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RADON RISK REDUCTION IN EUROPE



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IS INDOOR RADON NATURAL ?

Radon is natural but indoor radon levels are not natural.

Indoor radon levels are ,in general, a consequence of the activities of the construction industry.

An elevated indoor radon level is an example of TENR (Technologically Enhanced Natural Radiation)

Long-term indoor radon surveys in some European countries*

COUNTRY AND POPULATION (IN MILLIONS)	NO. OF DWELLINGS SAMPLED	PERIOD AND APPROX DURATION OF MEASUREMENT	MEAN VALUE BQ/M ³	GEOMETRIC MEAN BQ/M ³	PERCENT. >200 BQ/M ³	MAX.** BQ/M ³
Czech Republic (10.2)	>150000	1984-present 1 year	140	110	12-18	25000
Denmark (5.5)	3120	1995-96 1 year	53	64	2.9	590
Finland (5.2)	3074	1990-91 1 year	120	84	12.3	33000
Germany (82.4)	>50000	1978-2003 1 year	49	37	1.6	>10000
Ireland (4.2)	11319	1992-99 1 year	89	57	7.5	1924
Italy (58)	5361	1989-1998 1 year	70	52	4.1	1036
UK (61)	450000	1980-2005 3-12 months	20	n/a	0.5	17000

*National Summary Reports at <http://radonmapping.jrc.ec.europa.eu/>

** These max values are those from national surveys only.
Higher values have been found in many countries

Indoor Radon in Sweden

. It is difficult to estimate accurately the number of dwelling units in Sweden that may be above the 200 Bq/m³ Reference Level .

In the scientific literature an average value for Sweden of about 110 Bq/m³ has been quoted and the percentage of dwelling units estimated to be over 200 Bq/m³ has been stated to be about 6%.

On the otherhand two large radon surveys have taken place in Sweden in recent years (ELIB 1991/92) and the Radon Survey (2000)). The “average” radon values determined by these surveys range from 75 to 140 Bq/m³ respectively with the percentage above 200 Bq/m³ being in the range 5% to 18% for ELIB and in the range 28% to 35% for the Radon Survey (2000). These differences reflect the differences between the design and methodologies of these two surveys .



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Key international organisations/documents addressing the reduction of radon risk

1. **World Health Organisation , “WHO Handbook on Indoor Radon (2009)”**
2. **EU BSS (European Commission Basic Safety Standards 2013)**
3. **IAEA BSS (International Atomic Energy Agency Basic Safety Standards ,*under review*)**
4. **ICRP (International Commission on Radiological Protection) , “Radiological Protection against Radon Exposure, (2013)”**



Extracts from the new EU Basic Safety Standards (BSS) in regard to Radon

Article 74.1 : **National Reference Levels for radon shall not exceed 300 Bq/m³**

Article 74.2 : **Member States shall promote action to identify dwellings with high Radon concentration** (as an annual average) exceeding the reference level and encourage, where appropriate, by technical or financial means, radon concentration-reducing measures in these dwellings.

Article 103 : ...**Member States shall establish a National Action Plan** addressing long-term risks from radon exposures in dwellings, buildings with public access and workplaces for any source of radon ingress, whether from soil, building materials and water. The action plan shall take into account the issues specifically set out in Annex XVI...”



Annex XVI . Radon Action Plan: List of items to be considered

1. Surveys to estimate indoor radon distribution...
2. Criteria to establish priorities.
3. Identification of types of workplaces & buildings with public access where measurements are required (with risk assessment).
4. Establishment of reference levels for existing dwellings, workplaces, buildings with public access and for new buildings.
5. Assignment of national responsibilities, coordination mechanisms and available resources for implementation of the action.
6. Strategy for reducing radon exposure in dwellings taking into account criteria for giving priorities.



Annex XVI . Radon Action Plan: List of items to be considered

7. **Strategies for** facilitating post construction **remedial action**.
8. **Strategy**, including methods and tools, **for preventing radon ingress in new buildings**, including identification of building materials with significant radon exhalation.
9. Schedules for reviews of the action plan.
10. **Strategy for communication** to increase public awareness and inform local decision makers, employers and employees of the risks of radon, including in relation to smoking.



Annex XVI . Radon Action Plan: List of items to be considered

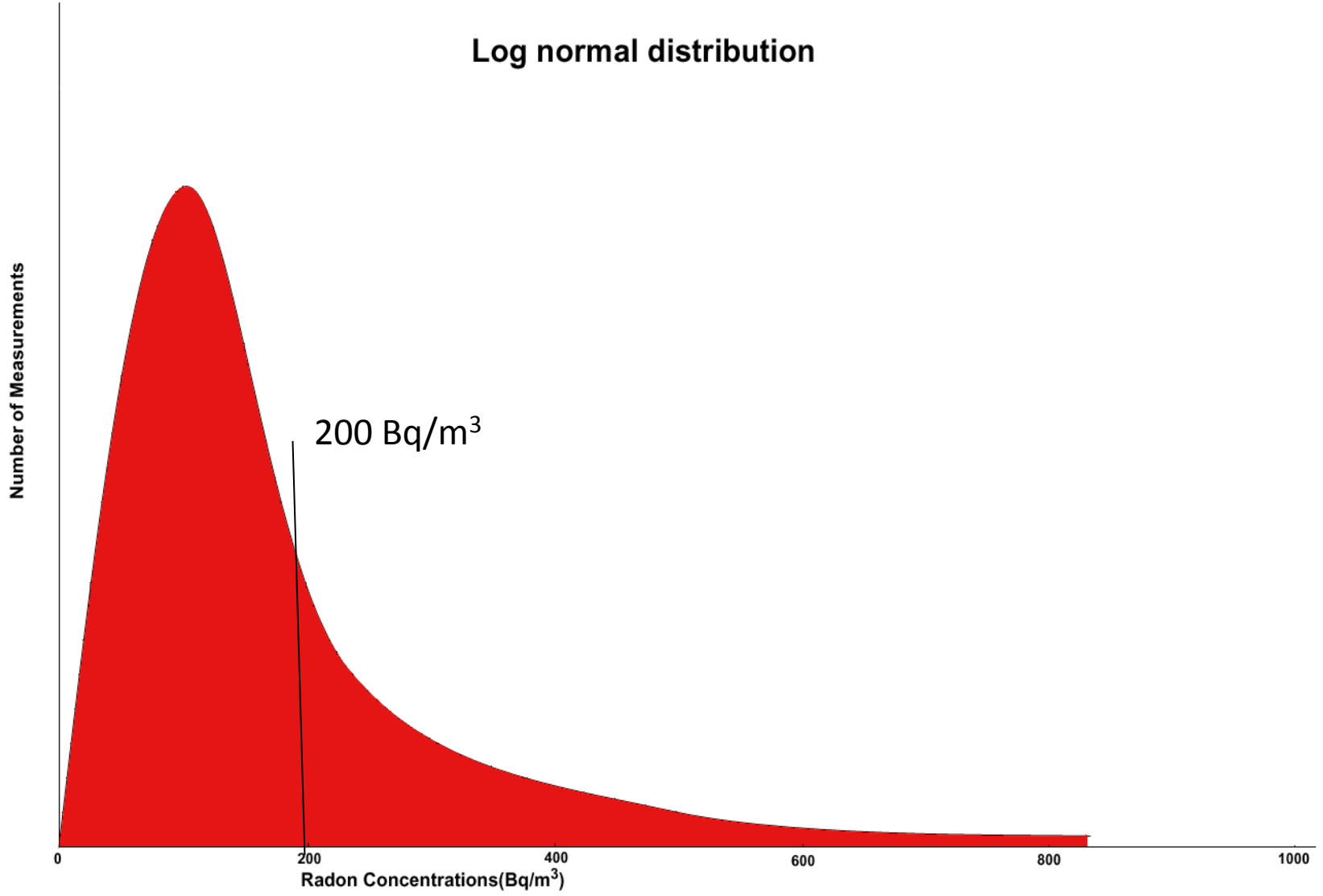
11. Guidance on methods and tools for measurements and remedial actions. Criteria for the accreditation of measurement and remediation services shall also be considered.
12. Where appropriate, provision of financial support for radon surveys and for remedial measures, in particular for private dwellings with very high radon concentrations.
13. Long-term goals in terms of reducing lung cancer risk attributable to radon exposure (for smokers and non-smokers).
14. Where appropriate, consideration of other related issues and corresponding programmes such as programmes on energy saving and indoor air quality.

SOME SURVEY ASPECTS TO CONSIDER IN DEVELOPING A RADON ACTION PLAN STRATEGY

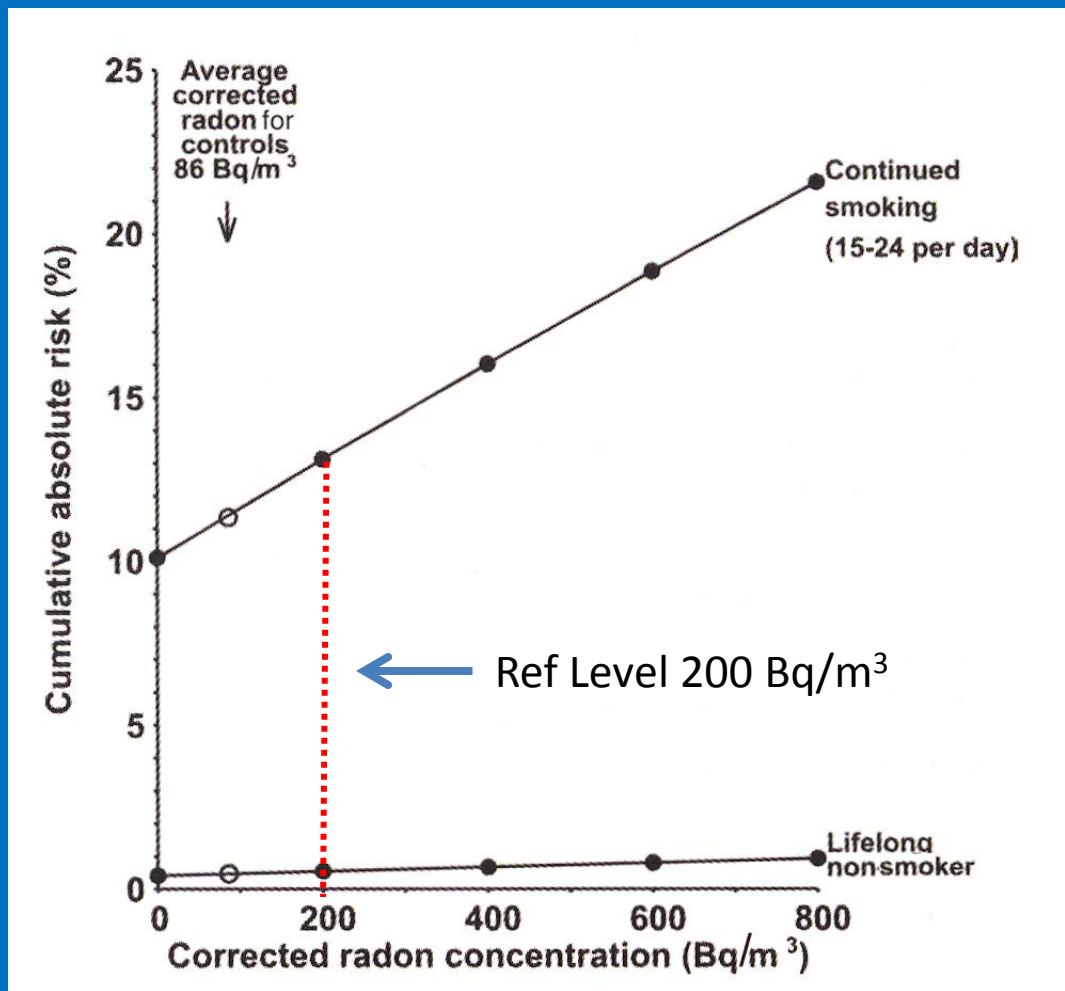
- (1) There may be more high radon houses in low radon areas having a high population density (like cities) than in high radon areas of low population density.
- (2) The distribution of indoor radon in many countries is approximately log.normal with most dwellings generally below some Reference Level such as 200 Bq/m³. **Most of the risk of radon related lung cancer will therefore occur to occupants of dwellings below the Reference Level.**

These considerations have important implications for a national radon action plan.

Log normal distribution



Cumulative absolute risk of death from lung cancer to age 75 years



*Darby et al Scand.J. of Work,Envir.& Health. Vol 32. Suppl 1. 2006

DEFINING A "HIGH" RADON AREA

There is not a uniform approach to this. In some countries such areas are defined in terms of a probability that a certain percentage of dwellings in an area will exceed a chosen Reference or Action Level. In some countries soil gas concentrations are used for defining a high radon area.

Examples :

1. **IRELAND.** A high radon area is a 10x10 km grid square where it is **predicted** ,on the basis of the National Survey, that 10 % or greater of the dwellings will exceed 200 Bq/m³.

2. **UNITED KINGDOM.** Here there are three categories of areas with respect to the 200 Bq/m³ Reference Level for dwellings:

Low probability areas where < 1 % exceed the Reference Level .

Intermediate probability areas where 1 to 10% exceed the Reference Level.

High probability areas where > 10% exceed the Reference Level.

3. **USA** . According to US EPA these are areas with highest radon potential and with a predicted average > 4 pCi/l (> 148 Bq/m³).

Predictive map based on National Radon Survey of Ireland (11319 homes were surveyed)

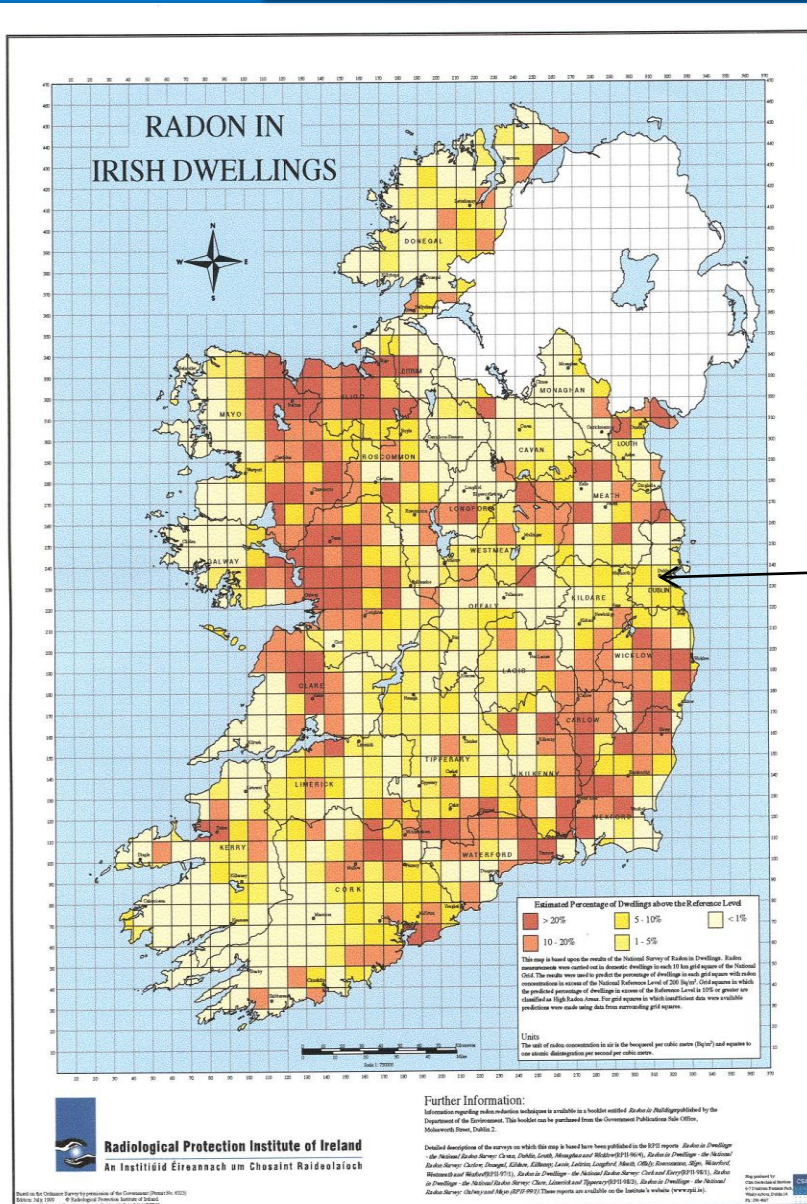
Predictive Map of radon in Irish dwellings; 7% of homes predicted $>200 \text{ Bq/m}^3$

High Radon Areas:

10 km grid squares in which 10% or greater of houses are predicted to exceed the national Reference Level

Dublin

Measured Mean indoor radon conc. = 89 Bq/m^3



Strategies to reduce radon in all dwellings to below 200 Bq/m³.

Find and remediate all existing dwellings above 200 Bq/m³.

Radon prevention construction of all new dwellings with a post-construction radon measurement.

Make post-construction radon measurement a necessary requirement to grant planning permission for defined dwelling modifications.

Radon measurement protocols to be part of all property transactions (buying/selling/renting).

Radon certification should be a necessary requirement for the granting of a mortgage by financial institutions.

COMMUNICATION BETWEEN
SCIENTISTS AND THE PUBLIC



Tack så mycket

Go raibh maith agaibh