Radon in Norway:
Implementing the national radon strategy

Will Standring

Ninth Irish National Radon Forum, 24 November 2011

Summary

- Studies of radon
- Radon risk in Norway
- NRPA recommendations for radon
- Norway's national radon strategy
- Implementing the strategy
- Challenges
- Status – so far so good??

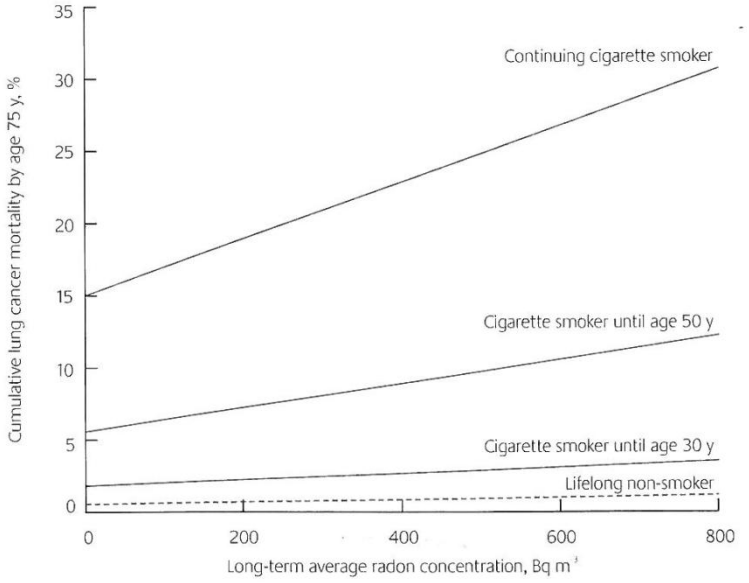
Studies of radon and lung cancer

- **Proposed as a likely cause for lung cancers in miners during the 1920s – increased mortality due to ”respiratory illnesses” first recorded in 1500s in miners working in Erz, Germany**
- **Radon recognised as a human carcinogen by the International Agency for Research on Cancer in 1988, based on data from mine workers**
- **The 11 largest studies on miners (60 000 individuals) were evaluated by the** Biological Effects of Ionizing Radiation **panel (BEIR VI, 1999).**
- **Indoor radon and lung cancer: Epidemiological studies**
- **Three large pooled analyses (2005-2006) indicate a linear relationship between estimated radon exposure and the risk of developing lung cancer, also at low/moderate exposure levels i.e. in the general population**
  - **The pooled analyses made corrections for smoking habits**
  - **The pooled analyses agree well with each other**
- **Studies of miners and the above-mentioned pooled analyses present strong evidence that exposure to radon can increase risk of lung cancer**

Radon and cigarette smoking

The pooled analyses have shown:

- **the relative increase in lung cancer risk from a given radon exposure is the same for smokers and non-smokers**
- **the absolute radon risk is ~25 times higher for smokers compared to non-smokers**
- **the majority of lung cancers induced by radon exposure are caused by a synergy effect between smoking and exposure to radon**
- **These lung cancers could have been avoided if the individual *either* had not chosen to smoke *or* had not been exposed to radon**

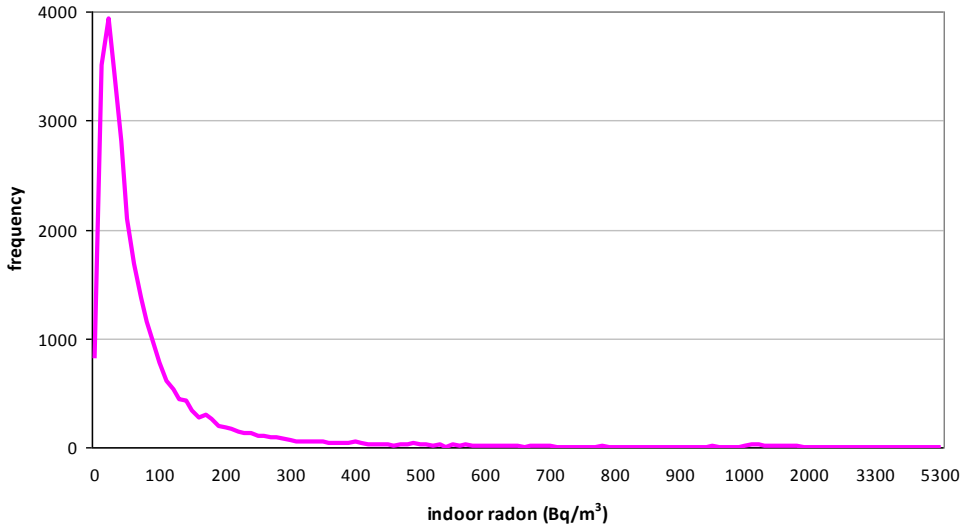


Cumulative absolute risk of death from lung cancer by 75 years of age versus long term average indoor radon concentration for continuing cigarette smokers, ex-smokers and lifelong non-smokers in the UK

Source: Radon and Public Health. Report from the Independent Advisory Group on Ionising Radiation. HPA – UK (2009)

Radon risk in Norway

- Radon concentrations in Norwegian homes are approximately log-normally distributed
- Most Norwegians are exposed to low/moderate levels in the home
- A linear increase in relative risk proportional to indoor radon exposure is assumed, with no lower threshold value
- About 300 new cases of lung cancer will occur each year in Norway where inhalation of radon is deemed as a contributing cause
- ~70 % of these lung cancer cases occur at indoor radon concentrations of below 200 Bq/m³



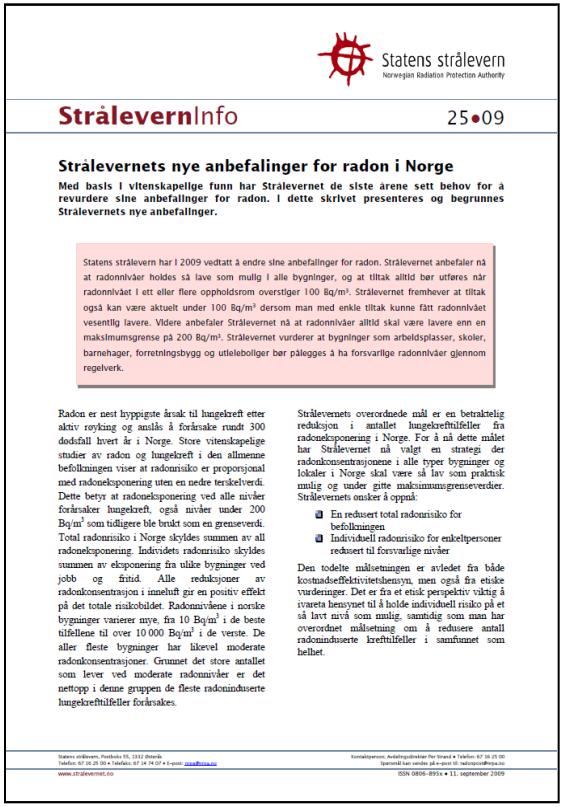
Results from a national radon mapping campaign in dwellings 2000-2001.

One radon measurement per dwelling, calculated as the annual average. Notice change of scale intervals on x-axis at indoor radon concentrations >1000 Bq/m³; Total number of dwellings measured approximately 29 000. [StrålevernRapport 2001:6] available on www.nrpa.no (in Norwegian).

National average (homes) estimated as 89 Bq/m³

NRPA recommendations for radon - 2009

- All buildings should have radon levels as low as reasonably achievable and within recommended limits:
  - 100 Bq/m^3 – Action Limit
  - 200 Bq/m^3 – Maximum Limit
- All buildings should be measured for radon regularly and always following modifications
- Radon measurements should be performed long-term during winter months using track-etch detectors
- Radon mitigation measures in existing buildings should be source-specific
- Radon measurements should be repeated after mitigation measures have been carried out



Statens strålevern
Norwegian Radiation Protection Authority

StrålevernInfo 25•09

Strålevernets nye anbefalinger for radon i Norge

Med basis i vitenskapelige funn har Strålevernet de siste årene sett behov for å revurdere sine anbefalinger for radon. I dette skrivet presenteres og begrunnes Strålevernets nye anbefalinger.

Statens strålevern har i 2009 vedtatt å endre sine anbefalinger for radon. Strålevernet anbefaler nå at radonnivåer holdes så lave som mulig i alle bygninger, og at tiltak alltid bør utføres når radonnivået i ett eller flere oppholdsrom overstiger 100 Bq/m³. Strålevernet fremhever at tiltak også kan være aktuelt under 100 Bq/m³ dersom man med enkle tiltak kunne fått radonnivået vesentlig lavere. Videre anbefaler Strålevernet nå at radonnivåer alltid skal være lavere enn en maksimumsgrense på 200 Bq/m³. Strålevernet vurderer at bygninger som arbeidsplasser, skoler, barnehager, forretningsbygg og utleieboliger bør pålegges å ha forsvarlige radonnivåer gjennom regelverk.

Radon er nest hyppigste årsak til lungekreft etter aktiv røyking og anslås å forårsake rundt 300 dødsfall hvert år i Norge. Store vitenskapelige studier av radon og lungekreft i den allmenne befolkningen viser at radonrisiko er proporsjonal med radoneksponering uten en nedre terskelverdi. Dette betyr at radoneksponering ved alle nivåer forårsaker lungekreft, også nivåer under 200 Bq/m^3 som tidligere ble brukt som en grenseverdi. Total radonrisiko i Norge skyldes summen av all radoneksponering. Individets radonrisiko skyldes summen av eksponering fra ulike bygninger ved jobb og fritid. Alle reduksjoner av radonkonsentrasjon i inneluft gir en positiv effekt på det totale risikobildet. Radonnivåene i norske bygninger varierer mye, fra 10 Bq/m^3 i de beste tilfellene til over 10 000 Bq/m^3 i de verste. De aller fleste bygninger har likevel moderate radonkonsentrasjoner. Grunnet det store antallet som lever ved moderate radonnivåer er det nettopp i denne gruppen de fleste radoninduserte lungekrefttilfeller forårsakes.

Strålevernets overordnede mål er en betraktelig reduksjon i antallet lungekrefttilfeller fra radoneksponering i Norge. For å nå dette målet har Strålevernet nå valgt en strategi der radonkonsentrasjonene i alle typer bygninger og lokaler i Norge skal være så lav som praktisk mulig og under gitte maksimumsgrenseverdier. Strålevernets ønsker å oppnå:

- En redusert total radonrisiko for befolkningen
- Individuell radonrisiko for enkeltpersoner redusert til forsvarlige nivåer

Den todelte målsetningen er avledet fra både kostnadseffektivitetshensyn, men også fra etiske vurderinger. Det er fra et etisk perspektiv viktig å ivareta hensynet til å holde individuell risiko på et så lavt nivå som mulig, samtidig som man har overordnet målsetning om å redusere antall radoninduserte krefttilfeller i samfunnet som helhet.

ISSN 0804–895x • 11. september 2009

The national radon strategy

- The Norwegian government published its national strategy for reducing radon exposure 1 July 2009.
- The strategy is based on the findings of a Norwegian multi-sector working group (2007-2008) and is in agreement with WHO Handbook on Indoor Radon.

- Two main goals:
  - All buildings in Norway to be below given (indoor) concentration values for radon.
  - (Indoor) radon concentrations are as low as reasonably achievable.

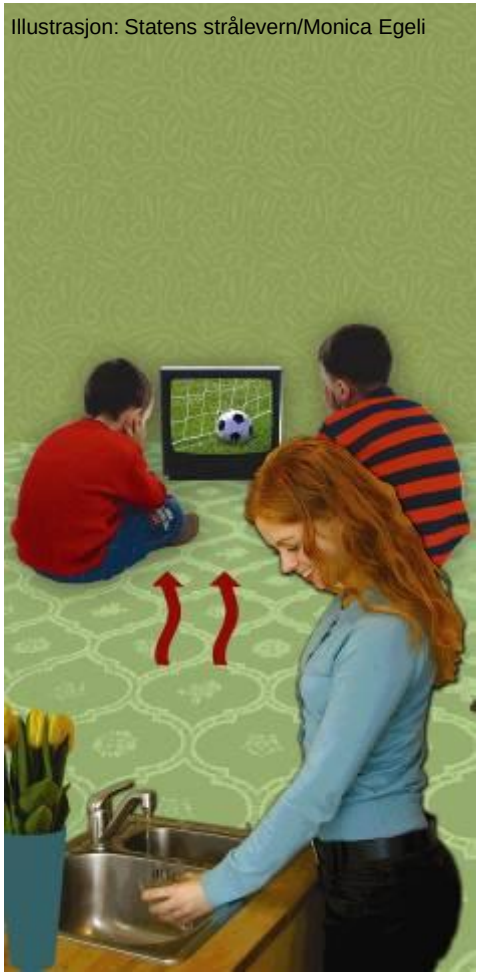
The national radon strategy

- **The choice of strategic goals is based on the assumption that the risk from radon is proportional to exposure (with no lower "safe" threshold value) such that all reduction of radon exposure should have the potential to yield a health benefit to the population.**
- **Strategy period: 2009 - 2014**
- **Radon can be present in all types of building and premises, and efficient prevention of radon risk therefore implies that radon levels should be reduced generally across society.**
- **The strategic goal of achieving ALARA is supplemented with legally binding limits where appropriate such that authorities have a basis for enforcement and compliance.**

… is made up of 6 sub-strategies

Sub-strategies all have separate goals and suggested initiatives:

- **Radon in land planning**
- **Radon with regard to new-build**
- **Radon in existing homes**
- **Local communities in Norway with extreme radon problems**
- **Radon in buildings and localities where the public have access**
- **Radon in the workplace**


Illustrasjon: Statens strålevern/Monica Egeli

Implementing the radon strategy

- **A Coordination Group was created October 2009 and has held regular meetings up to November 2011.**
  - **The aim was to coordinate and prioritise multi-sector radon initiatives and produce an overall action plan.**

Coordination group members:

The Norwegian Labour Inspection Authority , The Norwegian Directorate of Health, The Norwegian State Housing Bank , The Norwegian Institute of Public Health, Geological Survey of Norway , National Institute of Occupational Health, National Office of Building Technology and Administration, County Governor of Buskerud, County Governor of Oslo and Akershus, Local authorities in Oslo and Bærum municipalities & NRPA (leader + secretariat).

Implementing the radon strategy: Planning

- The Coordination Group agreed upon an overall action plan to implement the strategy
- Mitigation measures suggested in the government's strategy have been prioritised and grouped under 22 milestones
- Milestones are described as concrete objectives with a quantifiable outcome within a specified date
- The milestones have been incorporated into 13 proposed projects & cost estimates for the projects have been generated
- This report has been delivered to the government
- However, the funding required to complete the proposed projects remains uncertain

Implementing the radon strategy: Regulations

Two new regulations with legally binding limit values for indoor radon concentrations have been implemented in Norway in 2010:

- **New build**
- **Schools, kindergartens and rental accommodation**

Radon regulation: New-build

Implemented 1 July 2010 (legally binding from 1 July 2011)

Part of new "technical building regulations"

§ 13-5. *Radon*

- (1) buildings shall be planned and erected with radon mitigating initiatives such that the flow of radon (into the building) is minimised. The indoor radon concentration (in the finished building) shall not be over 200 Bq/m^3 .
- (2) The following shall at least be fulfilled:
  - a) Buildings planned for long-term occupation shall have a radon barrier against the ground.
  - b) Buildings planned for long-term occupation shall have suitable mitigation structures in the foundations which can be activated (e.g. by installing an electric fan) when the indoor radon concentration exceeds 100 Bq/m^3 .
- (3) Subsection (2) does not apply if it can be shown that it is not necessary for satisfying the demand stated in subsection (1).

Radon regulation: Schools etc.

- Part of new radiation protection regulations
- Implemented 29 October 2010
- Legally binding indoor radon limits for schools/kindergartens + rental accommodation (will come into effect 1 January 2014)
- 100 Bq/m^3 action level, 200 Bq/m^3 maximum level.
- Affects existing buildings and private housing (e.g. rented basements)

Radon regulation: Communication

- New regulations should help implement the radon strategy.
- Legally binding radon concentrations require more direct communication to local authorities, the public and building professionals to ensure compliance.
- Demand for “radon services” is expected to increase due to new regulations.
- Increased demand will lead to more people offering their services for radon mitigation.
- This increase requires concerted communication efforts & competence building to ensure the quality of services is maintained.

Challenges with regard to communication

- Coordination between relevant authorities
- Arena / discussion forum for authorities + building professionals
- Proper and complete guidance documentation
- Competence building
- Inspection / accreditation ?
- Informing the public / local authorities about required standards

Challenges when implementing the strategy

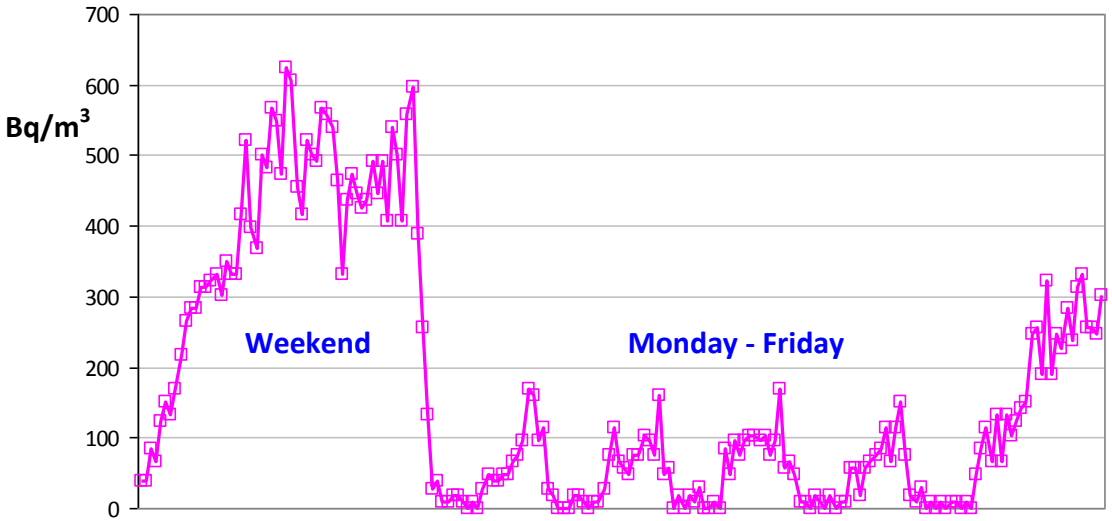
include the following:

- **Working with the new regulations – generating new guidance material**
- **Measurement standards:**
  - **Acceptable standards for measuring radon in different categories of buildings**
  - **Ensuring the quality of radon measurements**
  - **Diagnostics**
- **Radon mitigation techniques (prevention & mitigation):**
  - **Increasing competence in municipalities, authorities, entrepreneurs etc.**
  - **Minimum standards for radon mitigation techniques in existing buildings**
- **Knowledge development & quality assurance:**
  - **Good products available for measurement & mitigation**
  - **Information to the public**

Measurement standards: Schools

- On-going test of suggested protocol in 170 Oslo schools
- Large buildings/many rooms/active ventilation systems
- Track-etch detectors & continual logging of radon concentrations

Indoor radon measured over hourly intervals with a logging instrument in a school building



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Status – so far so good?

- Regulatory work on-going
- Coordination Group work:
  - A plan for 2011 – 2014 has been developed
  - Prioritisation and ambition level has been discussed
- However: Wide-ranging & ambitious goals
  - Will require long-term coordinated, systematic and sustained efforts
  - Additional funding for implementation work has not been finalised – prioritisation and ambition level may need reconsideration
  - Still a long way to go…