



RadoNorm
Managing risks from radon and NORM

Update on RadoNorm: Overview of regulatory approaches to control radon in dwellings, workplaces and large-scale buildings: lessons learned and recommendations

Angelika Kunte, AGES GmbH

CARST2023 - Canada's 12th Annual Radon Conference

Victoria, B.C., April 12th – 16th, 2023



This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 900009.

OVERVIEW: What is the RadoNorm project all about?

Funding by: EURATOM Horizon 2020

<https://www.radonorm.eu>

Task 5.1

Task 5.2

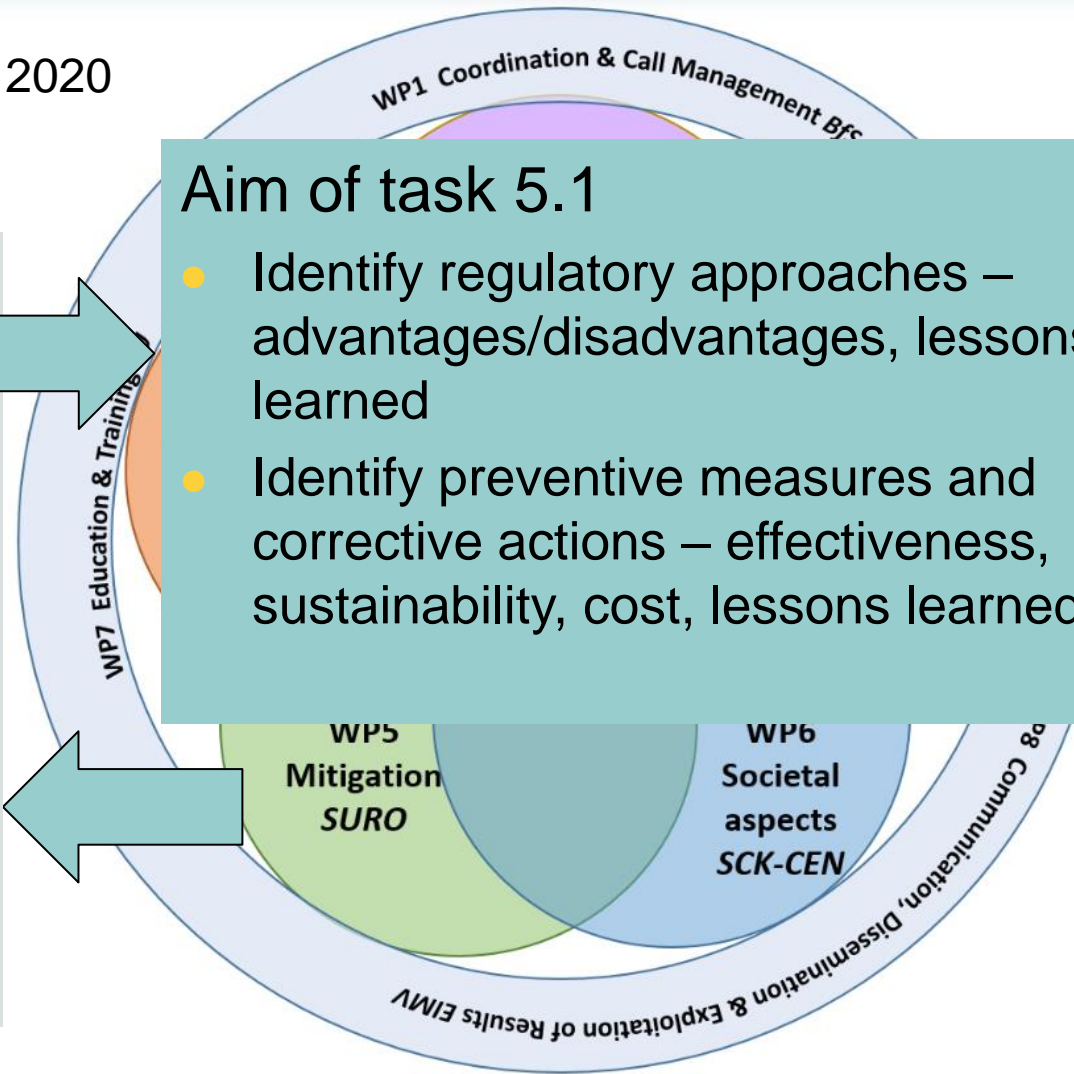
Task 5.3

Task 5.4

Task 5.5

Aim of task 5.1

- Identify regulatory approaches – advantages/disadvantages, lessons learned
- Identify preventive measures and corrective actions – effectiveness, sustainability, cost, lessons learned



Overview: Task 5.1 Covering the results from 3 surveys & a workshop

- Workshop on regulatory approaches to control radon in homes, workplaces and large buildings: Lessons learned and recommendations – 36 participants from 17 countries
- Questionnaire “Overview of regulatory approaches and national standards on radon in dwellings, workplaces and large buildings” (**RAS – Regulatory Approaches Survey**) – 22 participants
- Questionnaire “Overview (status quo) of radon control technologies for new buildings (preventive measures used) and existing buildings (radon mitigation measures used)” (**RCTS – Radon Control Technologies Survey**) – 16 participants
- Questionnaire „**LBCS - Large Building Case Study**“ - 15 case studies
- Outcome: Report on regulatory approaches and radon control technologies used in dwellings, workplaces and large buildings

Partner institutes within RadoNorm task 5.1

Leader: **Austrian** Agency for Health and Food Safety (AGES)

Partners:

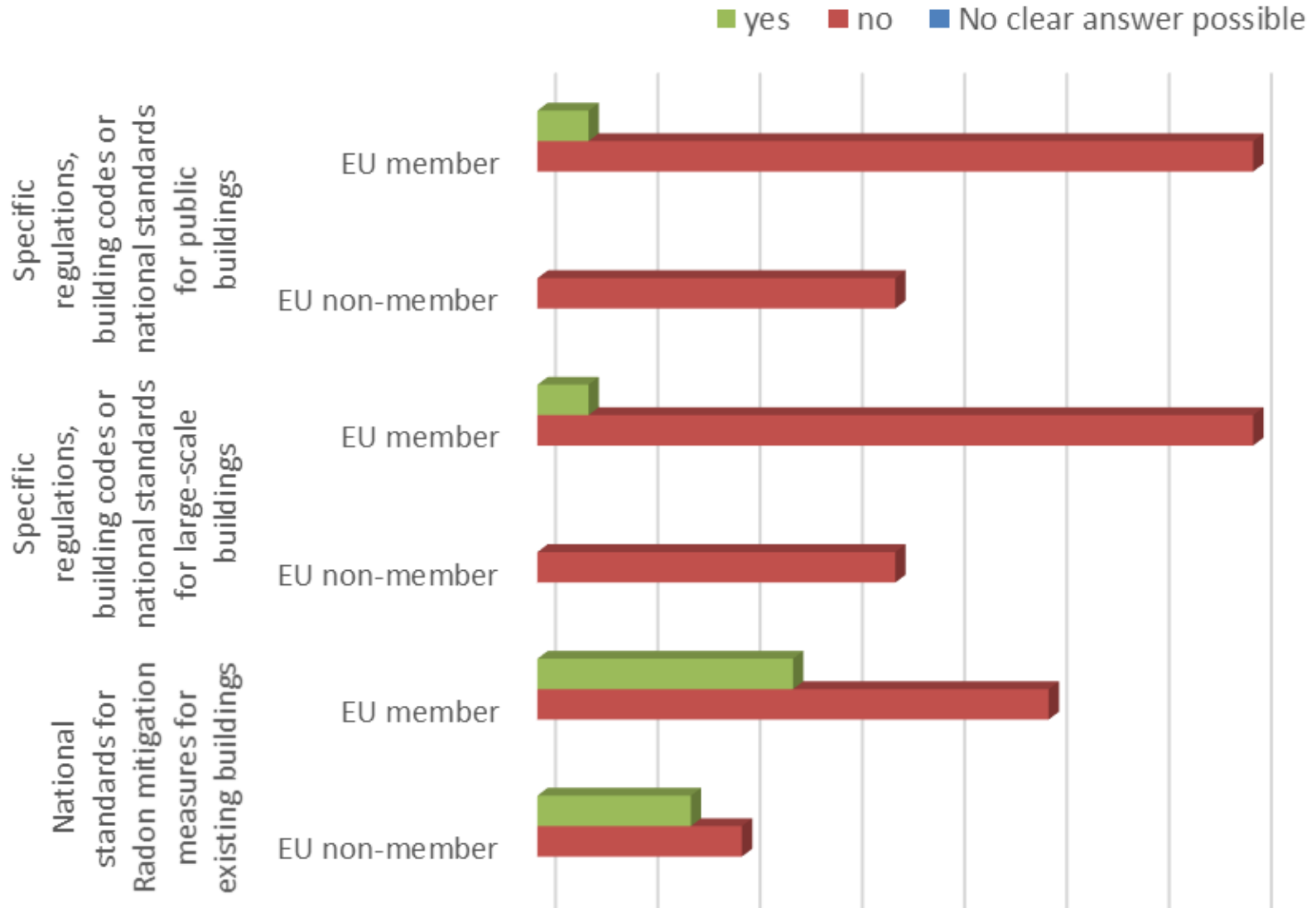
- National Radiation Protection Institute, **Czech Republic** (SURO)
- **Italian** National Institute of Health (ISS)
- **Norwegian** Radiation and Nuclear Safety Authority (DSA)
- Radiation and Nuclear Safety Authority, **Finland** (STUK)
- Central Mining Institute, **Poland** (GIG)
- Scientific and Technical Center for Building, **France** (CSTB)
- **Czech** Technical University (CVUT)
- University BABEȘ-BOLYAI, **Romania**

Available documents for different aspects of radon regulation

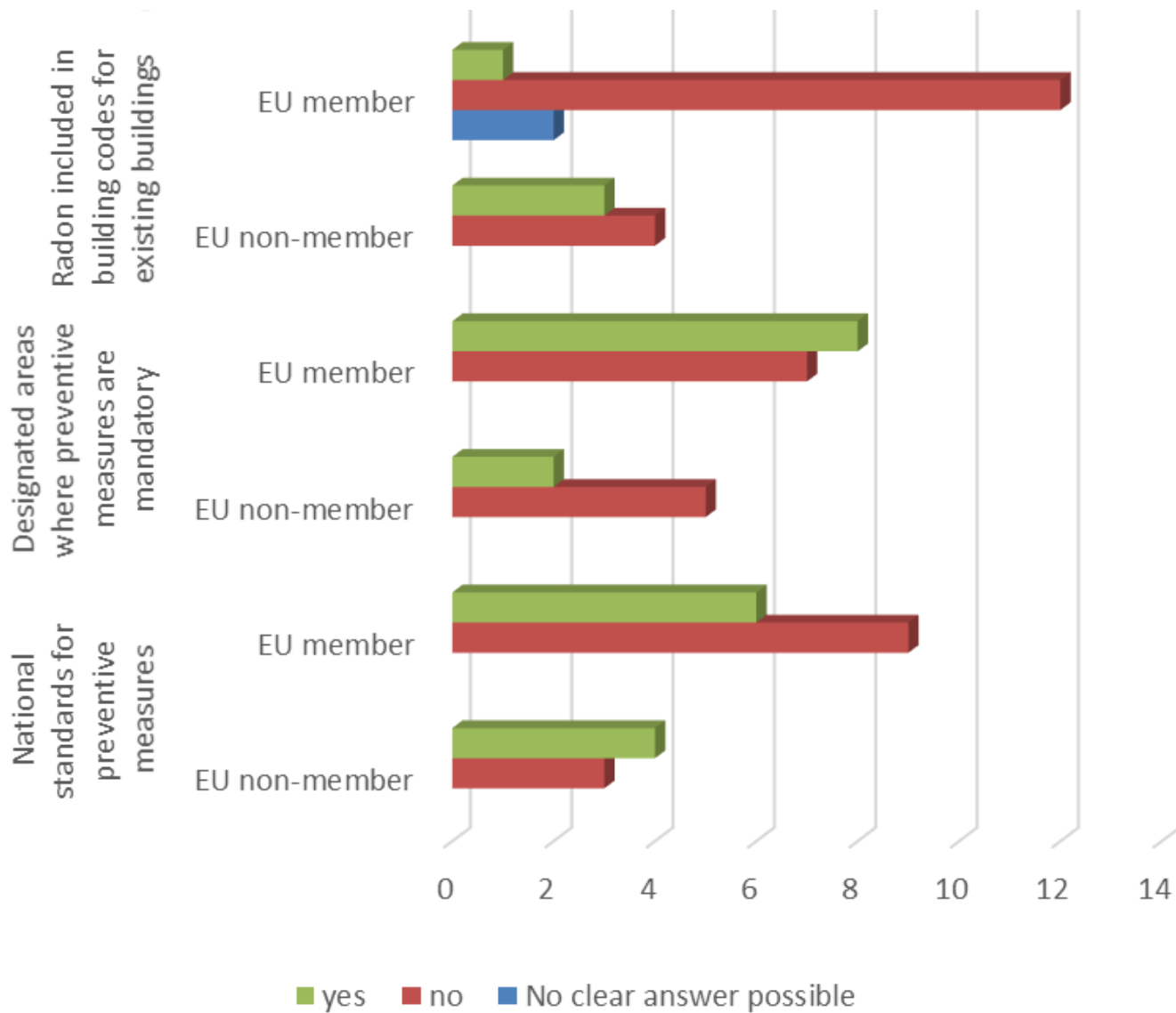
	Regulations for Radon exposure in dwellings	Building codes for Radon preventive measures for new buildings	Distinctions between provisions for new dwellings, workplaces & public buildings	National standards for radon preventive measures for new buildings	Specific building codes, regulations or national standards for new buildings in designated areas	Radon included in building codes for existing buildings (f.e. for renovation measures or thermal retrofit)	National standards for Radon mitigation measures for existing buildings	Specific regulations, building codes or national standards for large-scale buildings	Specific regulations, building codes or national standards for public buildings
EU member states									
Austria	X	X		X	X	X	X		
Belgium	X	X			X				
Croatia	X								
Czech Republic	X	X		X			X		
Estonia	X			X			X		
Finland	X	X							
France	X	X	X			X		X	X
Germany	X								
Ireland		X		X					
Italy	X	X							
Poland	X								
Portugal	X			X			X		
Romania									
Slovenia	X	X		X		X	X		
Sweden	X	X							
Non-EU countries									
Argentina	X								
Australia									
Canada		X	X	X	X		X		
Norway	X	X		X	X	X	X		
Russian Federation	X	X	X	X		X	X		
Switzerland	X								
United Kingdom	X	X	X	X	X	X			



Comparison of EU member & EU non-member states



Comparison of EU member & EU non-member states



Comparison of different approaches to Rn regulation

Country	%
Germany	2.4 %
Austria	4 %
Poland	7 %
Czech Republic	~ 10 %
United Kingdom	15 %
Belgium	20 %
Slovenia	25 %
Ireland	33 %
Estonia	50 %
France	100 %
Portugal	100 %

Percentage of Radon Priority Areas* of total surface

*Radon priority areas: Designated areas where radon measurements are mandatory for general workplaces in basements and ground floors

Comparison of different approaches to Rn regulation

Various criteria for the declaration of these designated areas:

- **Italy:** Areas where the % of buildings with annual Rn conc. $> 300 \text{ Bq/m}^3$ is higher than 15%.
- **UK:** A grid (25 x 25m) is defined as affected area, when at least 1% of existing or future dwellings are expected to exceed 200 Bq/m^3 .
- **Austria:** Municipalities with a predicted average Rn conc. $> 300 \text{ Bq/m}^3$.
- **Belgium:** Municipalities, where $> 5 \%$ of measured dwellings had Rn conc. $> 300 \text{ Bq/m}^3$.
- **Germany:** Areas where 75 % of the considered administrative units within this region have more than 10 % of buildings with radon levels $> 300 \text{ Bq/m}^3$. (among other criteria)
- **Finland:** Areas where $> 10 \%$ of measured buildings in this area exceeded 300 Bq/m^3 .
- **Estonia:** Rn conc. in soil air is $> 75.000 \text{ Bq/m}^3$ at least 10% of study points in a certain area.
- **Ireland:** Areas, where it is predicted that more than 10% of dwellings will be $> 200 \text{ Bq/m}^3$.
- **Czech Rep.:** Municipalities where $> 30\%$ of workplaces are predicted to be $> 300 \text{ Bq/m}^3$.
- **Poland:** Declaration is based on geological analysis and screening of radiation background.

Comparison of different approaches to Rn regulation

EXAMPLE OF A DETAIL OF THE SWISS APPROACH:

Maximum period until a remediation should be carried out depends on the function of the measured radon concentration and the residence time in the room.

Measured radon gas concentration [Bq/m ³]	Rooms with long residence time (> 30h/week)	Rooms with short residence time (15 - 30h/week)	Rooms with no residence time (< 15h/week)
300 – 600	10 years	30 years	No measures necessary
600 – 1000	3 years	10 years	
1.000 – 3.000	1 year	3 years	
> 3.000	< 1 year	1 year	

Authorities involved in Radon regulation



**Institute in
charge for**



RADON ACTION PLAN

Ministry of Social Affairs
and Health

SURVEILLANCE
OF WORKERS

BUILDING CODES

Municipal administrations

STUK (Radiation and
Nuclear Safety
Authority)

**Authorities in
charge for radon
exposure**

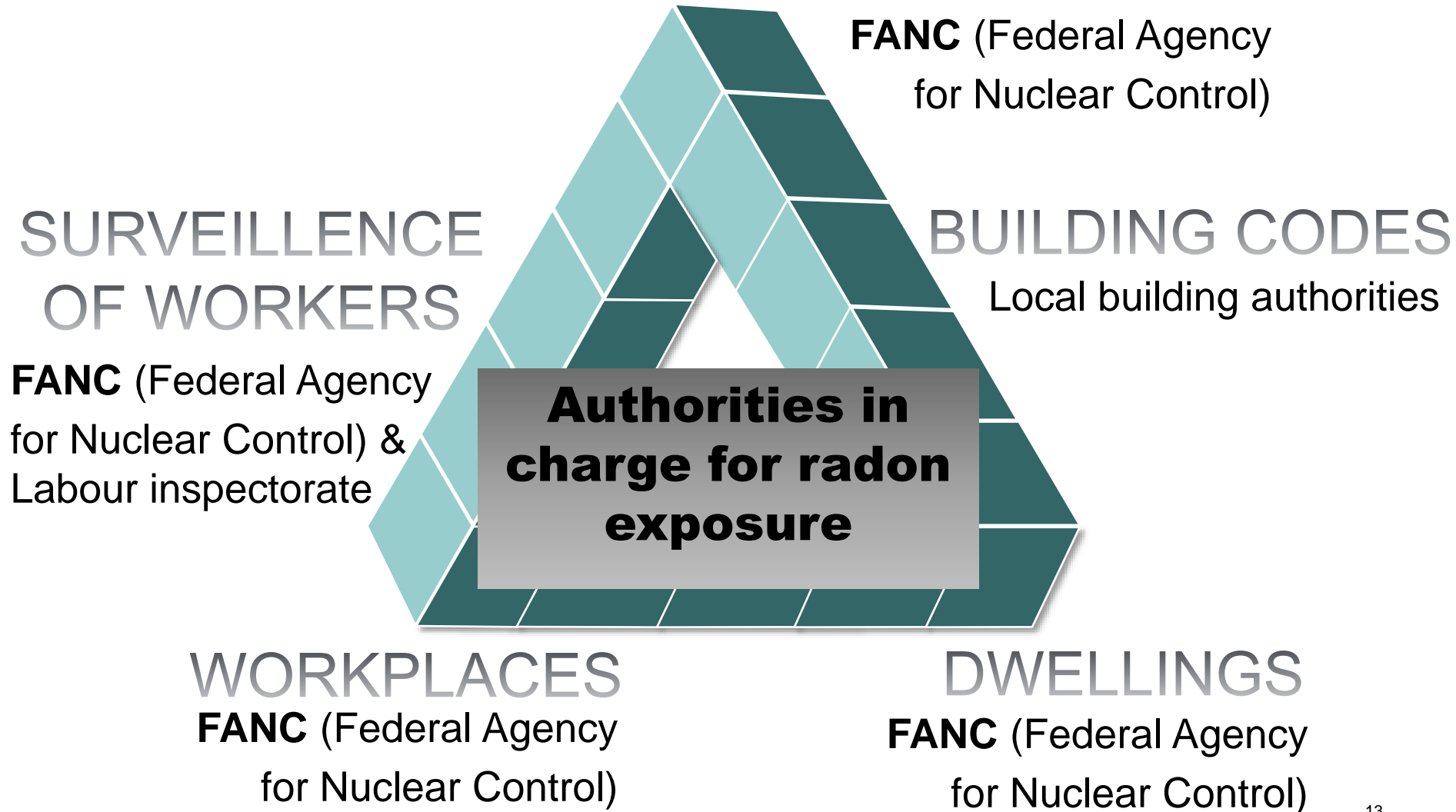
WORKPLACES
STUK (Radiation and
Nuclear Safety Authority)

DWELLINGS
Ministry of Social Affairs
and Health

**Institute in
charge for**



RADON ACTION PLAN



**Institute in
charge for**



RADON ACTION PLAN

Department of Environment,
Climate and Communications

SURVEILLANCE
OF WORKERS

EPA (Environmental
Protection Agency)

BUILDING CODES

Department of Housing,
Planning and Local
Government

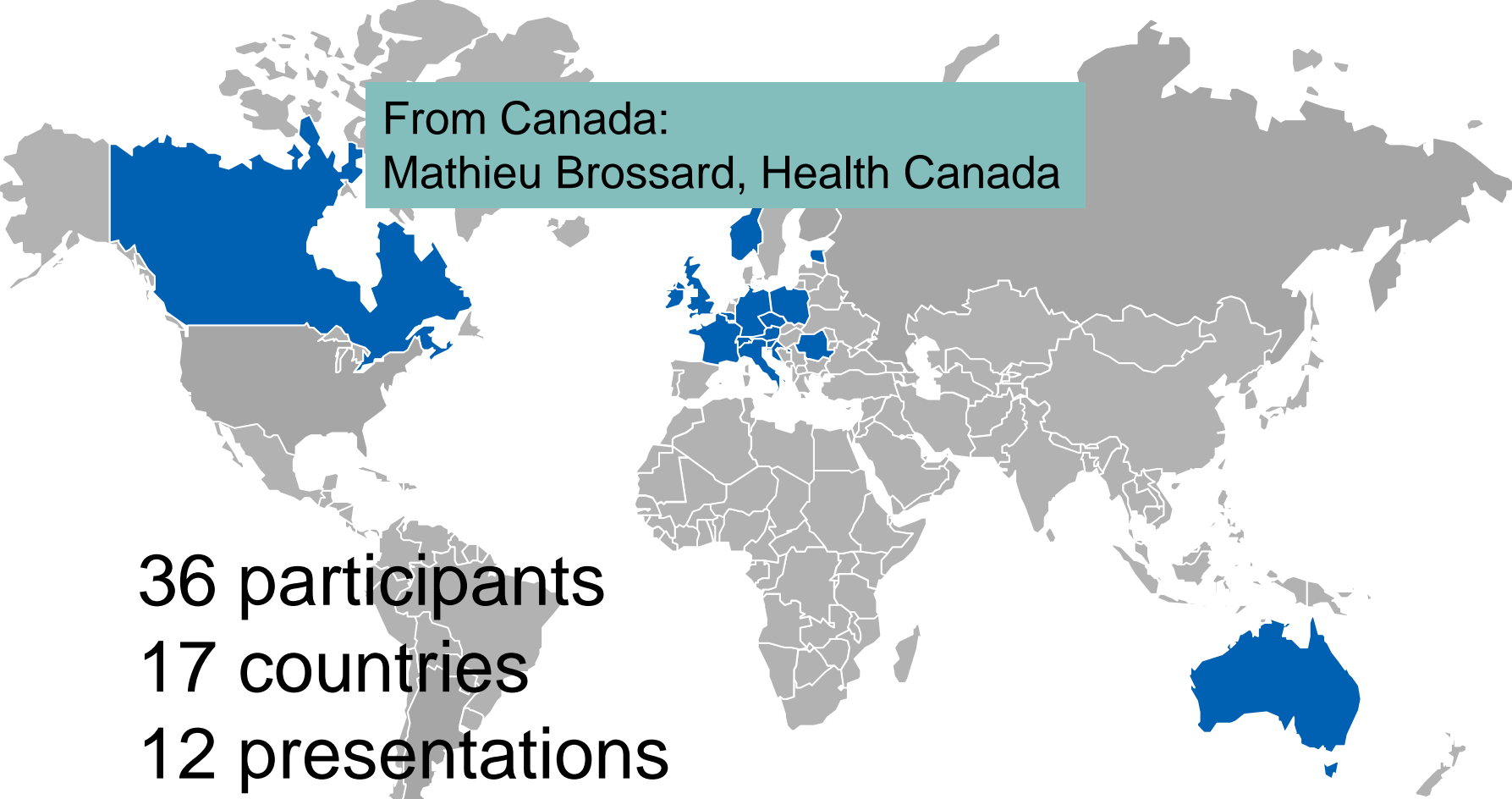
**Authorities in
charge for radon
exposure**

WORKPLACES

EPA (Environmental Protection
Agency)

DWELLINGS

Online workshop: June 27th/28th, 2022

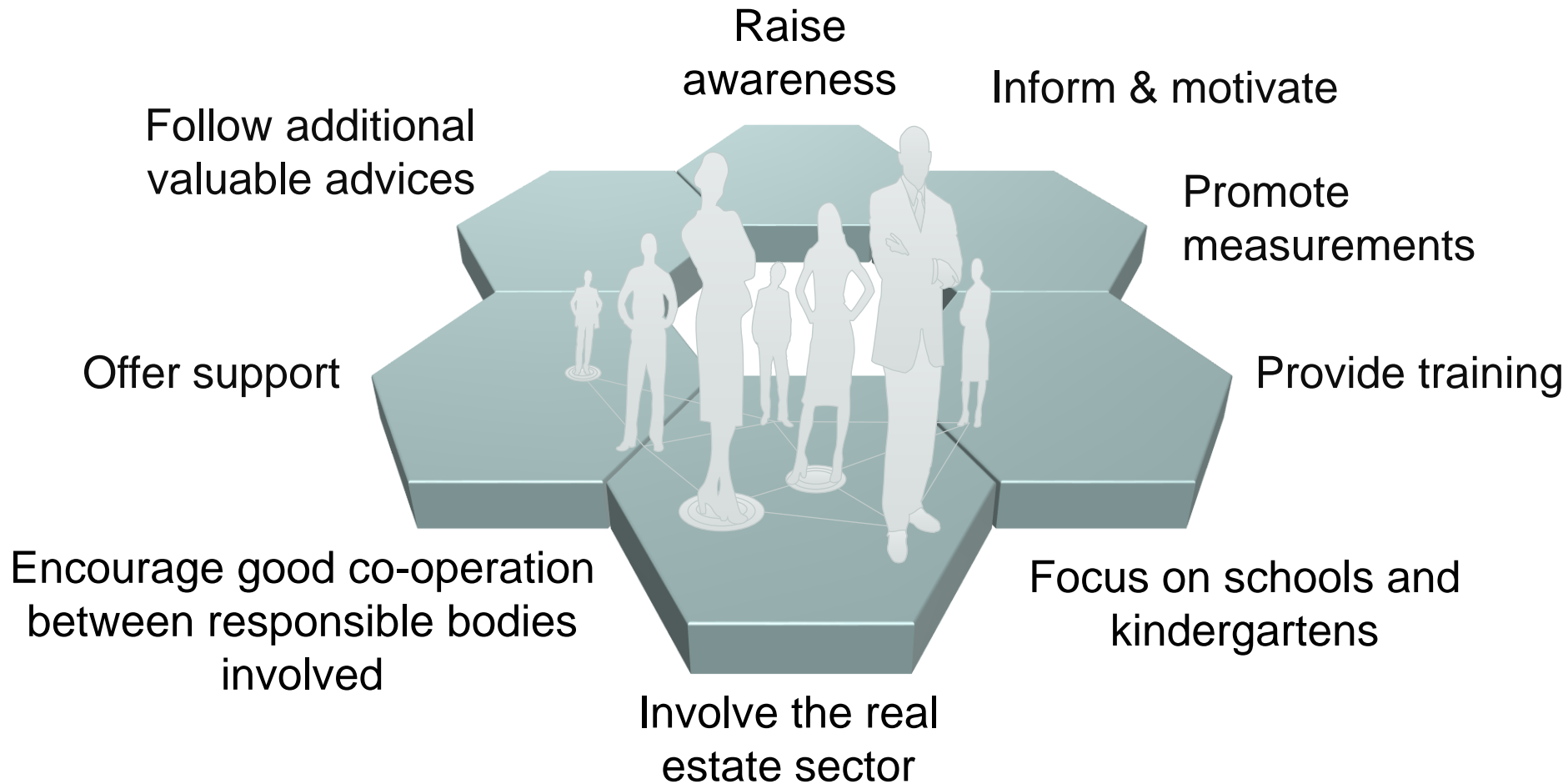


From Canada:
Mathieu Brossard, Health Canada

36 participants
17 countries
12 presentations
3 working groups sessions



List of recommendations for radon authorities for regulating radon in dwellings & workplaces

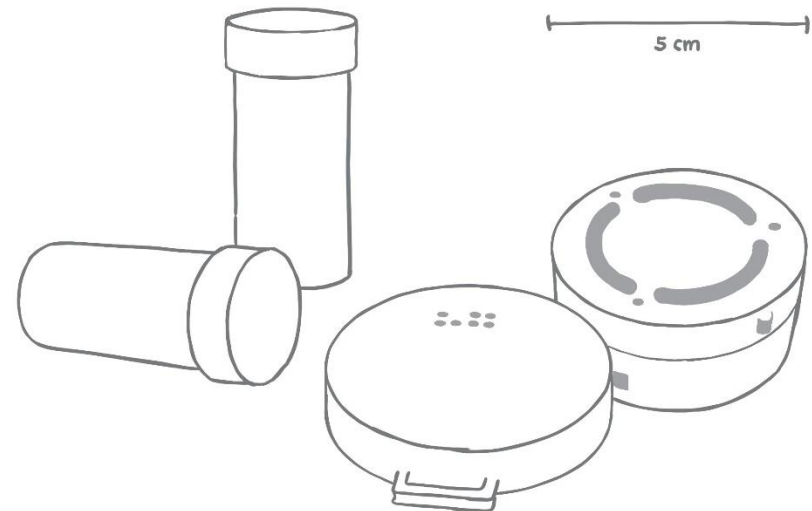


Raise Awareness

- Focus on Radon awareness campaigns for high risk workplaces being implemented through workplace safety regulator!
- Improve communication of the health risk and determination of the individual radon risk!
- Develop and improve better monitoring techniques for high radon locations, especially radon progeny in caves and mines!
- Maintain a national uniformity like national radon reference level and shared codes and standards!

Promote measurements

- Radon measurements should be prioritised in selected areas, but should not be limited to them!
- Provide **free radon tests** for **private dwellings**!
- Promote measurements for **social housing**!
- Allow municipalities to launch free local radon monitoring campaigns for the population!
- Provide **free control measurements** (after remediation)!



Provide training

- Provide training courses for building experts, that enable them to carry out radon mitigation measures in existing buildings and install radon preventive measures in new buildings!
- Train architects and building professionals how to install radon preventive measures!
- Train local governments to provide radon info for new builders and distribute brochures for new builders!
- Establish knowledge about radon with construction engineers!

Involve the real estate sector

- Guidance on professional obligations for agents to treat radon as a latent defect
- Implement radon measurement or radon info in case of new constructions and housing transactions
- Include the following radon questions in the contract of sale for homes: Has a radon test been carried out? If a radon test has been carried out, please supply the report? Has any action to reduce radon levels been undertaken?
- Regulate rental accommodations even more designated than owner-occupied dwellings
- Inclusion of radon in real estate Property Disclosure Statements
- Campaigns and actions to incentivize landlords to perform radon measurement in dwellings (ground floor and below) in the priority areas
- Requirement of radon mitigation in rental properties by tribunals to prevent conflicts between landlords and tenants

Technologies Survey - 16 respondents

Country	Organization
Switzerland	SUPSI
Spain	CSIC
Spain	Fundación Vivo Sano
Canada	ENVIROPORTA INC
Ireland	Dept Housing, Local Government and Heritage
Finland	STUK
Peru	Pontifical Catholic University
France	Solutions Radon
France	VOLTHELIOS
France	NEOSFAIR
Austria	AGES GmbH
Austria	PLAN-ED GmbH
Romania	Babes-Bolyai University of Cluj-Napoca
Norway	Norwegian Radiation and Nuclear Safety Authority (DSA)
Czech Republic	CTU in Prague
Italy	Protezione Radon S.r.l.

Results from the RCTS survey

Radon preventive measures used for family houses and residential buildings

Preventive measure	No. of countries
Passive or active soil ventilation of any type	9
Continuous waterproof or radon-proof insulation	7
Sealing of the wall/floor joint	5

Radon mitigation measures used for family houses and residential buildings

Corrective measure	No. of countries
Passive or active soil ventilation of any type	10
Sealing entry routes	8
Improving existing / installing a new mechanical ventilation of living spaces	7
Improving natural ventilation of living spaces	6
Improving cellar ventilation	5
Improving crawl space ventilation	3
House pressurization	3

Results from the RCTS survey

Soil depressurization systems:	Effectiveness (%)
Radon sump	50 – 99
Radon well	70 – 90
Perforated pipes in continuous gravel layer	70 – 95
Perforated tubes drilled into original soil	70 – 95
Soil pressurization	90 – 95
Sealing entry routes	20 – 60
Sealing of wall/floor joint	10 – 80
Continuous membrane – protective measure in new buildings	60 – 95
Continuous membrane – corrective measure in existing buildings	15 – 60
New floor + continuous membrane + soil depressurization	90 – 97
Improving natural ventilation of living spaces	0 – 50
Improving existing / installing a new mechanical ventilation of living spaces	25 – 70
Improving cellar ventilation	10 – 50
Improving crawl space ventilation	70 – 90
House pressurization	50 – 95

Results from the RCTS survey

Measure	Installation costs (€)	Annual operating costs (€)	Lifetime (years)
Soil depressurization systems:			
Radon sump – active	2.000 – 4.000	80 – 120	5 – 20
Radon sump - passive	1.000 – 2.000	0	15 – 50
Radon well	2.000 – 5.000	80 – 200	5 - 20
Perforated pipes in continuous gravel layer	5.000 – 7.000	60 – 100	5 - 20
Perforated tubes drilled into original soil	3.000 – 5.000	60 – 120	5 - 20
Soil pressurization	2.000 – 4.000	80 – 120	5 – 20
Sealing entry routes	300 – 500	0	5 – 15
Sealing of wall/floor joint	300 – 1.500	0	15 – 50
Continuous membrane – protective measure in new buildings	1.500 – 3.500	0	30 – 60
Continuous membrane – corrective measure in existing buildings	1.500 – 3.500	0	30 - 60
New floor + continuous membrane + active soil depressurization	5.000 – 10.000	80 – 120	5 – 20
Improving natural ventilation of living spaces	2.000 – 3.000	0	30 – 60
Improving existing / installing a new mechanical ventilation of living spaces	2.000 – 6.000	40 – 160	5 – 10
Improving cellar ventilation	1.000 – 2.500	40 – 100	5 – 10
Improving crawl space ventilation	1.000 – 2.500	40 – 100	5 – 10
House pressurization	1.500 – 5.000	40 – 160	5 – 10



Summary & Conclusions

- Most of the participating countries (including Non-EU countries) of the RAS survey have quite advanced regulations for radon exposure at workplaces.
- Regarding the implementation of radon preventive measures and mitigation methods for existing buildings into the building codes and national standards there is space for improvement in many of the participating countries.
- Several various approaches to protect people from radon have been detected, usually depending on the resources and national circumstances as well as on the experience and engagement of the people involved.
- To reach the aim to improve the successfulness of radon regulation measures it is central to increase the knowledge about radon for the different target groups.
- Federal and local authorities need to co-operate.
- Those that are responsible to do the measurements and take actions to reduce the Rn conc., must be made aware that they indeed have this responsibility and act accordingly.
- Unsatisfactory differences how the different local or regional authorities fulfil their role related to radon problems do occur.
- The members of the radon community are very open to share their experiences with each other.
- Even though regional and national conditions are unique, there are several things we can learn from each other regarding radon regulation and protection of workers and the public from radon.



**THANK YOU FOR YOUR
ATTENTION!**

ANY QUESTIONS?

