products for indoor use	several types of construction products	several types of products for indoor use	several types of construction products	textile floor coverings	products for installation of floor coverings	several types of construction products

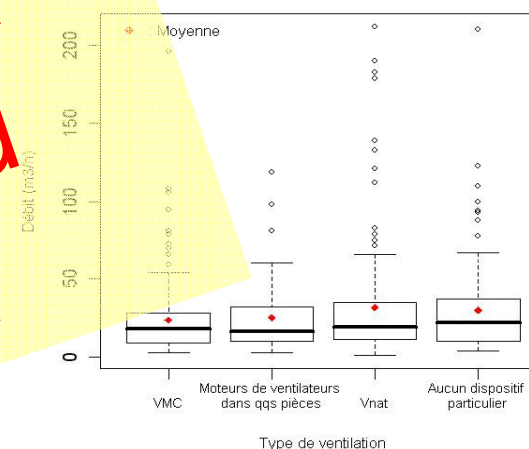
Ventilation : Air exchange rate are not related to the type of ventilation systems installed.

Recent dwellings show better ventilation conditions due to mechanical systems but those show frequent disfunction limiting their reliability.

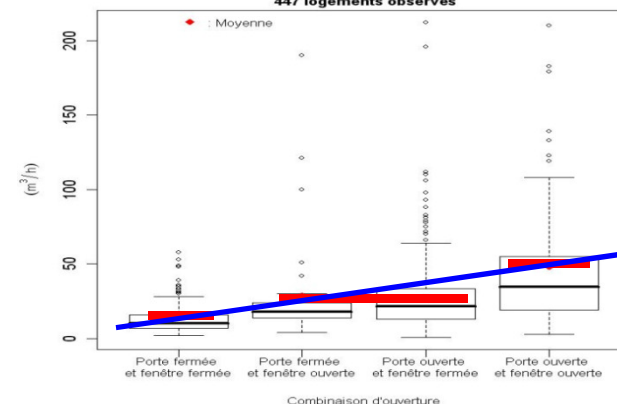
Occupants (behaviours, use, living conditions) play a role as important as technical performance of the building

Strategy n° 2  
Ensure good ventilation

Distributions des RAn selon le type de ventilation.  
447 logements observés



de la chambre expérimentée et des fenêtres en CHAMBRES la nuit.  
447 logements observés

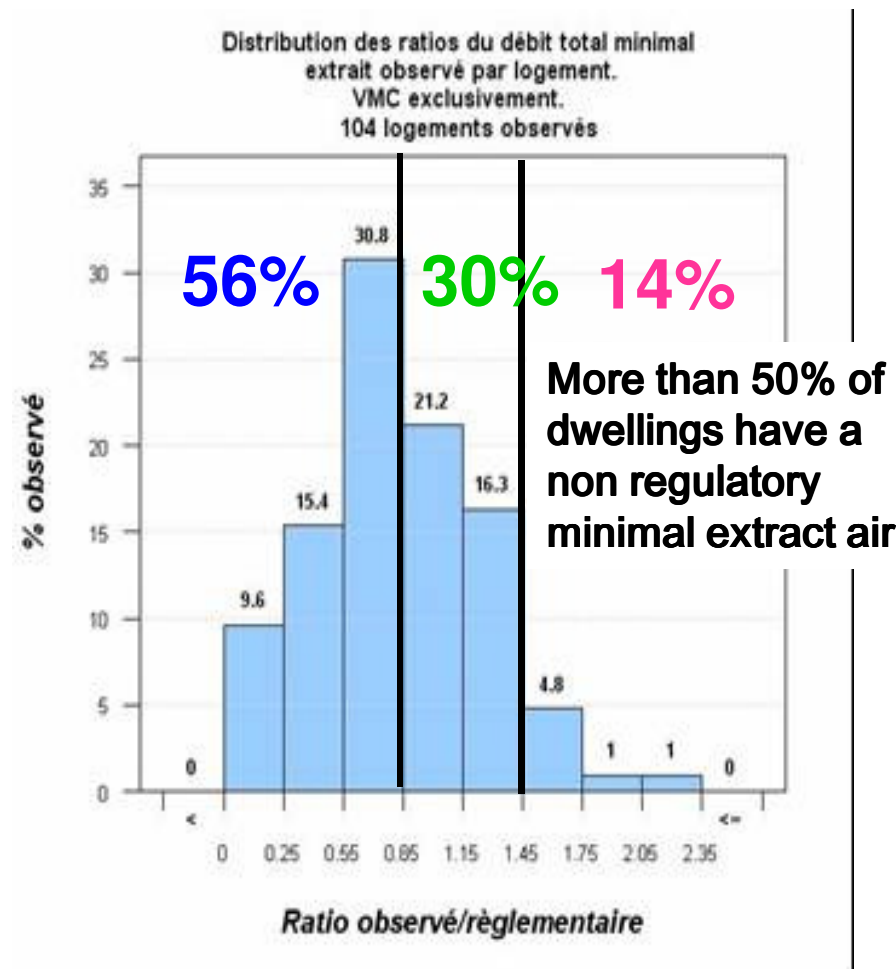




# Manage air taking into account energy consumption

- more finely regulate the airflow rate depending on the occupation of buildings
- recover heat from the exhaust air
- incorporate treatment systems (filtration, purification, decontamination)

... being careful about the design, sizing, implementation and maintenance of the systems



(Source OQAI)

For the remainder  
(when one have limited all pollution at the source  
and ventilate properly the building)

- microbiological contamination from the occupants (viruses, bacteria, ...)

- outdoor air

- ...?.

Strategy n°3  
Purify the air ?

# The occupant has a significant role on the final performance of the building

- Choose robust systems, equipments
- Assist the occupant to effectively manage its building (**sensors**)
- Respond to requests for advice and complaints
- Inform on IAQ

Strategy n° 4  
Design for occupants



# intelligent sensors to improve the quality of our environment ?



Dynamic minimum ventilation control on the basis of **carbon dioxide** concentration and **humidity** measurement



“Odor sensors on the outside of the car will be able to detect **unpleasant smells**, close the intake vents and then release an essential oil based “forest” smell throughout the car.”



“Oxygen air cleaner to help you remove **unwanted smells** with a new device that promises to clean the air in your home over the course of an hour.”

Based on odor sensor (electronic nose) detecting smells like solvents, exhaust fumes, cigarette smoke and other hazardous gases.

# CONCLUSION

## Axes for changes

### → Reduce polluting emissions at source:

- « Low emission » products : **all products**

### → Optimise ventilation conditions:

- Energy cost, IAQ, comfort, condensation, combustion
- Control, maintenance and **occupant**

### → Purify the air :

- Evaluation and performance - **safety**
- Maintenance

### → Inform / educate building's professionals and occupants

Thank you

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[www.air-interieur.org](http://www.air-interieur.org)