



La gestion de la problématique du radon en Belgique **De aanpak van de radonproblematiek in België** **Managing indoor radon in Belgium**



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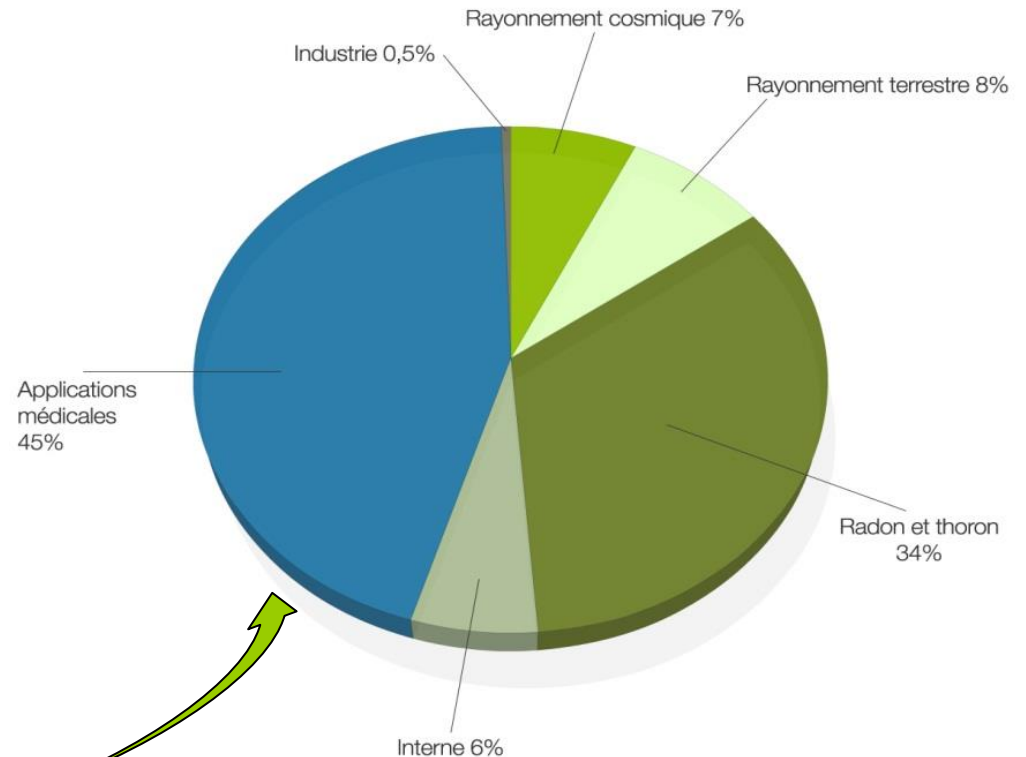


FANC

Federal Agency for Nuclear Control

Protection of the **population**, the **workers** and the **environnement** against the dangers from ionising radiation

- **150 collaborators**
(engineers, physicians, physicists, ...)
- 6 points of attention:
 - Nuclear **Installations**
 - Radioactive **waste**
 - **Security**
 - **Transport**
 - Protection of **health**
 - **Surveillance** of the territory and natural radiation



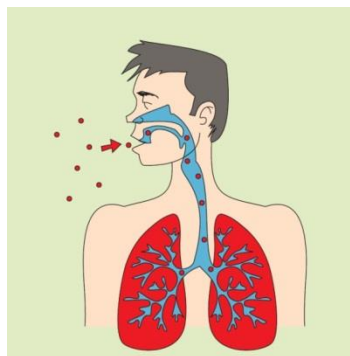
Contents

- Radon related risk
- The national Radon Action Plan
- Radon reference level and consequences
- Radon and IAQ
- Conclusions

Properties of radon

Gas

- Natural (from radium and uranium)
- tasteless
- colorless
- No smell
- **Radioactive**

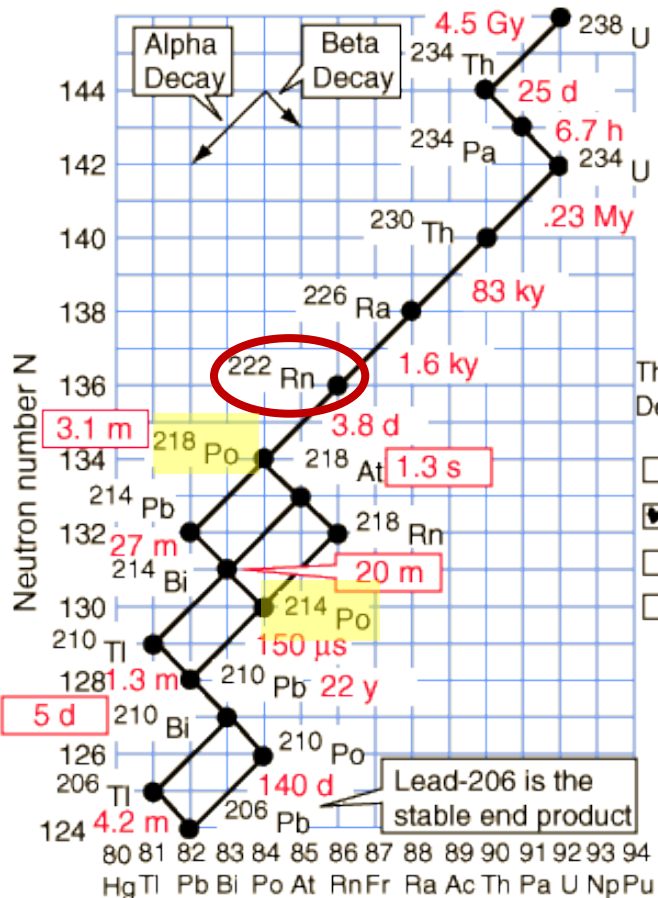


Radon inhalation increases lung cancer risk



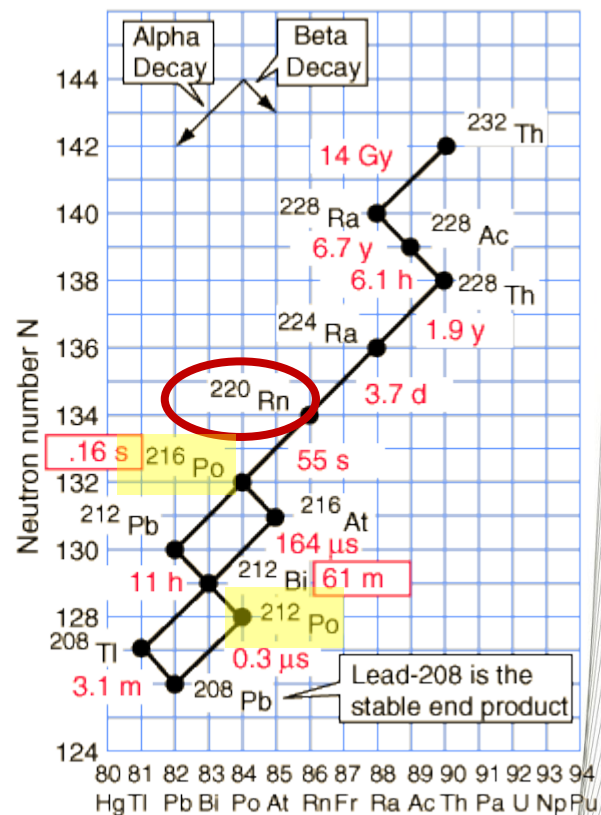
The Uranium-238 Decay Series

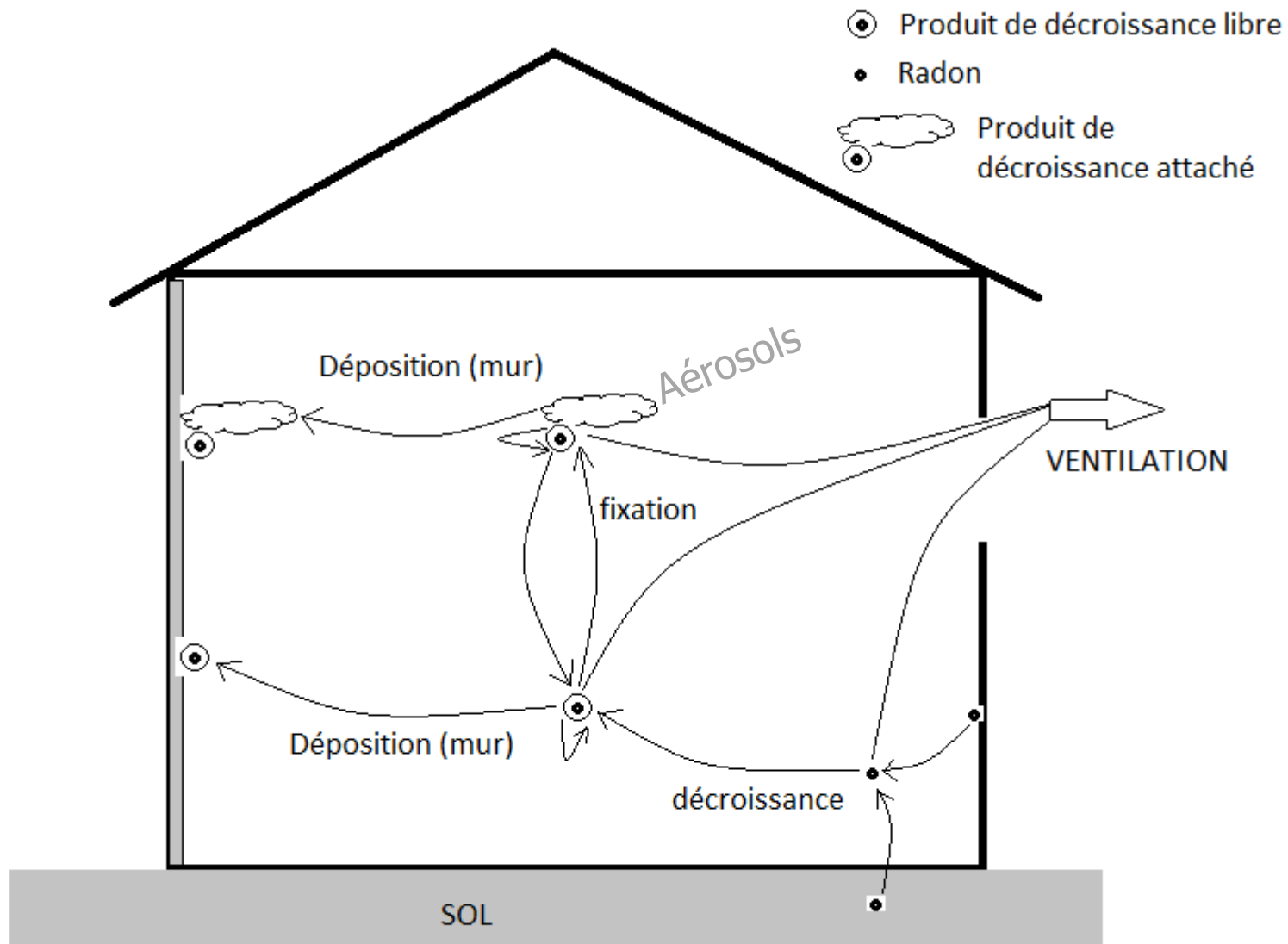
- ☐ ^{235}U Series
- ☐ ^{232}Th Series
- ☒ ^{238}U Series
- ☐ ^{237}Np Series



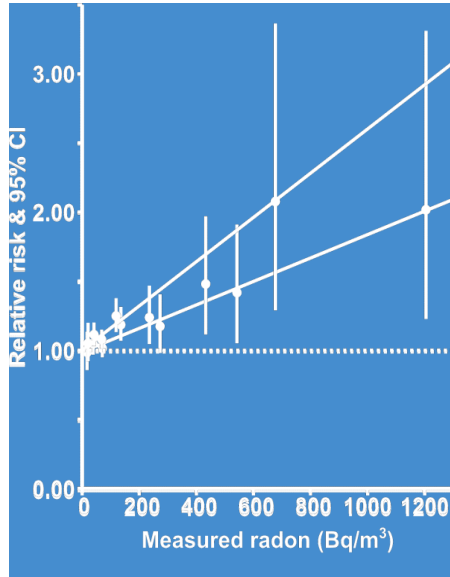
The Thorium-232 Decay Series

- ☐ ^{235}U Series
- ☒ ^{232}Th Series
- ☐ ^{238}U Series
- ☐ ^{237}Np Series





● Meta-EPI study in 13 countries (1994-2004)



Concentration Radon (Bq/m ³)	Cancers pulmonaire par 1000 NON-fumeurs	Cancers pulmonaire par 1000 fumeurs
0	4,1	101
100	4,7	116
200	5,4	130
400	6,7	160
800	9,3	216

Darby *et al.*, 2005



FANC Radon Action plan: Objectives

- **Long term:** general prevention for new buildings (design level of 100 Bq/m^3)
⇒ substantial reduction of LC-incidence
- **Short term:** remediation of high levels
⇒ trace buildings with high exposure and remediate buildings above the Action Level ($\text{AL}=400 \text{ Bq/m}^3$ corresponding to 10 mSv/y)



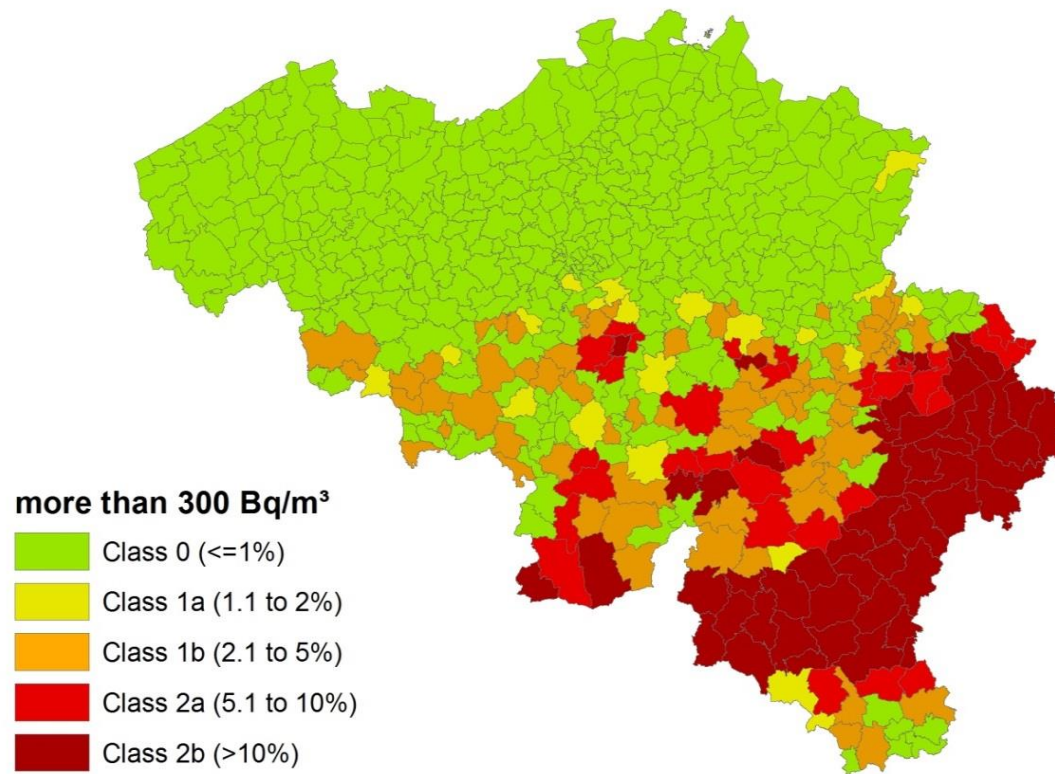
● Reference Level: graded approach (following 2013/59/Euratom)

Bq/m ³	NEW	existing buildings
600	<i>unacceptable</i>	<i>unacceptable</i>
300	<i>unacceptable</i>	<i>Mostly unacceptable (locally accepted)</i>
100	<i>Optimisation</i>	<i>Optimisation</i>

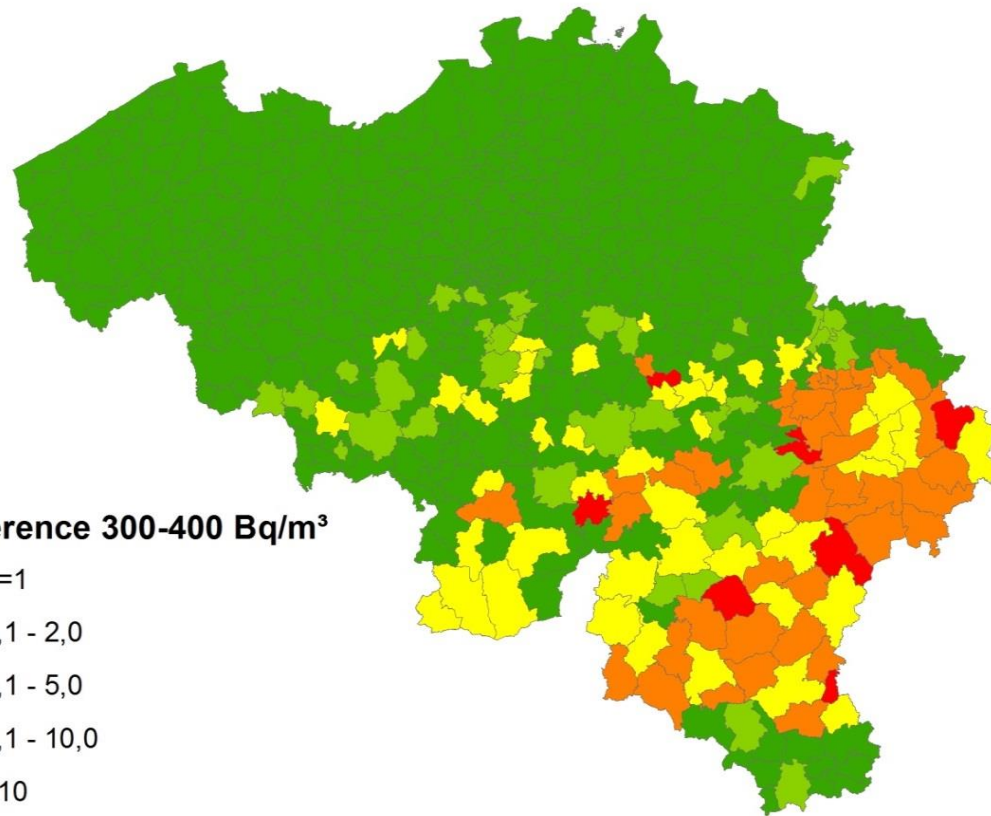
Reference level

Target level

Perspectives for the new reference level



% Difference 300-400 Bq/m³



	class 2 at 400 Bq/m ³	class 2 at 300 Bq/m ³
# municipalities	45	81
# dwellings	20k	36k
# workplaces	1,5k	2,5k
population	270k	730k



	dwelling	>100	>200	>300	>400	>800
Belgium	3742000	360000	84000	36000	21000	5600
Wallonia	1325000	280000	79000	35000	21000	5600
Flanders	2191000	70000	some	some	0	0
Brussels	226000	9000	5000	some	0	0
Radon prone areas	130000	56000	43000	22000	17000	5500

	LC risk NS	LC risk S	LC NS	LC S	total	Due to radon
Belgium	4.4	108.4	399	6558	6958	477 (27 NS and 450 S) (7%)
Wallonia	4.5	113.1	135	2221	2356	252 (14 NS and 238 S) (11%)
Flanders	4.3	107.0	228	3740	3967	222 (13 NS and 209 S) (6%)
Brussels	4.3	107.0	38	630	669	37 (2 NS and 35 S) (6%)
Radon prone areas	5.0	122.0	16	263	279	48 (3 NS and 45 S) (17%)
No radon*	4.1	101.0				





REMEDIATION

- Stimulate remediation through
 - information sessions
 - Training courses for building professionals
 - Free control test (after remediation)
 - Free test extractors



PREVENTION

- Negotiate with local governments to include radon preventive measures in the building code
- Provide detailed scale radon maps for new builders
- Train local governments to provide radon info for new builders
- Distribute brochures for new builders
- Train architects and building professionals

● Radon in building materials

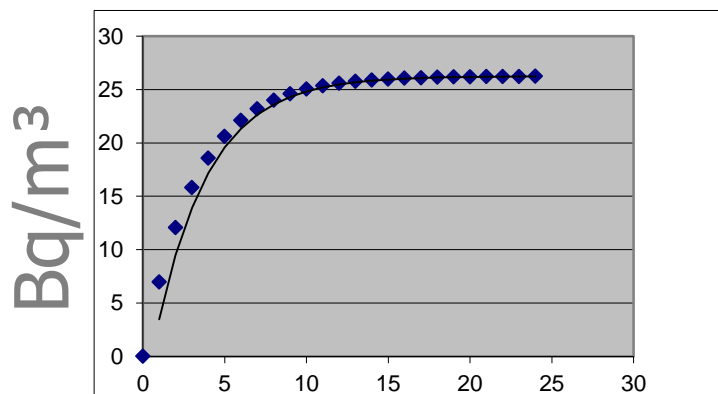


Building materials contain radionuclides (U, Ra, Th, K...en Bq/kg):

bouwmateriaal	Ra-226	Th-232	K-40
beton	20-70	05 tot 40	16-1100
baksteen	10-140	10-130	230-1200
cement	15-100	10 tot 60	50-600
gips	10-300	1 tot 300	20-800
graniet	10-160	10-350	20-2500
caramiek	20-200	30-70	300-1000



Leading to a buildup of concentration:





Radon in low-energy buildings

Air-tightness of the building!

Natural air renewal =
Blower door 50 Pa/20 (10 to 30)

$0.6/20 = 0.03 \text{ h}^{-1}$ (15m³ for 500m³)

Blower Door test

Air changes per hour at pressure difference of 50 Pa:

n50:

~3 h⁻¹ relatively airtight building

~1 h⁻¹ strongly airtight building

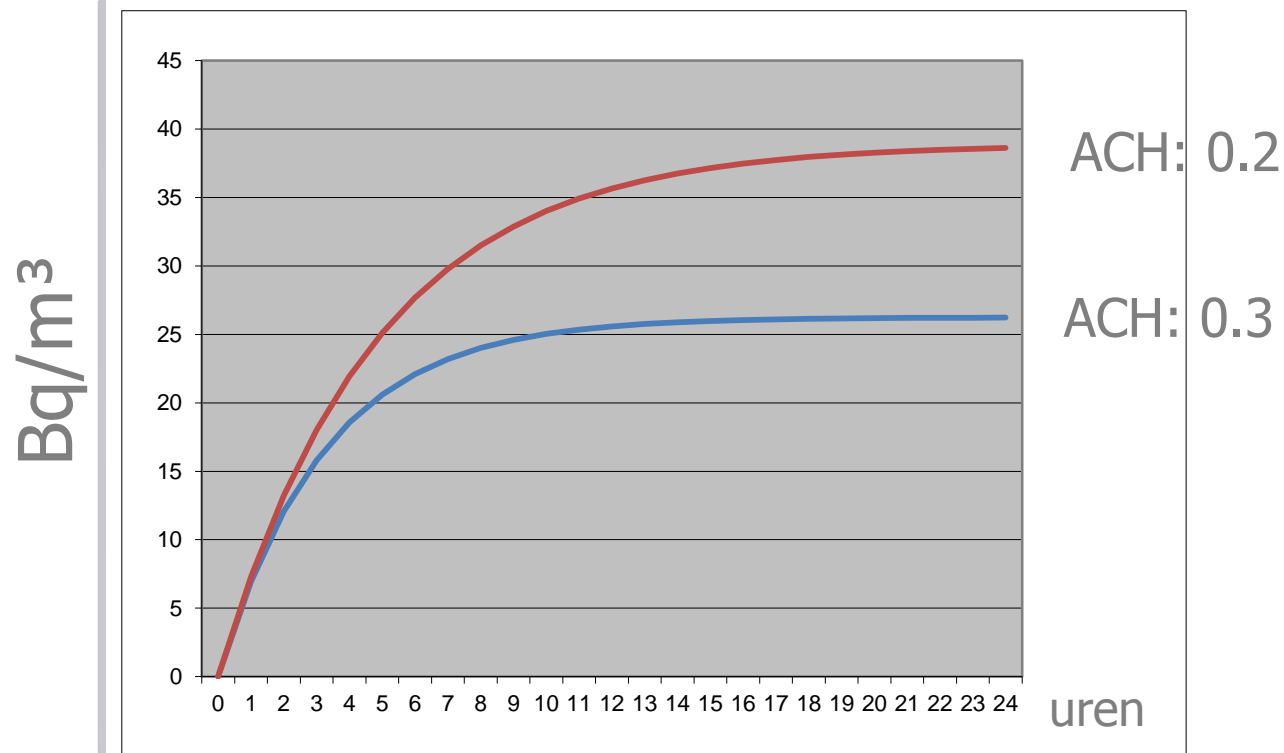
<0.6 h⁻¹ passive house





Radon in low energy buildings

Ventilation is essential:



Exhalation = 5 Bq/m²/h in a standard room



CONCLUSIONS

- Radon affects the Belgian population and workplaces
- It has to be considered from a radiation protection point of view, and from an IAQ perspective
- Belgian Radon Action Plan is an operational tool to manage radon exposure at home and at work
- Radon in dwellings and in workplaces has to be regulated following the 2013/59/Euratom EU Directive
- Key issues are:

Mapping, informing, tracing, training and protecting

● **THANK YOU for your attention!**



More info?

www.actionradon.be : testing radon at home

www.radonatwork.be : testing radon at work and declaration

FANC web site www.fanc.fgov.be, click on

