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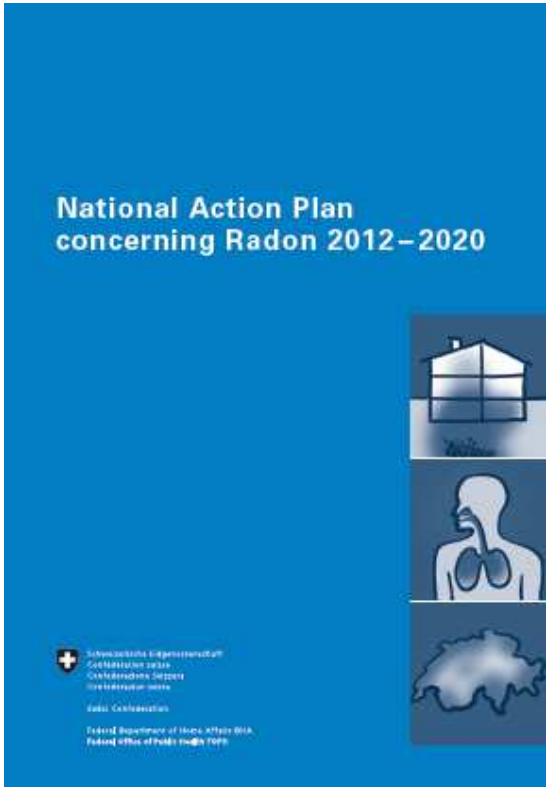
The Swiss national radon action plan 2012/2020

www.ch-radon.ch



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Radiation Protection Division

HERCA Workshop , ASN Paris 30 September 2014

Content

- Investigation of the radon problem since the early 1980s
  → RAPROS 1992
- Swiss radon program 1994 – 2014
  → census completed in the 26 cantons in 2004
- More than 150000 measurements since 1994 leading to the Swiss radon map (Alps and Jura strongly affected)

1. Revision of the legal regulations
2. Extending our knowledge of radon exposure in dwellings
3. Promotion of protective measures against radon in buildings
4. Planning an efficient strategy for remediation
5. Including radon in the training of construction experts
6. Improving public awareness to health problems caused by radon
7. Developing the tools and methods (R&D)

Radon Program Switzerland (RAPROS, 1992)

- Investigations in the early 1980s
- A major fraction of the average annual exposure to IR is **caused by indoor radon**

  - Radon measurements
  - Radon and geology
  - Construction materials
  - Radon & air tightness of buildings
  - Radon remediations

Projection:
- 10000 buildings (1%) over 1000 Bq/m^3
- 30000 buildings (3%) over 500 Bq/m^3
- 100000 buildings (10%) over 200 Bq/m^3

- Strongly affected regions in Switzerland (Alps & Jura)
- Introduction of radon regulations into the ordinance on RP 1994

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Ordinance on radiological protection, 1994

Limiting values of the annual radon concentration:
- homes and dwellings: **1000 Bq/m³**
- work places: **3000 Bq/m³**

Reference value for new and renovated buildings: **400 Bq/m³**

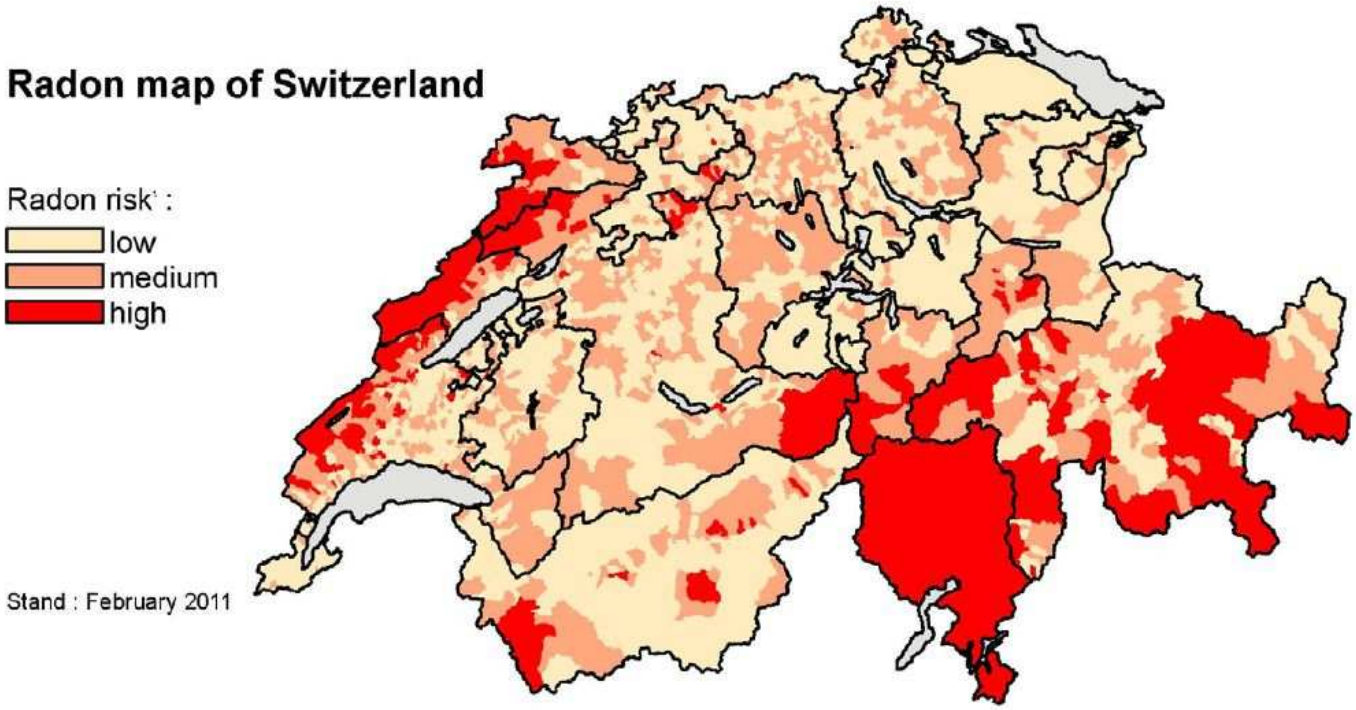
Measurements have to be performed by an approved measuring service and have to last at least one month

Campaigns were planned in collaboration with local authorities, which organized the dispatch of the dosimeters with an emphasis on regions where high radon levels were suspected

Total number of measurements in living spaces between **1994 and 2012: 156761**

All measurements with passive dosimeters and at least one month long, preferably performed in winter

Swiss radon map



Classification of communities (based on the annual average):

– Rn < 100 Bq/m^3 = low risk area
– 100 Bq/m^3 ≤ Rn < 200 Bq/m^3 = medium risk area
– Rn ≥ 200 Bq/m^3 = high risk area

Pilot study on effectiveness of remediation methods

Mean values: before 1314 Bq/m³
after 661 Bq/m³

Remediation method	Ventilation	Tightness	Drainage/ Radon well	Ventilation Hollow space
Number of cases	67	50	21	9
Average reduction all case	38%	26%	48%	49%
Average reduction Initial radon concentration <1000 Bq/m³	24%	31%	44%	52%
Average reduction Initial radon concentration >1000 Bq/m³	48%	22%	56%	48%

Drainage/Radon well, hollow space: effective, but generally expensive
Ventilation: more effective at higher radon levels
Tightness: more effective at lower radon levels

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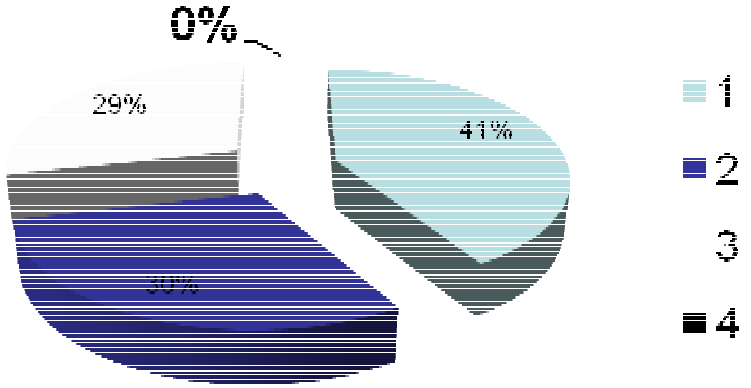
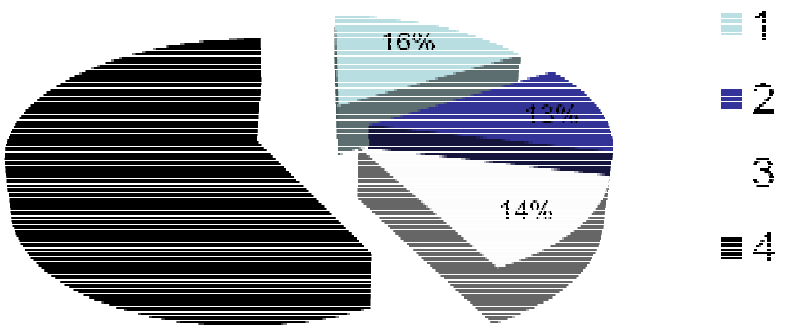
Why a national radon action plan ?

1980: natural ~ 100 mrem



2000: natural ~ 2.5 mSv



CF based on ICRP 65

2010: natural ~ 5 mSv

New risk assessment
New CF ICRP 115

1 Terrestrial
2 Cosmic
3 Human body
4 Radon

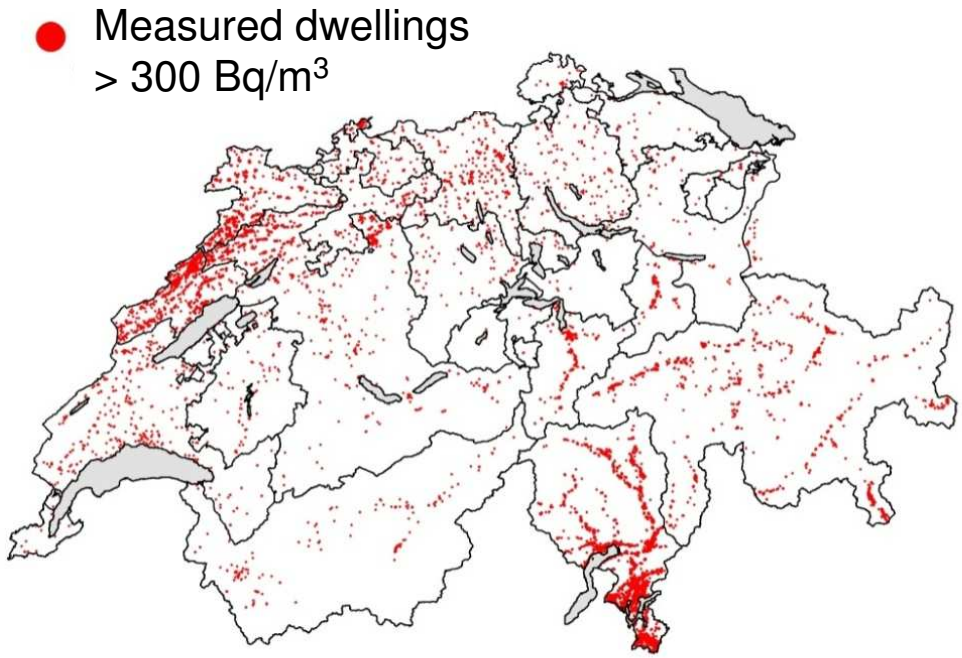
1. Revision of the legal regulations

- The current legal requirements are not consistent with the latest international recommendations (WHO, ICRP, etc.):

- Current limiting value for homes and dwellings: **1000 Bq/m³**

- Recommended upper reference level: **300 Bq/m³**

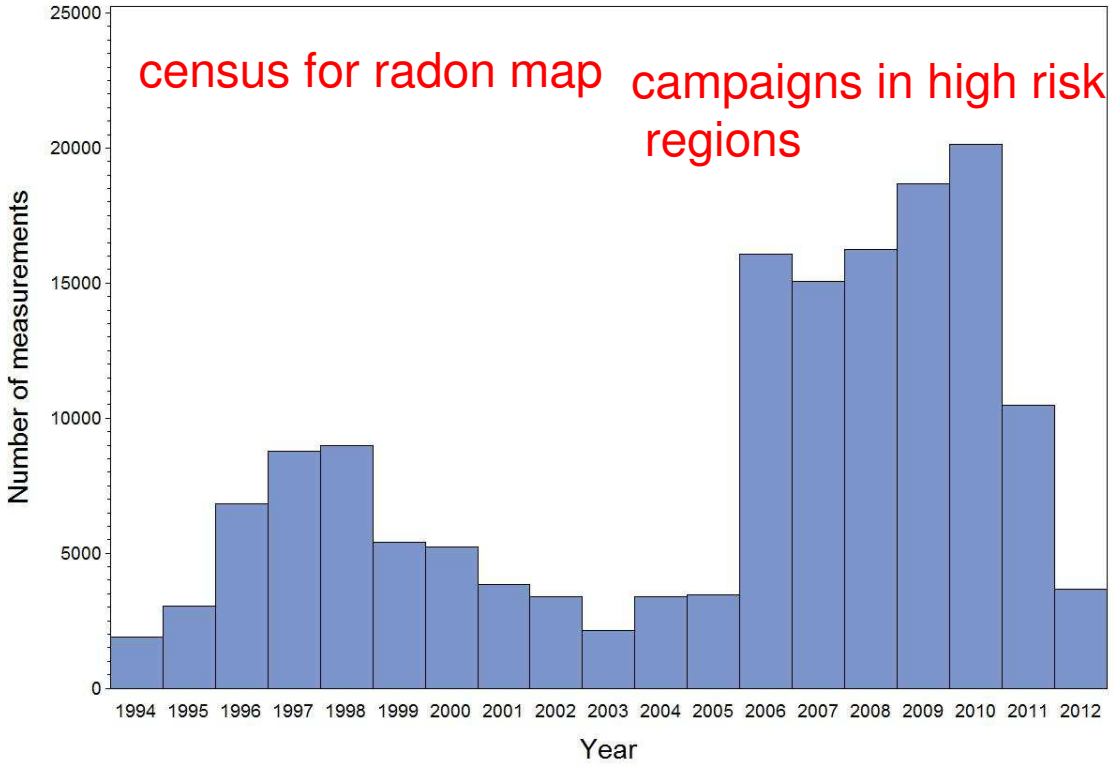
*Since Switzerland is strongly affected by radon, the entire country has to be considered as a high risk area (roughly **17000 measured buildings** have radon levels **> 300 Bq/m³**).*



2. Extending our knowledge of Rn exposure in dwellings

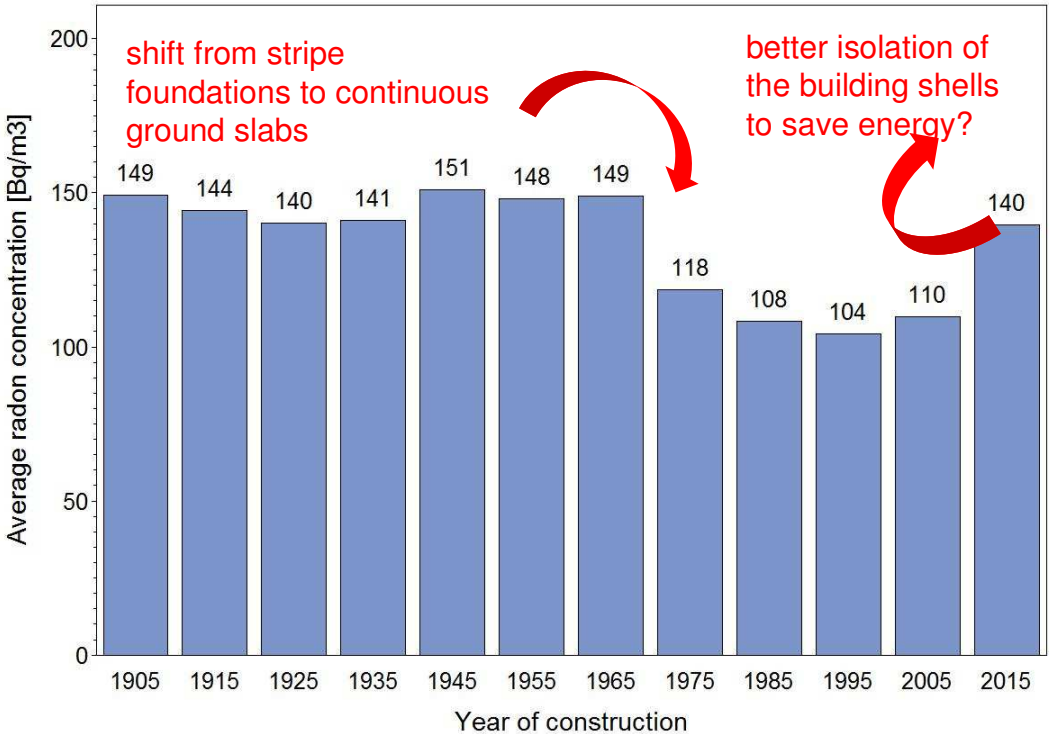
- Future measuring campaigns should not mainly be targeted to high risk areas, but more randomly population weighted.
- In view of the new recommendations, the denser populated regions in Switzerland turn into areas of medium to high radon risk.

Special emphasis will also be given to public buildings, particularly to schools, kindergartens, hospitals etc.



3. The promotion of protective measures against radon

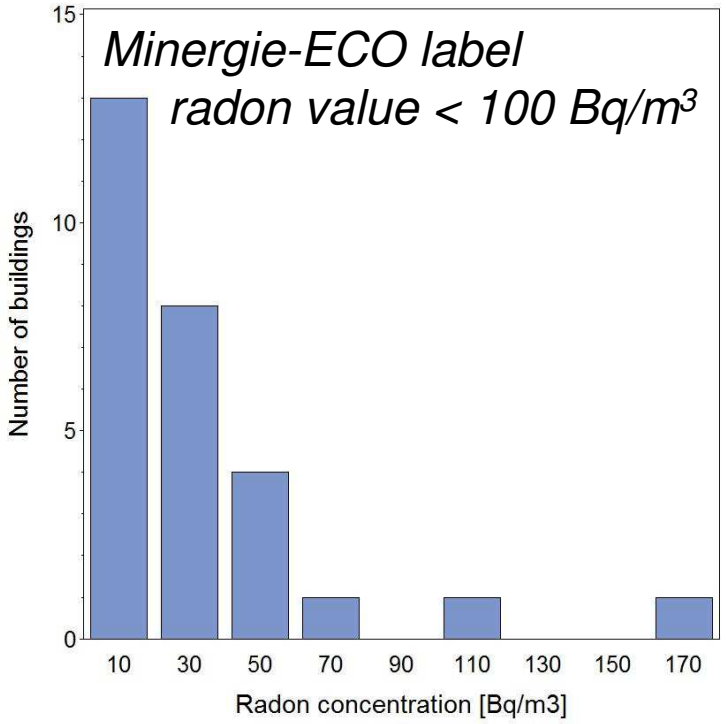
- If it would be guaranteed that new buildings are constructed radon safe, the radon problem would disappear in the long run.
- Prevention measures are the most cost-effective



4. Planning an efficient strategy for remediations

- With a RL of 300 Bq/m^3, it is estimated that the number of radon remediation in Switzerland will increase by a factor of ten.
- Start an initiative to monitor radon remediation and collect information about applied methods and techniques (see also the international platform **www.worldradonsolutions.info**)
- Identify the most effective methods
- Graded approach

A challenge arises from energy-conserving remediation showing a mean IRC increase of 26%
while new low energy houses & houses with geothermal heat collectors are generally radon safe.
Promote Rn issue in building standards of the Swiss Society of Architects & Engineers (SIA), e.g. SIA 180 (Mr. Roulet)



5. Including radon in the training of construction experts

- introduce the radon issue into all cursus of building professionals (engineers, architects, masons, electricians, etc.). Form everyone!
- organise advanced courses for the active professionals (official recognition of the formation, CAS/MASTER)
- offer a database on performed mitigations to building professionals & commit radon consultation and prevention to the private sector
- elaborate guides and standards on the methods of radon safe construction (SIA Norm)

→ **Pass knowledge to all professions concerned by construction**

- Lower legal values will require more competent radon specialists
- The FOPH has appointed 3 radon delegates who work on including the radon issue in the basic education of building experts, act as radon experts & supervise radon consultants (Mrs J. Goyette)

6. Improving public awareness to Rn impact on health

Most people in Switzerland do not know about radon:
60% have never heard about the radon problem
(30% in high risk areas, Gruson et al. 2010)

New brochures in collaboration with the Alpine countries distributed together with building permits

- Precautions for new buildings
- Mitigation measures in existing buildings
- The effect of retrofitting thermal insulation
- Radon measurement and evaluation

→ available at **www.ch-radon.ch**

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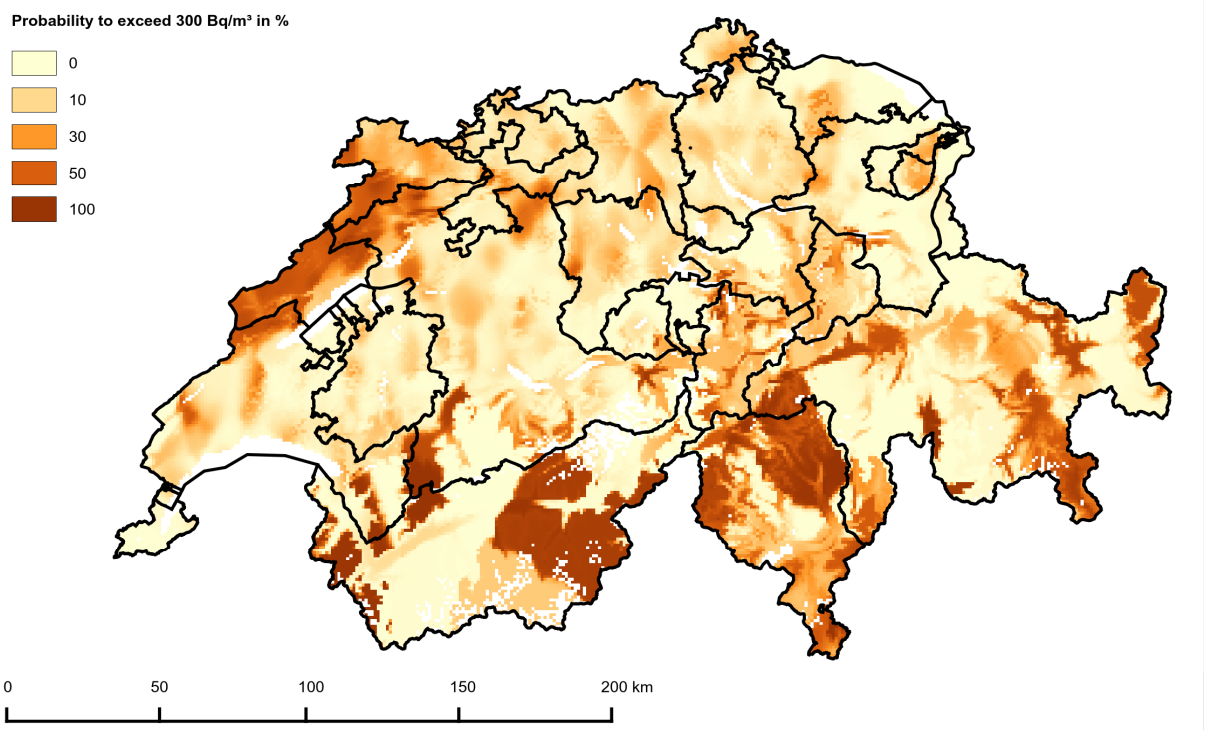
7. Developing the tools and methods

- ❑ Protocol for short term measurements (real estate transactions)
- ❑ Better statistical evaluation of available data (measurement/remediation)
- ❑ Higher knowledge of geological factors/influence of building characteristics

→ **a predictive mapping of the radon risk** (to be published in « Science of the Total Environment »

Kernel regression tool to map, predict & analyze IRC; could also be used for the interpolation of radon soil gas measurements by accounting for soil permeability & geology



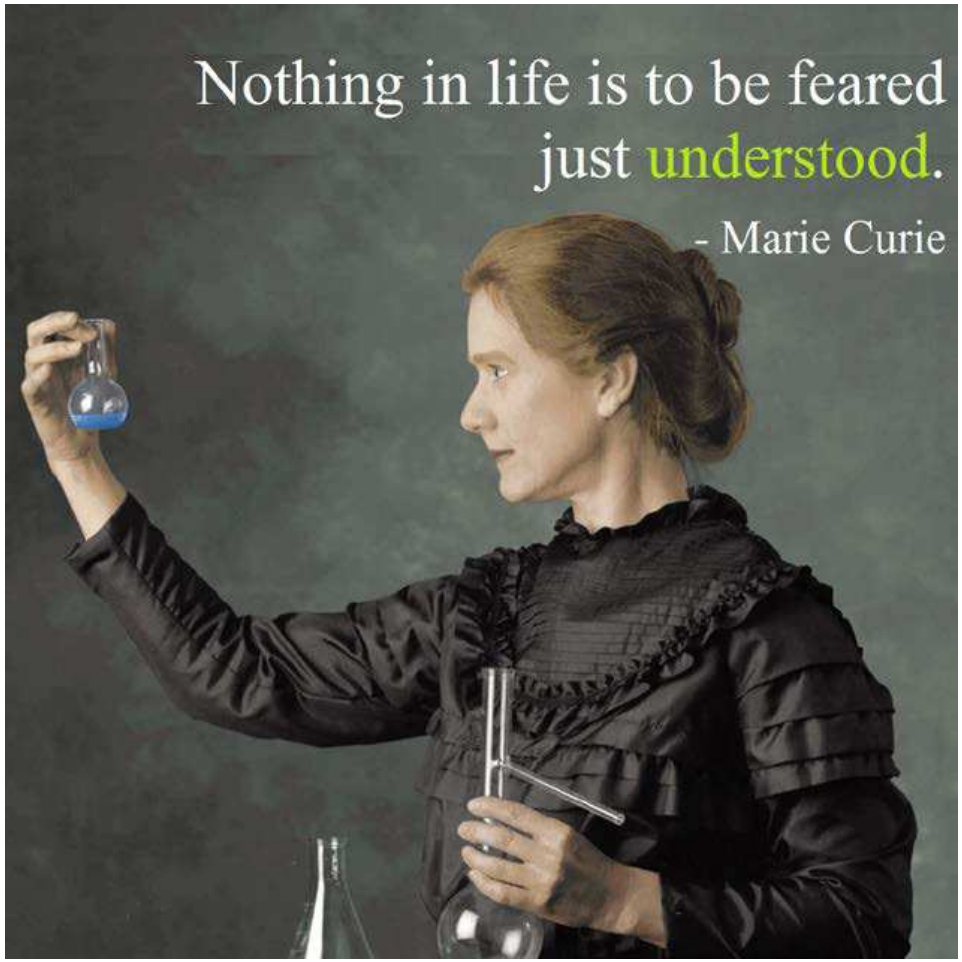
Priorities of the Swiss national radon action plan

- Radon & new buildings (prevention = the best solution to solve the radon problem in a long term perspective)
- Radon & Dwellings with high radon concentration (graded approach) Mitigation = current weakness of all protection programs against radon
- Radon in buildings receiving public (schools, children garden, hospital)
- Radon protection strategy coupling with energy saving transformations in buildings to avoid creating or enhancing the radon problem
- Radon: a theme for all aspects of building construction !
- Radon awareness for the protection of tenants
- Radon measurements, mapping & dose conversion factors: a lot to improve…

Key points for the discussion

- Should we only encourage measurements or regulate in this area?
- While the measurement is well pleasing, remediation is mandatory
- Is it an acceptable position that remediation for IRC below 3'000 Bq/m^3 can be done during the next transformation of the building?
- Radon dosimetry is relatively weak; would not it make sense to launch a research program at European level to improve it (e.g. p-size, F_{eq}, Th...) ?
- Could we not consider a protocol to exclude an unacceptable radon situation on the basis of a short measurement program (1 to a few days) ?
- Should we also consider periodic measurements (every 10 years for example) to assess the continuing effectiveness of remediation ?
- How to justify the same RL at home & at work when exposure times are about 3 times lower at work ? (Mrs L. Perazzi)

Many Thanks for Your Attention



Idea: launch a R&D program of indoor radon at European level.