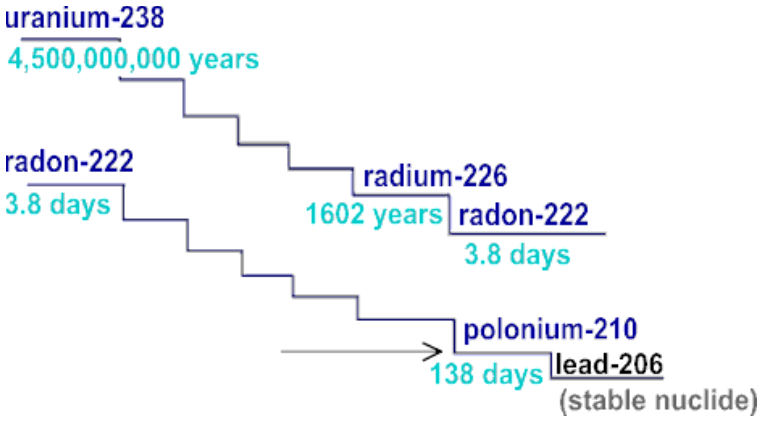
Los mapas de radón.
Experiencias internacionales.

Adolfo Figueiras

El radón en la naturaleza.

- El radón es un producto natural que procede indirectamente del U^{238}.
- Es un producto inestable que en su descomposición y en la de sus descendientes emite partículas alfa radiactivas.

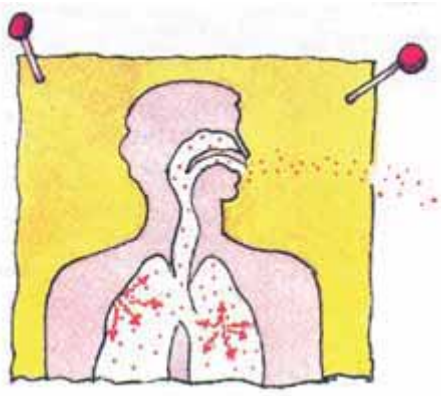


Antecedentes. Estudios en mineros

- Existía una enfermedad pulmonar desconocida en mineros en el siglo XIX.
- Fue identificada en 1879 en autopsias de mineros europeos como cáncer de pulmón (linfosarcoma).
- Se observó un exceso de muertes en mineros de uranio en USA, Checoslovaquia, Francia y Canadá.
- Se observó exceso de muerte en otros mineros en Suecia, Terranova, Suecia, Reino Unido, Francia y USA.

El radón como carcinógeno.

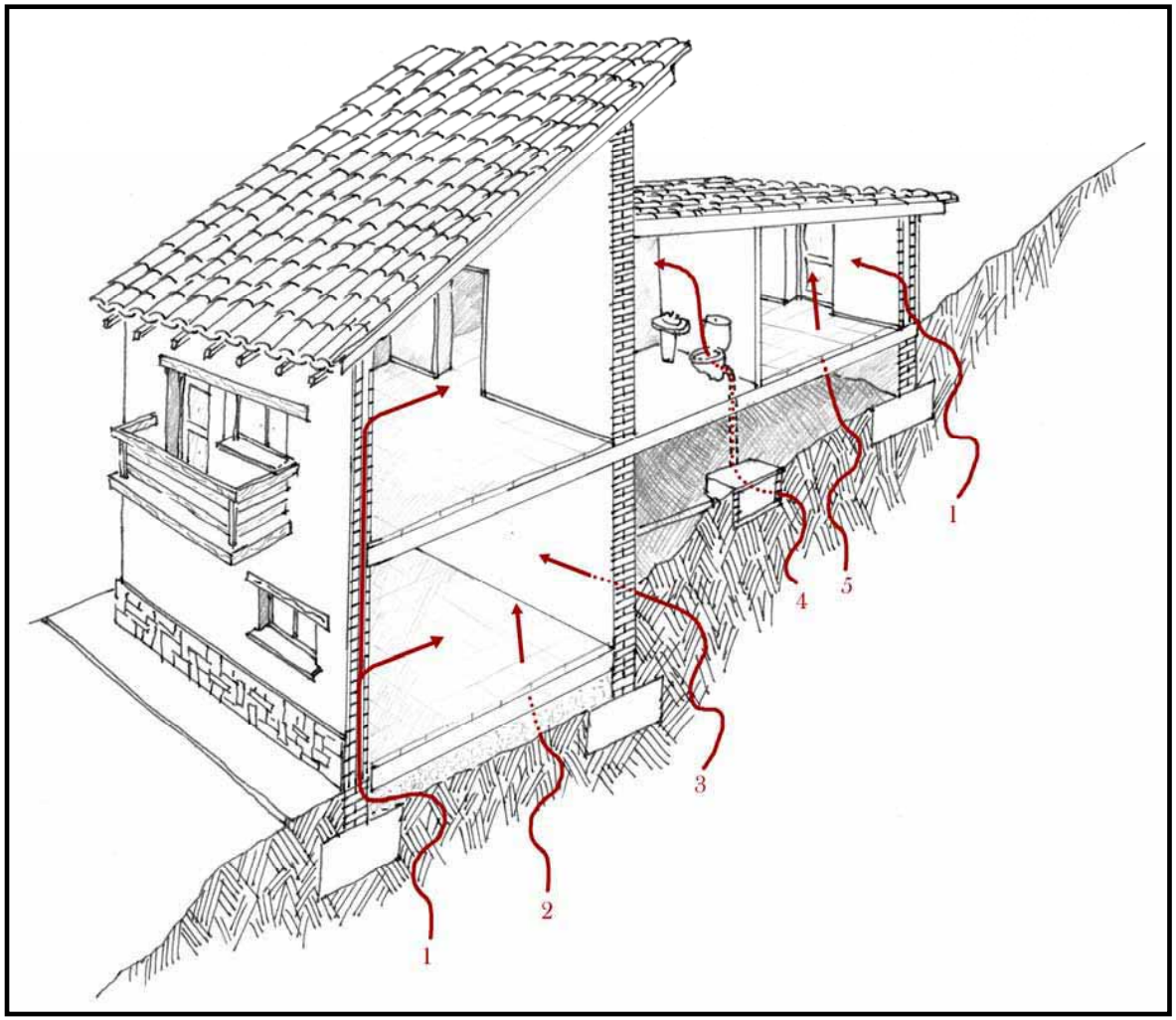
- El radón provoca cáncer de pulmón. La probabilidad de contraer cáncer de pulmón por el radón doméstico depende de:
  - La cantidad de radón en el domicilio.
  - El tiempo que se pasa en el domicilio
  - Si se es fumador o exfumador.



Estudios epidemiológicos sobre radón domiciliario

- Estudios poblacionales en los 80 y los 90 indican que un nivel elevado de radón domiciliario conlleva mayor riesgo de cáncer de pulmón.
- Diversos organismos deciden tomar medidas y fijar los llamados **“niveles de acción”**
  - EPA: 148 Bq/m^3
  - UE: 200 Bq/m^3
- Impacto en la **construcción de viviendas**, indicándose normativas en ciertos países o dando **subvenciones** (Reino Unido) para tomar medidas de mitigación.

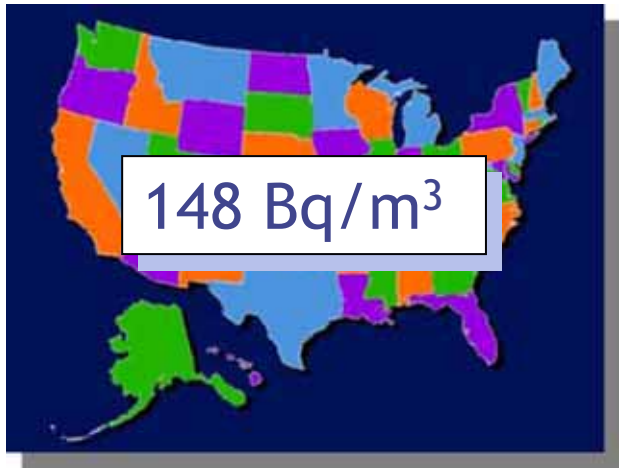
Problemática: Vías de penetración de radón al interior de los edificios



1- Por el interior de la cámara de aire de los muros exteriores.
2- A través de la solera
3- A través de los muros del sótano
4- A través de conductos de saneamiento
5- A través del forjado sanitario

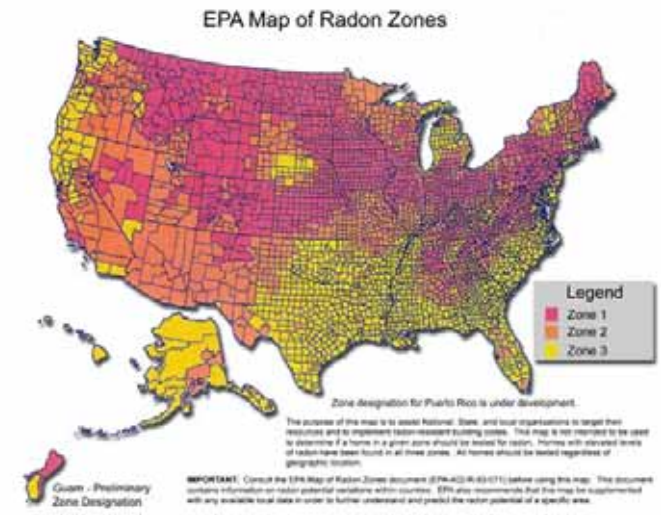
Mapas de Radón...

- Contaminante
- Factor de riesgo para el Cáncer de Pulmón
- Establecieron concentraciones de riesgo para la salud
- Establecer medidas preventivas.
- Mediciones de radón masivas para localizar aquellas áreas con mayores concentraciones radón en los domicilios



MAPAS DE RADON

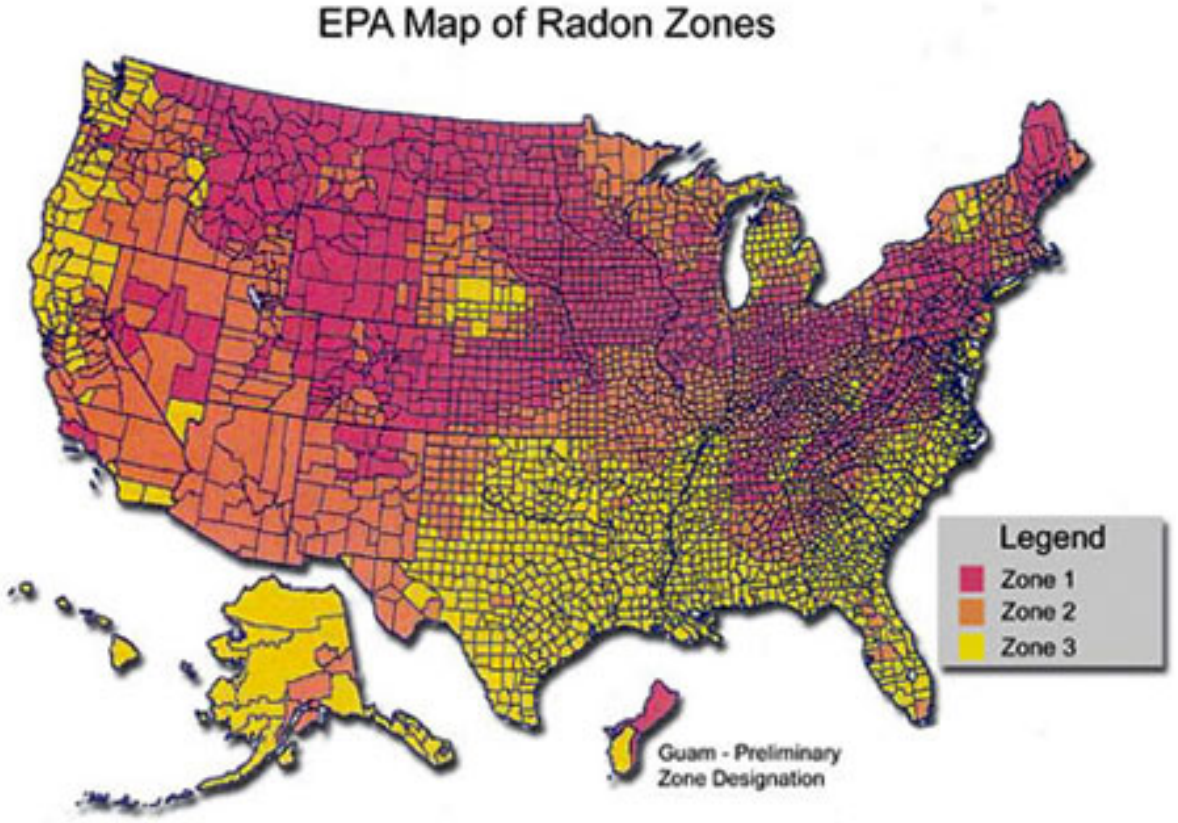
http://radon.com/radon/radon_map.html



Los mapas fueron desarrollados usando factores que determinan las potenciales concentraciones de radón:

1. Datos de medidas de radón
2. Geología
3. Radiactividad en el aire
4. Permeabilidad en el suelo

http://radon.com/radon/radon_map.html



	Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L (pico curies per liter) (red zones)	Highest Potential
	Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L (orange zones)	Moderate Potential
	Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L (yellow zones)	Low Potential

http://radon.com/radon/radon_map.html

EPA Map of Radon Zones

The purpose of this map is to assist National, State, and local organizations to target their resources and to implement radon-resistant building codes. This map is not intended to be used to determine if a home in a given zone should be tested for radon. Homes with elevated levels of radon have been found in all three zones. All homes should be tested regardless of geographic location. Important points to note:

- **All homes should test for radon**, regardless of geographic location or zone designation
- There are many thousands of individual homes with elevated radon levels in Zone 2 and 3. Elevated levels can be found in Zone 2 and Zone 3 counties.
- All users of the map should carefully review the map documentation for information on within-county variations in radon potential and supplement the map with locally available information before making any decisions.

	Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L (pico curies per liter) (red zones)	Highest Potential
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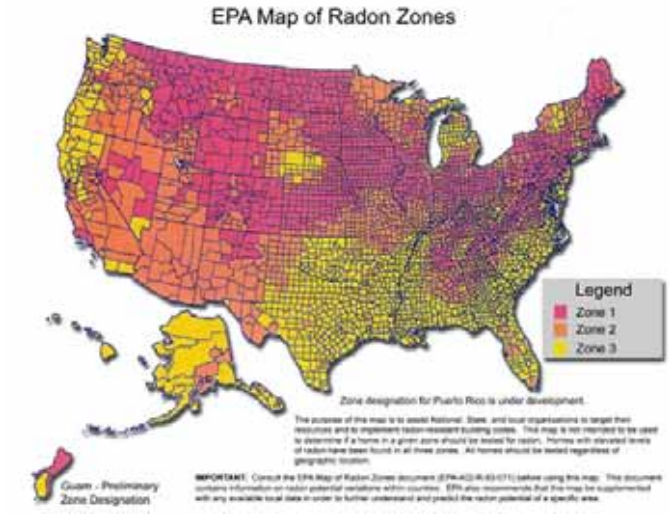
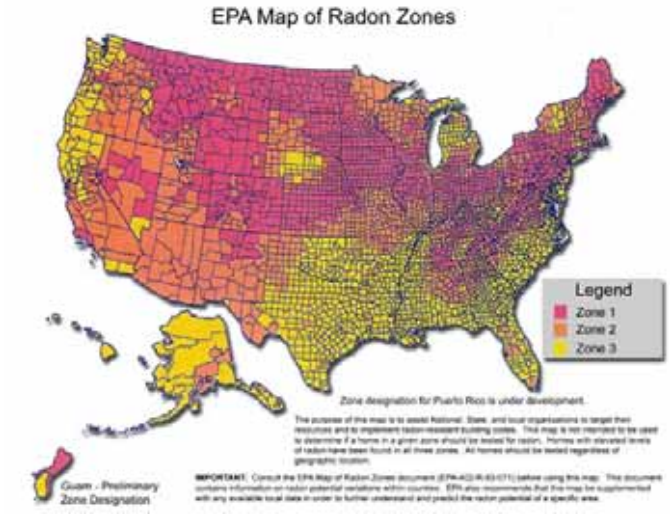
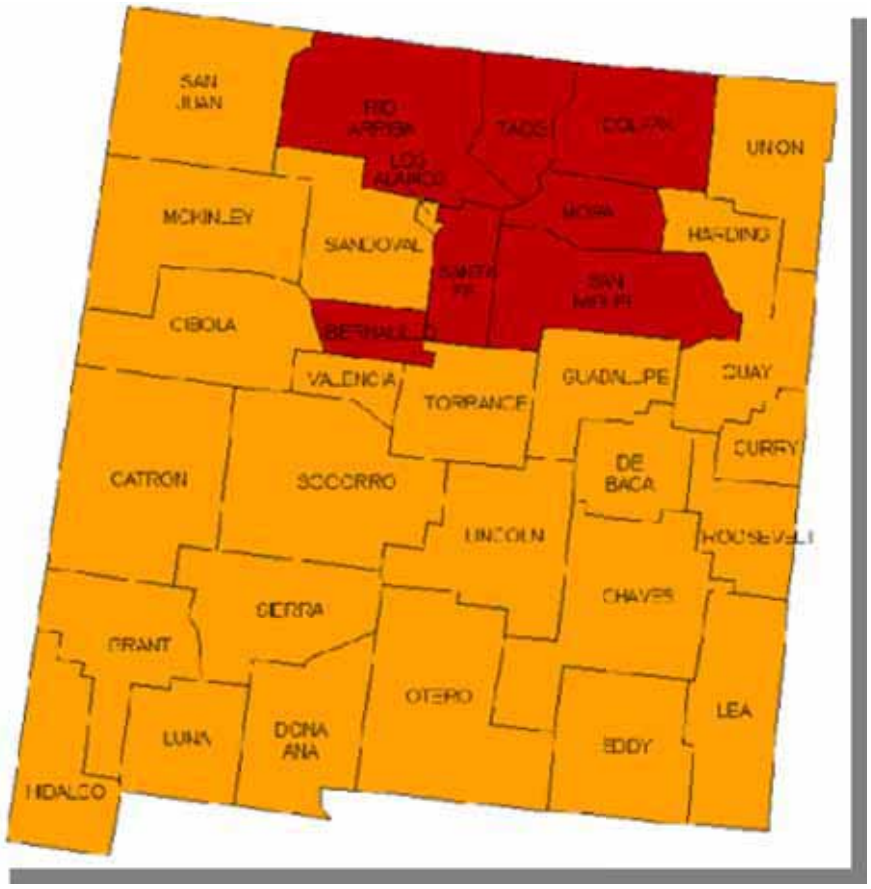


California →

http://radon.com/radon/radon_map.html



Nuevo México →



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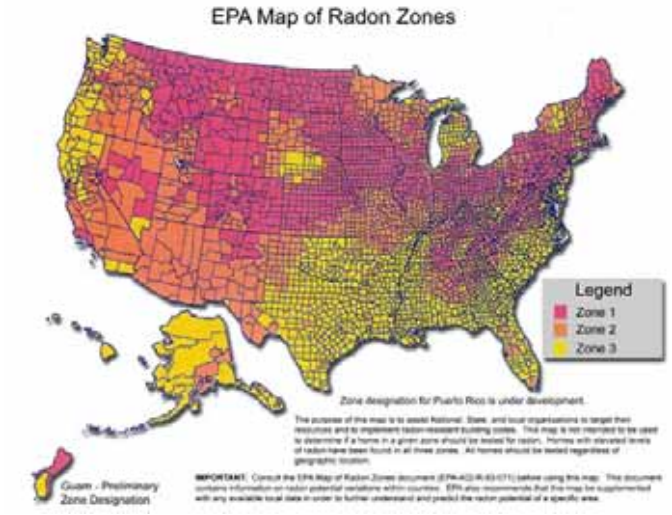
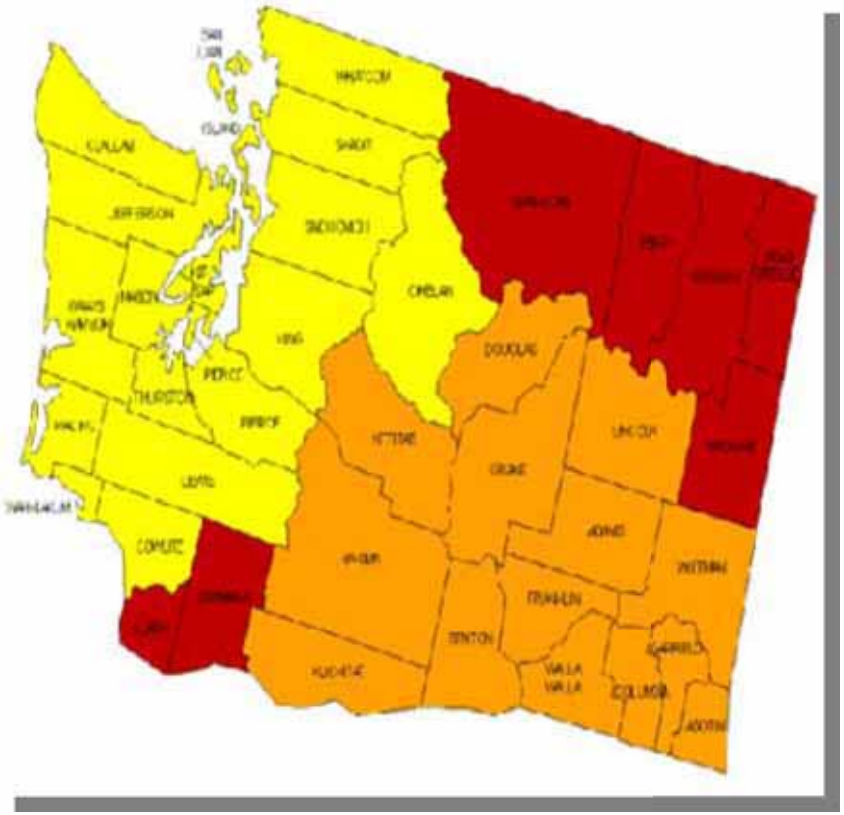
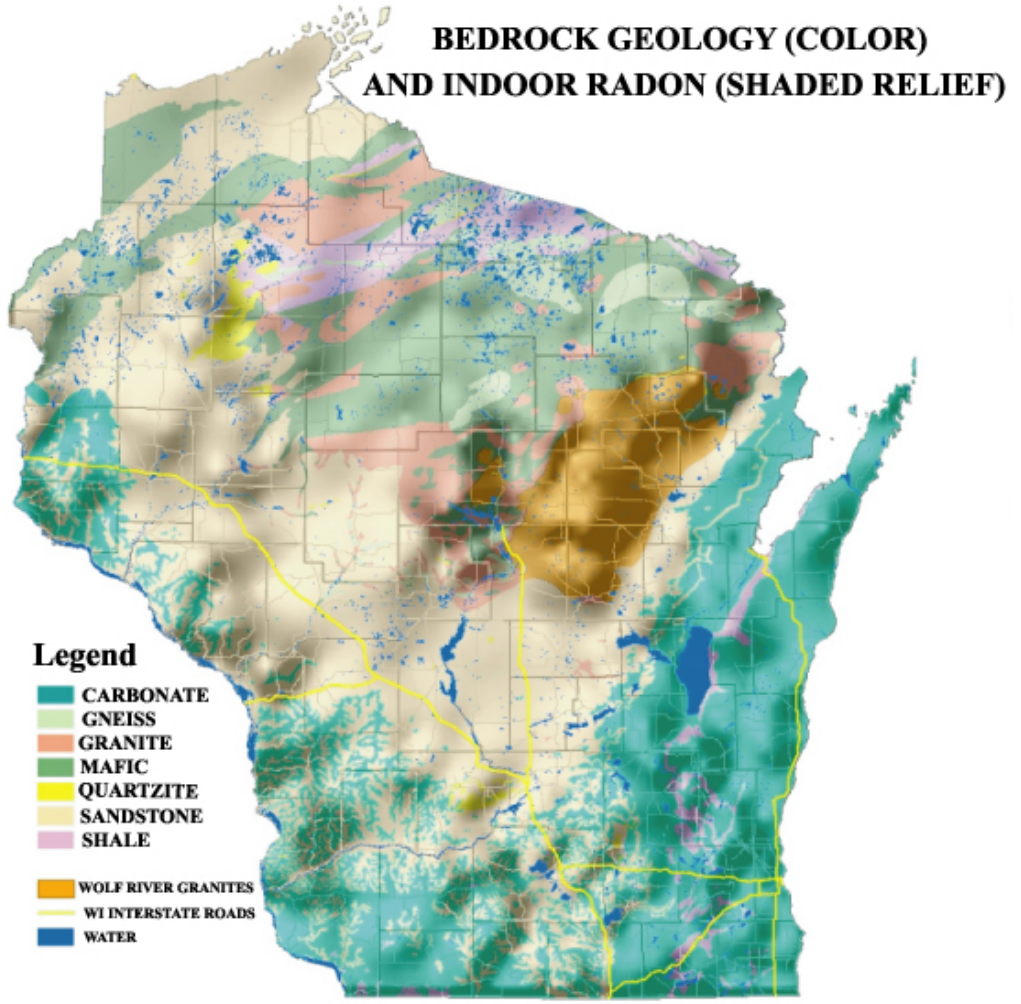


Washington →



Mapa de Radón de Wisconsin



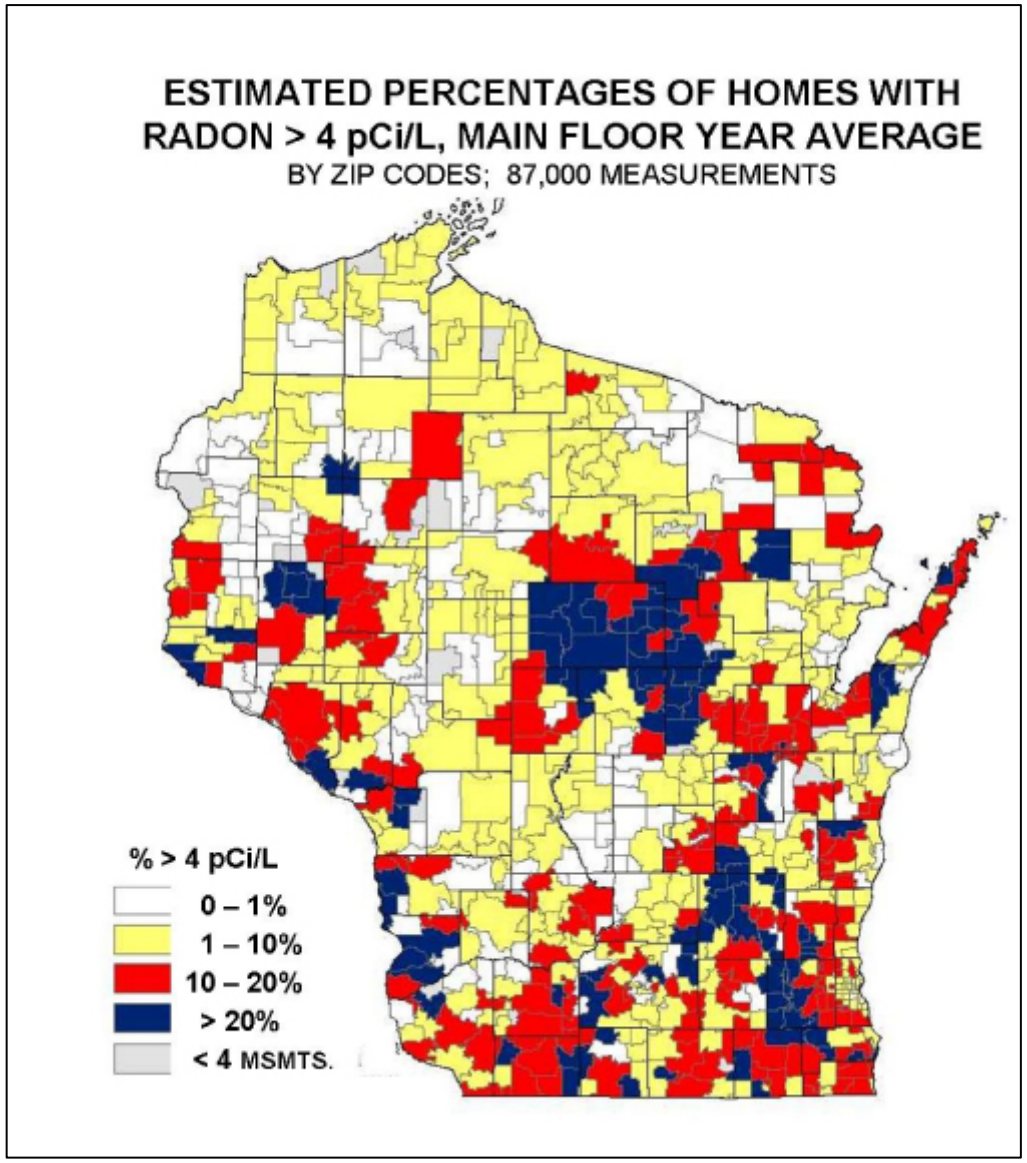
http://www.dhfs.state.wi.us/programs/publichealth.htm

Mapa de Radón de Wisconsin

- Es un mapa de la distribución de la concentración media anual de radón en el primer piso.
- Está basado en 115.000 medidas obtenidas de compañías que venden detectores de radón.
- La conversión a la media del piso principal está basada en una muestra de 1100 casas.
- Se realizaron medidas de un año en el primer piso de 200 casas donde determinaciones de dos días fueron superiores a 4 pCi/L (picocuries per liter).

http://www.dhfs.state.wi.us/programs/publichealth.htm

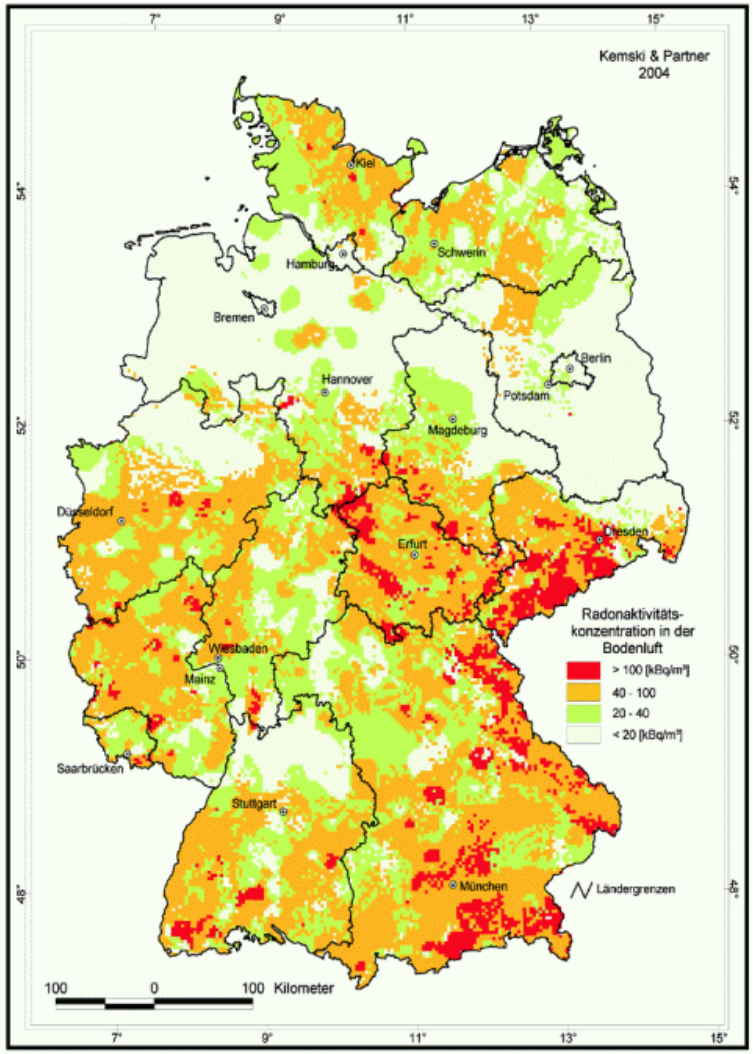
http://www.dhfs.state.wi.us/programs/publichealth.htm

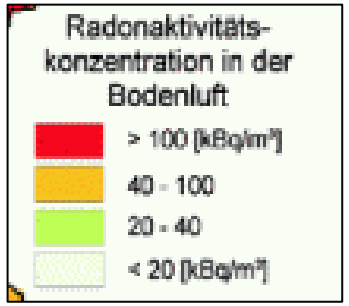


En Alemania….

- El mapa de radón de Alemania es una distribución regional de concentración de radón en el aire en los espacios porosos de la tierra **(aire del suelo) a 1 m por debajo** de la superficie terrestre.
- Se realiza a partir de **2.346** mediciones **geológicamente representativas** de lugares.
- La estimación nacional de la concentración de radón en el aire del suelo se realiza por medio de una interpolación entre determinaciones de lugares dentro de las **unidades geológicas** sobre la base de una retícula regular de 3 km x 3 km.

En Alemania….





http://www.bfs.de/en/ion/radon/radon_boden/radonkarte.html

En Francia….

- Todos los departamentos franceses fueron objeto de determinaciones
- La elección de los municipios ha sido hecha según un plano de sondeo que se apoya en **una red mallada** destinada á cubrir cada departamento de modo homogéneo.
- En cada **malla de 6 a 7 km** de lado, se realiza por lo menos una medida en el **municipio más poblado** en el que está situado en la malla.
- En los **municipios de los que la población** es importante se realizan **medidas suplementarias**
- En resumen, existen por término medio 140 puntos de medida por departamento.

En Francia….

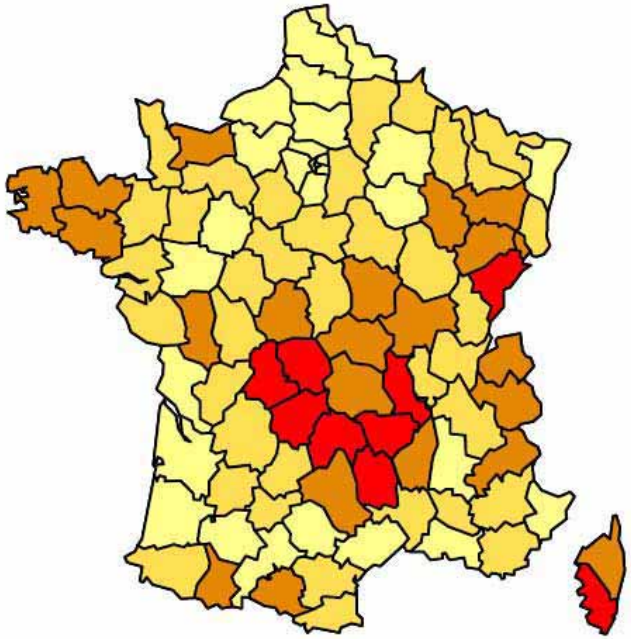
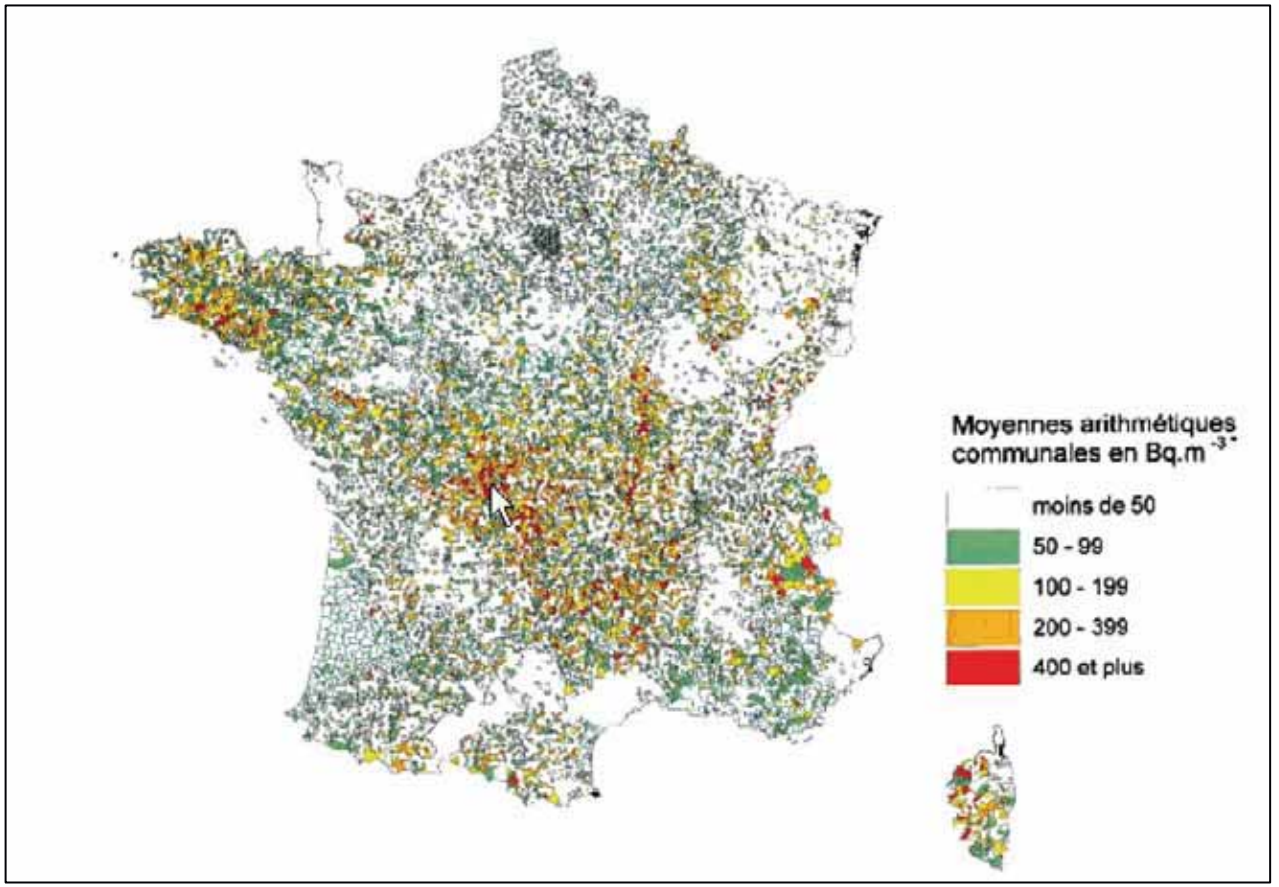


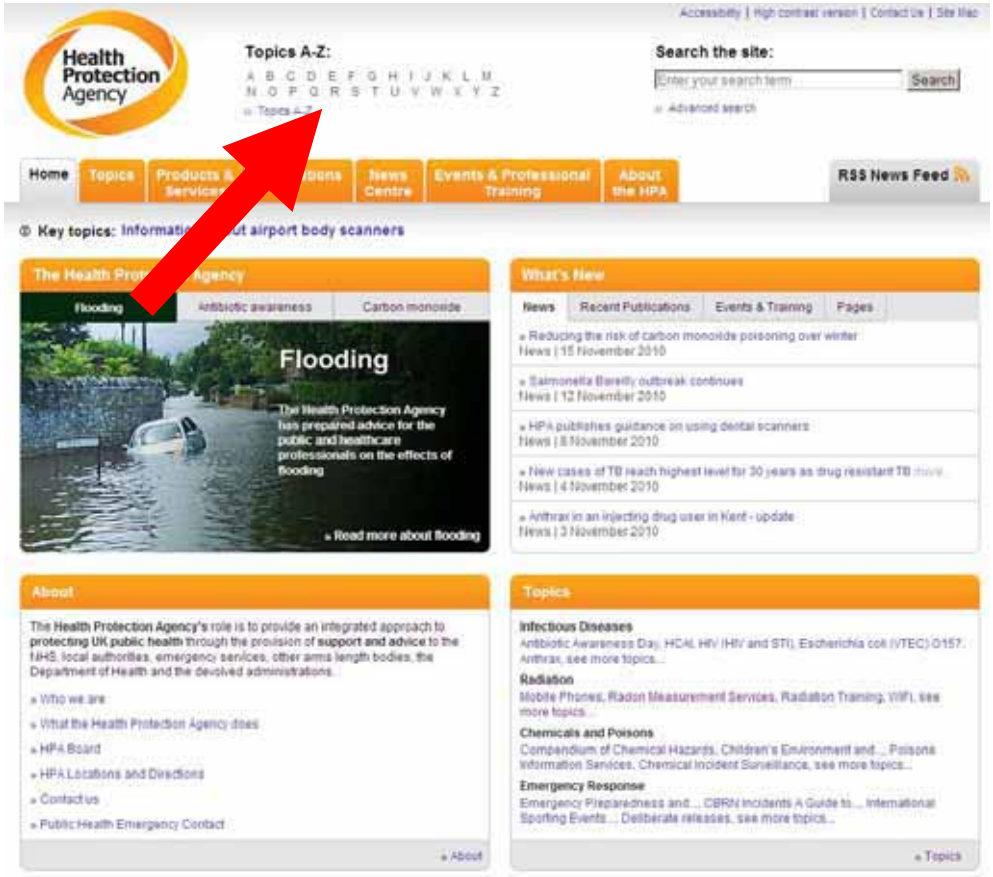
Figure 5 : Moyennes départementales des activités volumiques du radon ($Bq.m^{-3}$) dans l'habitat français
(Echantillon : France métropolitaine, 12641 mesures, janvier 2000) [5]

En Francia....


Moyennes arithmétiques communales en Bq.m -3
moins de 50
50 - 99
100 - 199
200 - 399
400 et plus

En Reino Unido….

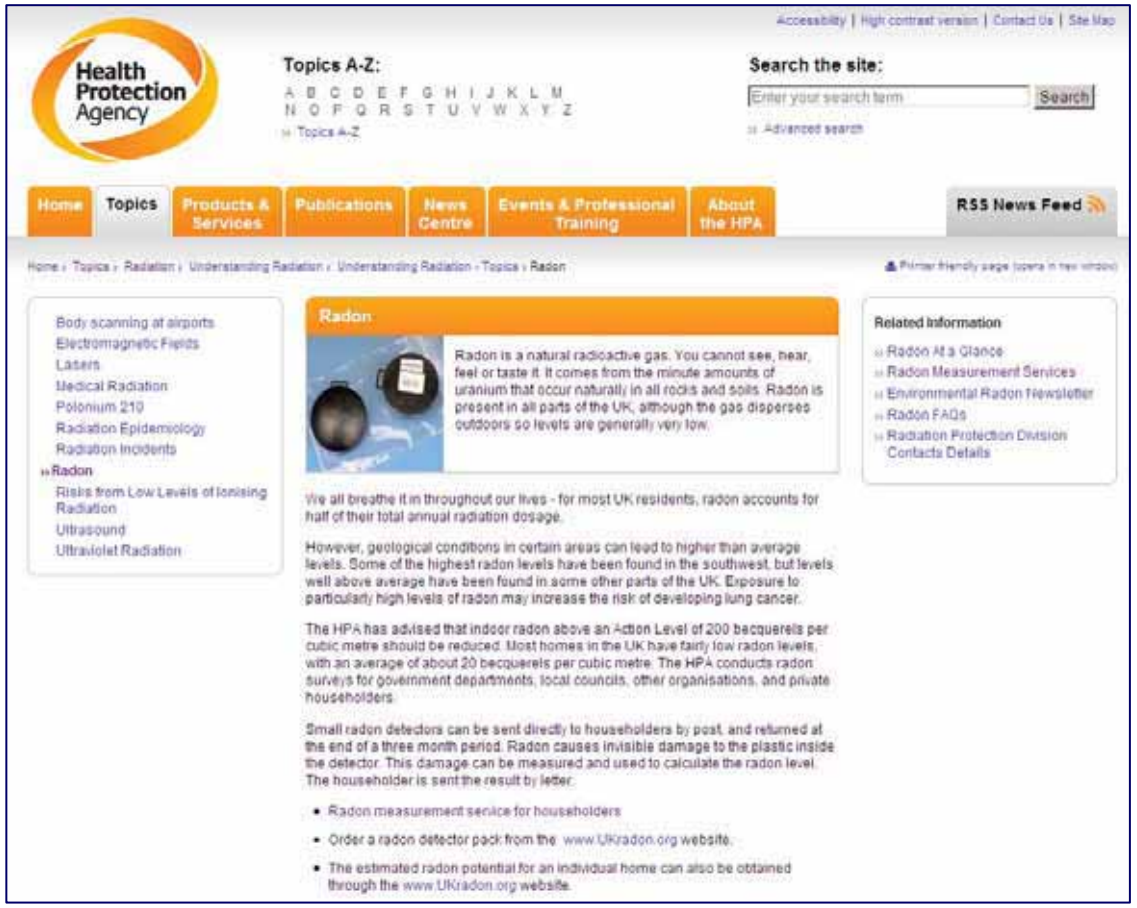
Health Protection Agency



http://www.hpa.org.uk/

En Reino Unido….

Health Protection Agency



http://www.hpa.org.uk/

En Reino Unido….

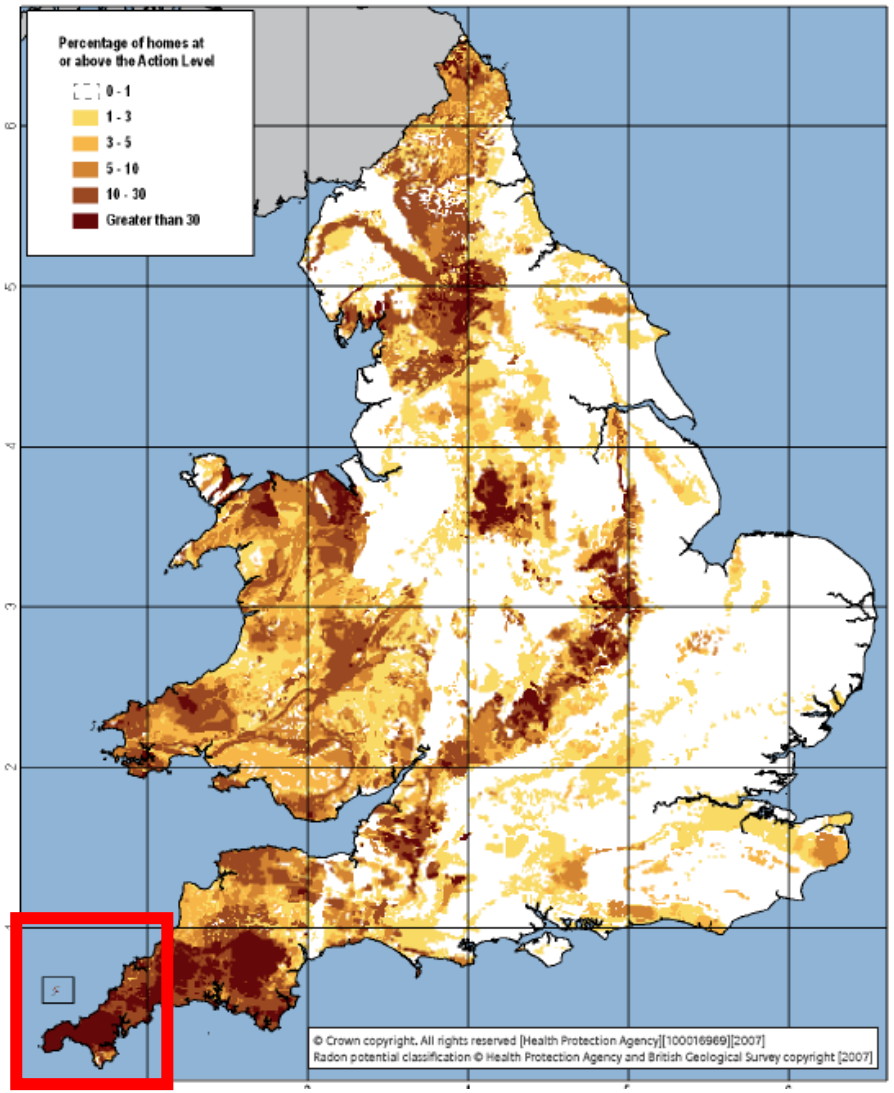
Health Protection Agency

http://www.hpa.org.uk/

En Reino Unido….

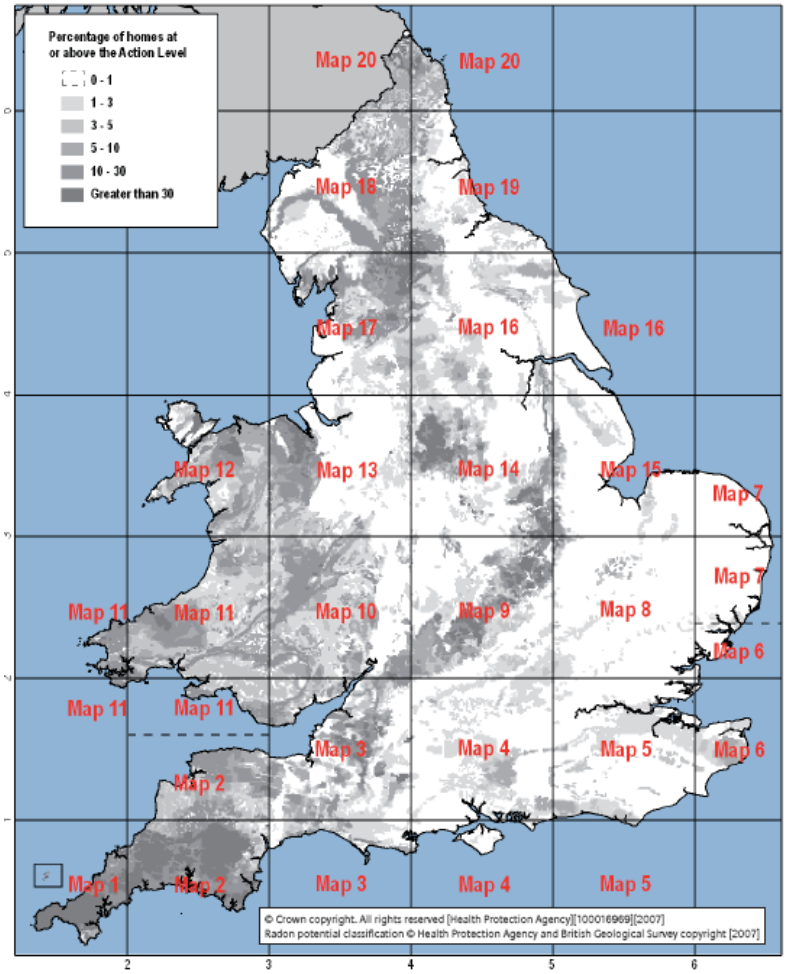
- Para poner en marcha el programa de radón en UK era necesario identificar las áreas con mas problemas de Radón.
- Elaboraron unos mapas de radón potencial, definido como el porcentaje de casas por encima del nivel de acción (200 Bq/m3)
- El mapa esta basado en las **medidas en 460.000 casas**.
- Los resultados de radón fueron agrupados (1º) zonas geológicas (2º) por cuadriculas de 1 km2
- Este método permite variaciones **entre y intra** de unidades geológicas.

En Reino Unido....



En Reino Unido....

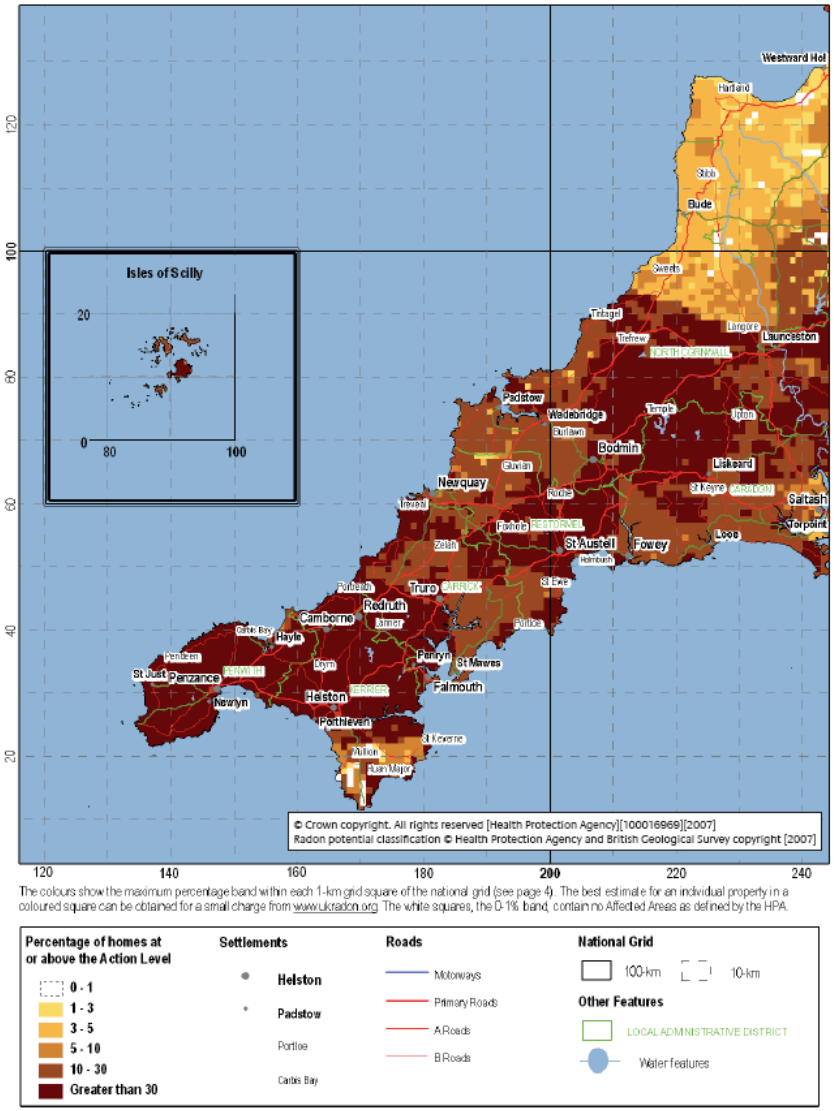
http://www.nrpb.org/radiation_topics/radon/radon_maps/uk_map.htm



En Reino Unido....

Percentage of homes at or above the Action Level

- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- 10 - 30
- Greater than 30



The colours show the maximum percentage band within each 1-km grid square of the national grid (see page 4). The best estimate for an individual property in a coloured square can be obtained for a small charge from www.ukradon.org. The white squares, the 0-1% band, contain no Affected Areas as defined by the HPA.

Percentage of homes at or above the Action Level

- 0 - 1
- 1 - 3
- 3 - 5
- 5 - 10
- 10 - 30
- Greater than 30

Settlements

- Helston
- Padstow
- Portloe
- Carbis Bay

Roads

- Motorways
- Primary Roads
- A Roads
- B Roads

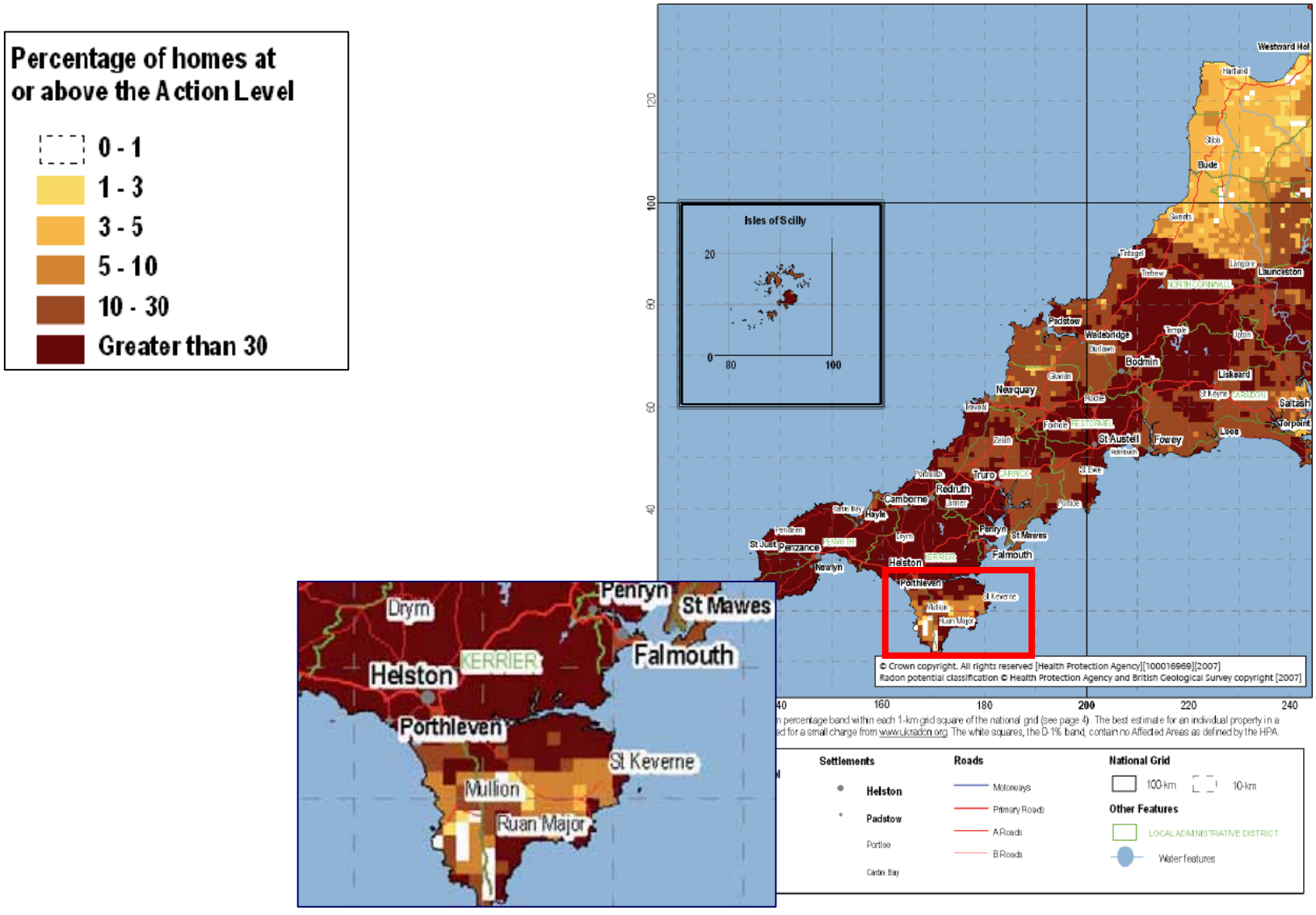
National Grid

- 100-km
- 10-km

Other Features

- LOCAL ADMINISTRATIVE DISTRICT
- Water features

En Reino Unido....



En Reino Unido….

- El mapa real con las zonas afectadas tiene **aun mucho mayor detalle** que el que muestran en los atlas.
- Existe una **base de datos** para incluir en los programas de sistemas de información geográfico para obtener resultados mucho mas detallados.
- Se pueden obtener datos de radón potencial a partir de **coordenadas o de códigos postales**.

En Reino Unido….

UKradon - *The UK reference site on radon, from the Health Protection Agency*

HOME | ORDER A RADON RISK REPORT | ORDER A DOMESTIC MEASUREMENT PACK | ORDER A WORKPLACE MEASUREMENT PACK | CONTACT US | HELP

ACCOUNT HOLDERS

Log In

Radon Information Pages

- The risks to your health from radon
- Radon Action Level and Target Level
- What is radon?
- UK maps of radon
- Radon and house sales
- Radon in the workplace
- Measuring radon
- How to reduce radon levels
- Radon and Building Regulations
- Newsletters and Reports
- Radon FAQ
- Topics: A-Z

EXTERNAL LINKS >>

Order a Home Measurement Pack

A radon measurement is easy to complete. We post you two detectors to place in your home: one in the living area and one in an occupied bedroom. After three months you post the detectors back to us in the pre-paid envelope provided. We analyse the detectors and post the results to you. The cost is £46.88 inc. VAT. You will receive the detectors within 7 working days.

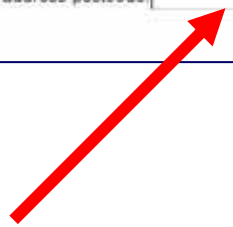
Please note this online service is for the UK only.

PLEASE NOTE THE FOLLOWING IMPORTANT POINTS

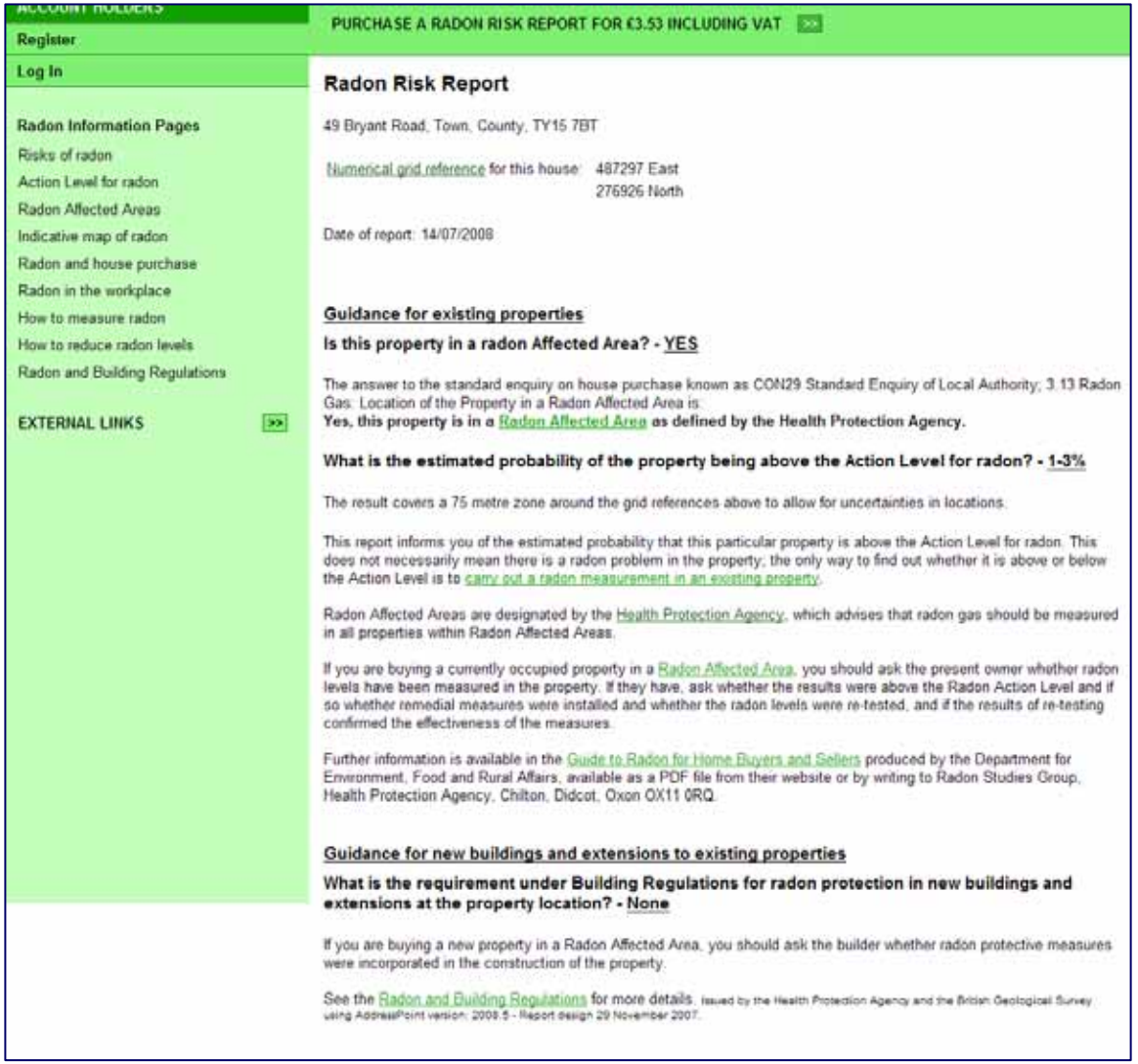
- Detectors record continuously and must be placed within a few days of receipt.
- The building should be in normal use during the measurement.
- Testing is not recommended:
  - during building work
  - when the house is empty for more than a fortnight
  - during a change of occupier
- Detectors must only be used for the address from which they are ordered.
- The instructions provided with the detectors need to be followed correctly to get accurate results.
- Measurement results will be held in a database and used for statistical purposes, but individual results will not be disclosed without express permission.
- Detectors shall remain the property of HPA Radiation Protection Division.
- HPA Radiation Protection Division shall not be liable for any errors in the interpretation of the results.

Please enter your postcode below to order a radon pack online. If you do not know your postcode you can click here to enter an address manually.

Enter the measurement address postcode: NEXT >>



En Reino Unido….



ACCOUNT HOLDERS

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Log In

Radon Information Pages

Risks of radon
Action Level for radon
Radon Affected Areas
Indicative map of radon
Radon and house purchase
Radon in the workplace
How to measure radon
How to reduce radon levels
Radon and Building Regulations

EXTERNAL LINKS >>

PURCHASE A RADON RISK REPORT FOR £3.53 INCLUDING VAT >>

Radon Risk Report

49 Bryant Road, Town, County, TY15 7BT

Numerical grid reference for this house: 487297 East
276926 North

Date of report: 14/07/2008

Guidance for existing properties

Is this property in a radon Affected Area? - YES

The answer to the standard enquiry on house purchase known as CON29 Standard Enquiry of Local Authority; 3.13 Radon Gas: Location of the Property in a Radon Affected Area is:
Yes, this property is in a Radon Affected Area as defined by the Health Protection Agency.

What is the estimated probability of the property being above the Action Level for radon? - 1-3%

The result covers a 75 metre zone around the grid references above to allow for uncertainties in locations.

This report informs you of the estimated probability that this particular property is above the Action Level for radon. This does not necessarily mean there is a radon problem in the property; the only way to find out whether it is above or below the Action Level is to carry out a radon measurement in an existing property.

Radon Affected Areas are designated by the Health Protection Agency, which advises that radon gas should be measured in all properties within Radon Affected Areas.

If you are buying a currently occupied property in a Radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were above the Radon Action Level and if so whether remedial measures were installed and whether the radon levels were re-tested, and if the results of re-testing confirmed the effectiveness of the measures.

Further information is available in the Guide to Radon for Home Buyers and Sellers produced by the Department for Environment, Food and Rural Affairs, available as a PDF file from their website or by writing to Radon Studies Group, Health Protection Agency, Chilton, Didcot, Oxon OX11 0RQ.

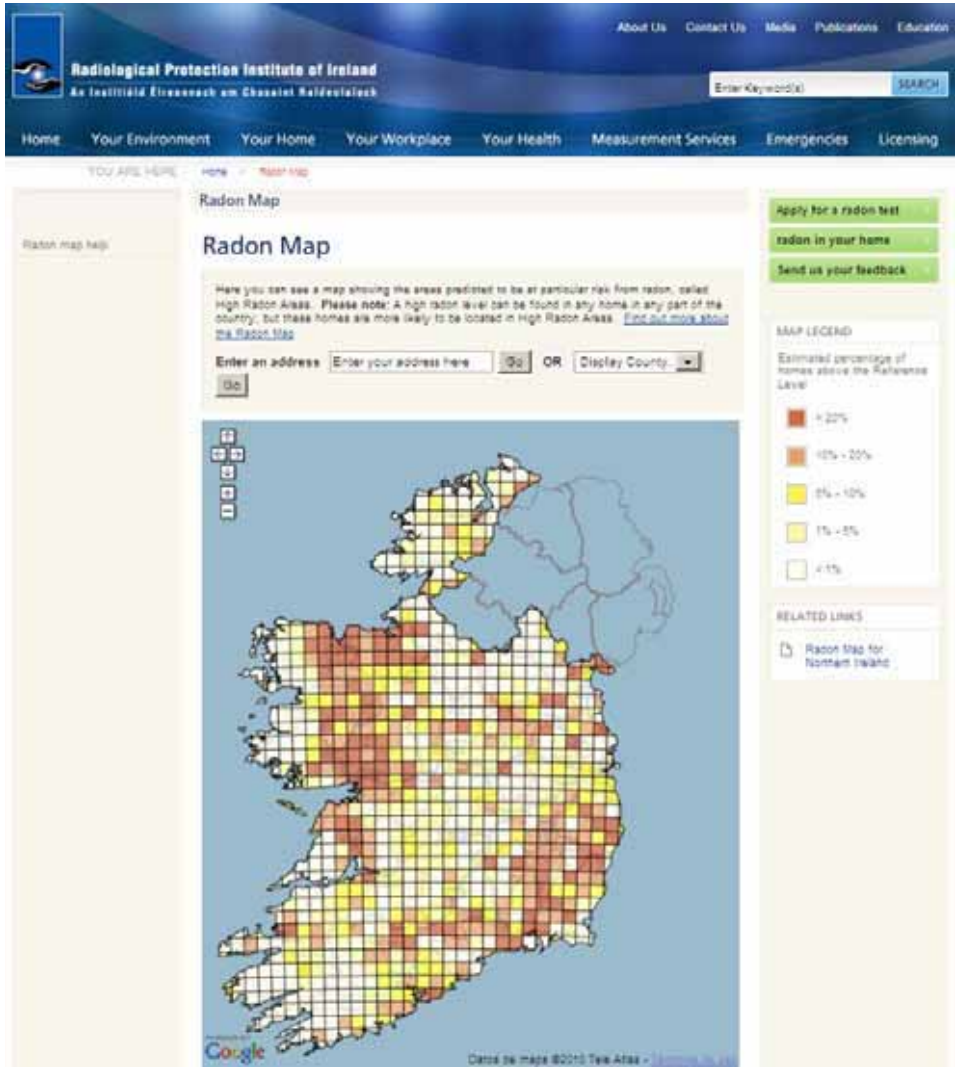
Guidance for new buildings and extensions to existing properties

What is the requirement under Building Regulations for radon protection in new buildings and extensions at the property location? - None

If you are buying a new property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

See the Radon and Building Regulations for more details. Issued by the Health Protection Agency and the British Geological Survey using AddressPoint version: 2008.5 - Report design 29 November 2007.

Irlanda



http://www.rpii.ie/radon-map.aspx

Irlanda

- Elaboraron una rejilla de 10 kilómetros cuadrados
- Las medidas radón interior se llevaron a cabo durante 12 meses
- Utilizaron detectores pasivos de partículas alfa
- Casas fueron seleccionadas al azar en cada cuadrícula.
- Nivel de Referencia para las casas: 200 Bq/m3.
- Las cuadrículas en el que esta predicción supera el 10% se designan las zonas de alta radón.

http://www.rpii.ie/radon-map.aspx

España: proyecto MARNA

- El proyecto Marna, es el resultado de un acuerdo entre el CSN y ENUSA Industrias Avanzadas, S.A.,
- Evaluó la tasa de exposición a la radiación gamma natural en España.

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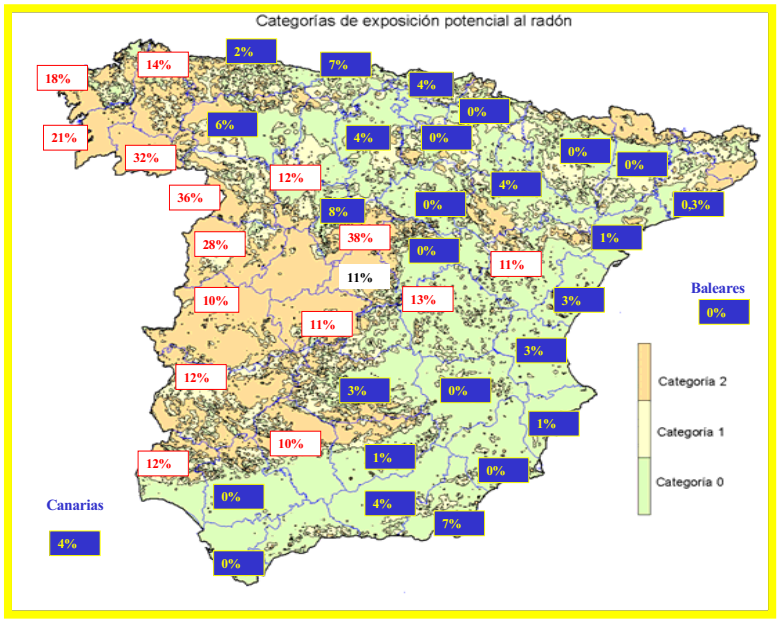
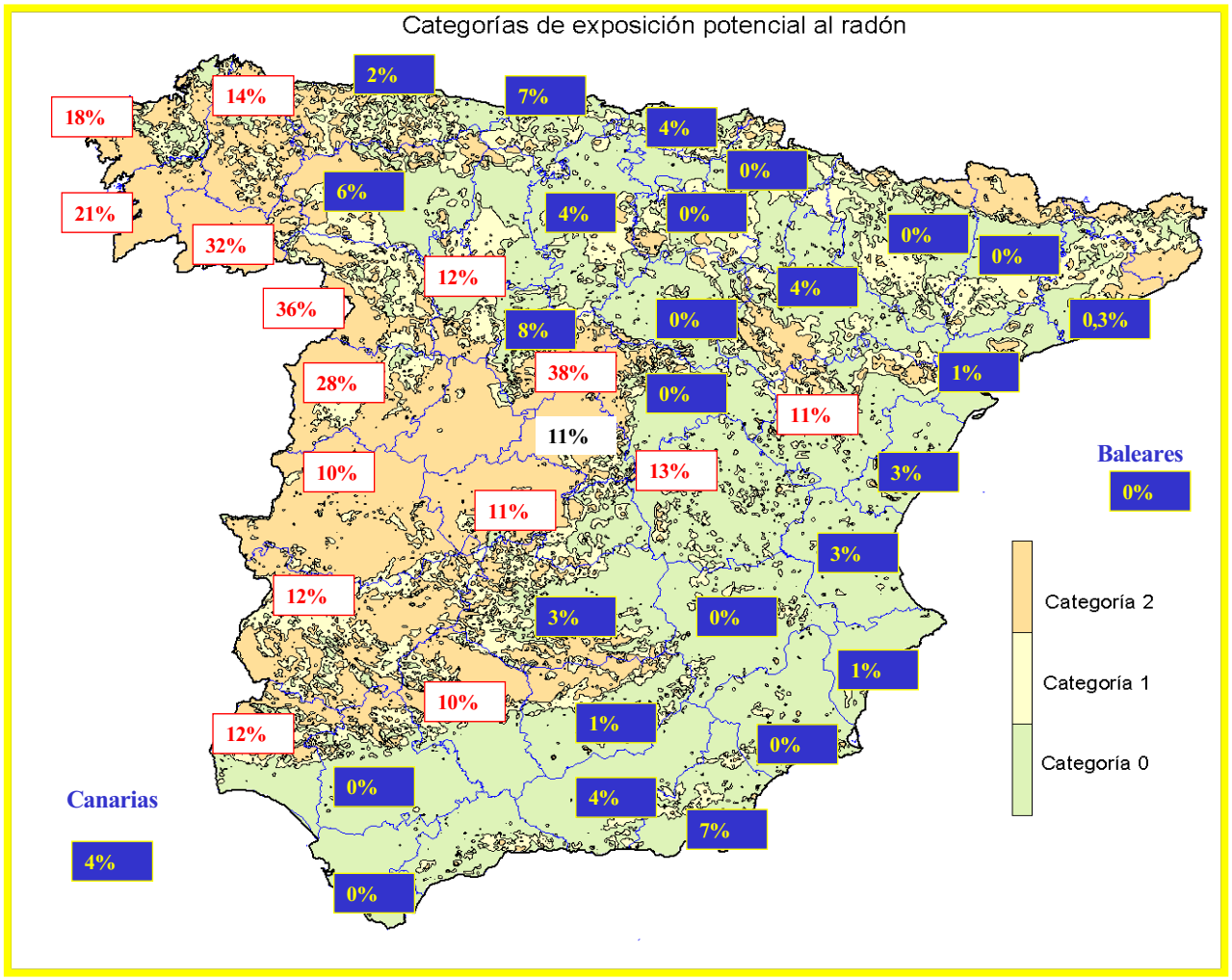


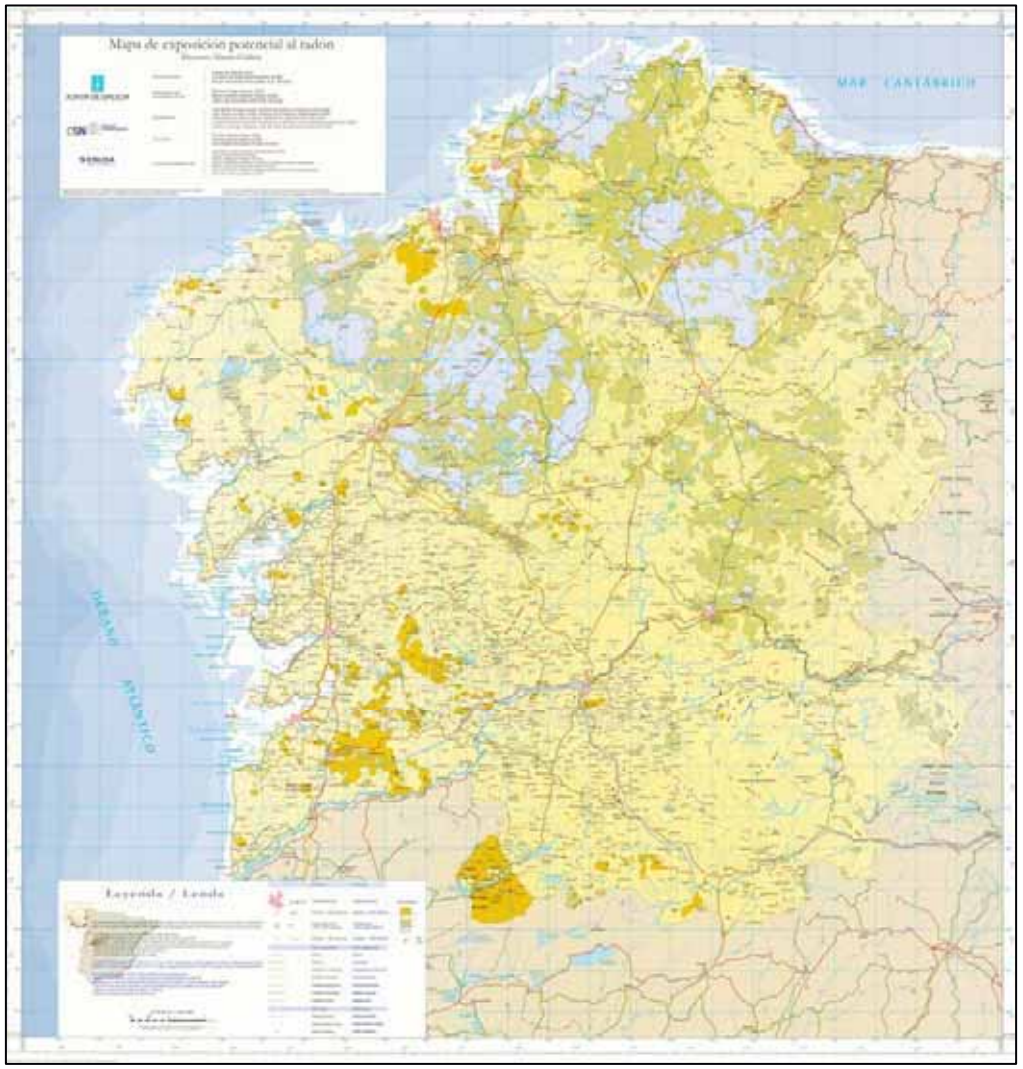
España: proyecto MARNA



MARNA-Galicia

- La Comunidad Gallega fue cubierta por lo que se ha dado en llamar Proyecto Marna-Galicia (fases 3 y 4)
- Contando con la colaboración de dirección de Interior y Protección Civil.
- Además de los objetivos del proyecto Marna, también se pretendía elaborar un mapa de potencial de emisión de radón
- Existe una coincidencia entre las zonas de mayor tasa de exposición con las de mayor potencial de exhalación de radón.
- La mayoría del territorio presenta niveles medios de potencial de exhalación de radón, recomendando que las zonas con mayor potencial sean estudiadas detenidamente.

MARNA-Galicia



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- New application for real time mapping of pollution
- Natural disasters: technologies for preparedness and response
- JRC collaboration with NASA results in earth science data transfer to Africa

Tags

- IES

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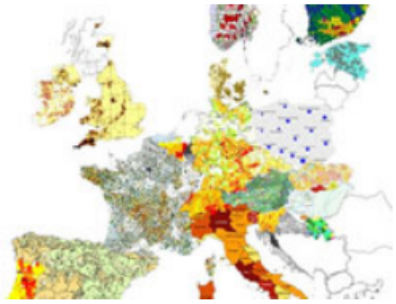


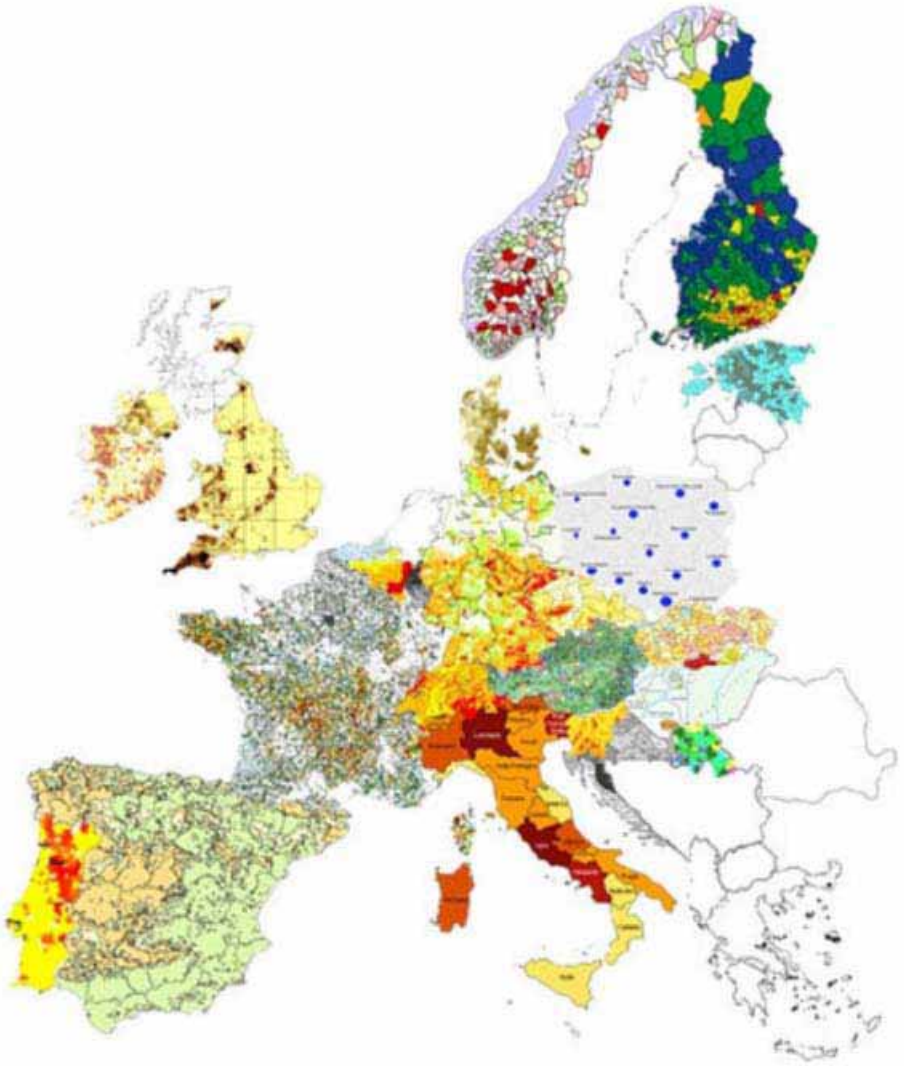
The patchwork of results from radon measurement campaigns across Europe

Radon Risk Mapping: JRC leading efforts to harmonise European map of radon levels

As part of the 33rd International Geological Conference, which opens in Oslo, Norway, today, the JRC is co-organising the 9th **International Workshop on Geological Aspects of Radon Risk Mapping** on the 12th and 13th of August, as well as a round-table entitled **"Radon Risk Mapping: From Soil-Gas to Indoor Concentrations"** on August 14th.

The workshops intend to address scientific and technical issues related to ongoing effort, led by the JRC, to produce a harmonised European map of indoor radon levels. The symposium with speakers from Europe, Japan, China and the USA, as well as the round-table, are co-organised by the Swedish Radiation Protection Authority, the Geological Survey of Sweden, the University of Oslo and the Czech radon monitoring company Radon v.o.s.

http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=5450&dt_code=NWS&lang=en



The patchwork of results from radon measurement campaigns across Europe

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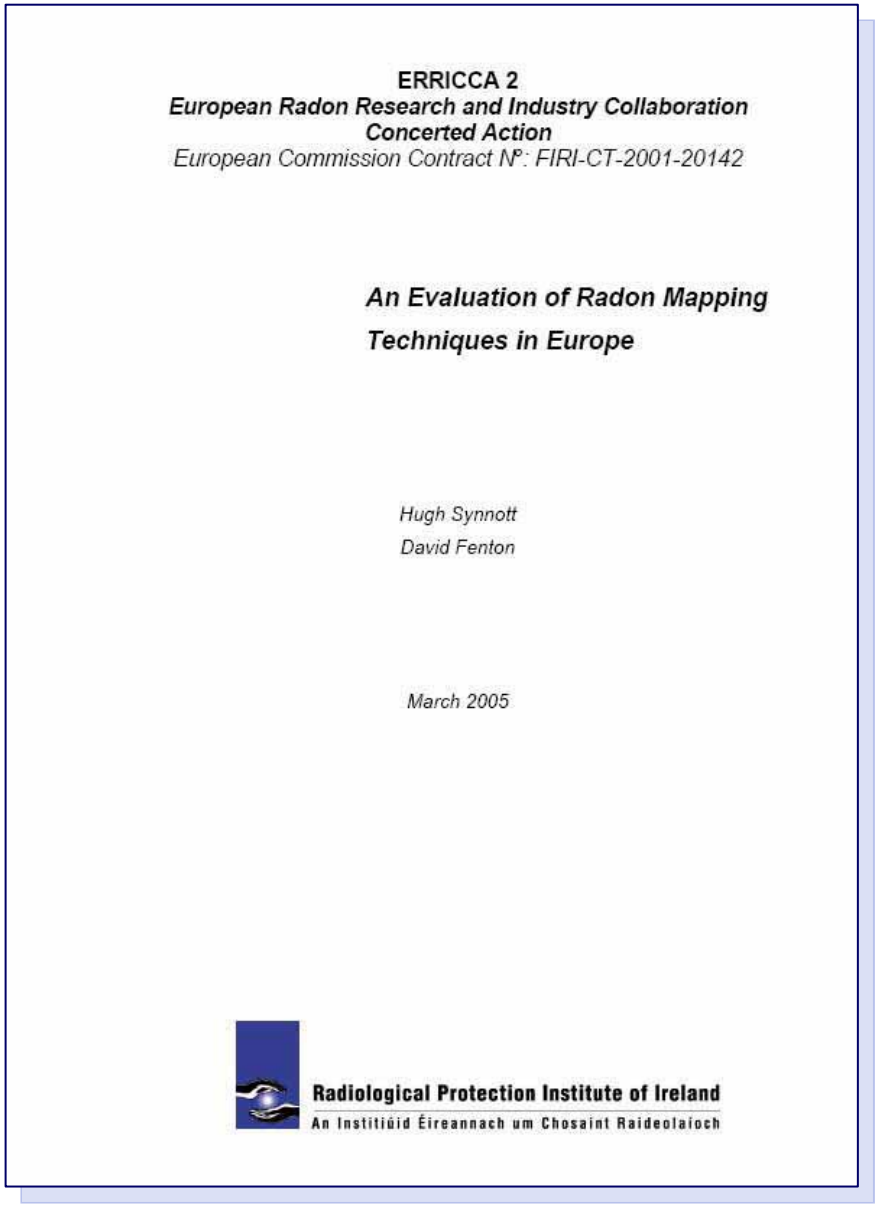


ERRICCA 2

European Radon Research and Industry Collaboration Concerted Action

European Commission Contract N°: FIRI-CT-2001-20142

An Evaluation of Radon Mapping Techniques in Europe

Hugh Synnott

David Fenton

March 2005

Radiological Protection Institute of Ireland

An Institiúid Éireannach um Chosaint Raideolaíoch

citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.135.4913...

Evaluación de los mapas de radón en europa

- Los datos fueron recogidos mediante un cuestionario, enviado a cada país.
- Todos los 20 países participantes enviaron sus respuestas.
- Se les preguntó por:

  - ¿Por quién?
  - Método empleado.
  - El mapa fue validado por ninguna encuesta de radón de seguimiento.
  - Los países que han cooperado compartir una frontera común
  - Con qué propósito (s), en su caso, los mapas de radón en cada país se utilizaron?

Table 3

Radon mapping methodologies used in mapping programmes

Indoor radon gas measurements	Soil gas radon measurements	Geological mapping	Other methods
Austria	Czech Republic	Czech Republic	Czech Republic[1]
Belgium	France[6]	Finland	Finland[2]
Czech Republic	Germany	France[6]	Greece[3]
Denmark	Greece	Germany	Spain[4]
Finland	Poland	Italy	Sweden[5]
France[6]	Romania[6]	Poland	
Germany	Sweden	Spain	
Greece			
Hungary			
Ireland			
Italy			
Netherlands			
Portugal			
Romania[6]			
Slovenia			
Spain			
Switzerland			
United Kingdom			

[1]gamma dose rate maps
[2]sub structure classification radon prognoses
[3]radium content of surface soil
[4]natural gamma radiation map
[5]airborne measurements
[6]while radon mapping programmes were reported in both countries details on the methodologies used were not given and therefore could not be reviewed in this report

Table 4

Uses of radon map predictions

Planning radon campaigns	Distribution of radon detectors	Radon prevention in new buildings	Increasing public awareness about radon	Other uses
Belgium	Czech Republic	Finland	Denmark	Austria[1]
Finland	Finland	France	Finland	Denmark[2]
Germany	United Kingdom	Ireland	France	Germany[3]
Greece		Italy	Ireland	Italy[4]
Ireland		Spain	Italy	Netherlands[5]
Italy		Sweden	United Kingdom	Sweden[6]
Spain		United Kingdom		Switzerland[7]
Sweden				
United Kingdom				

[1]results of radon mapping programme was utilised in drafting ONORM S5280 (Austrian Standard for radon)
[2]to assess the magnitude of the radon problem
[3]map was used to predict "radon areas"
[4]In some Italian regions the radon map predictions were utilised for regional recommendations aimed at limiting population exposure
[5]results of two radon surveys were used to observe trends of indoor radon concentrations with time. It is proposed that the average radon value in Dutch dwellings should not increase in the future
[6]geological maps and radon risk maps can be used to find wells with high radon concentrations
[7]there is a proposal to change the classification of radon areas from arithmetic mean to predicted percentage of dwellings above 200 Bq/m^3

Conclusiones

Organismos

- Llevados a cabo por organizaciones gubernamentales. Apoyo de universidades e institutos académicos y empresas consultoras privadas.

Fuentes de datos

- La mayoría de los países el uso de interior mediciones de gas radón.
- República Checa y Alemania: información geológica.
- Finlandia, usan una combinación mediciones de ambas.

Conclusiones

Muestreo:

- Área fija uniforme, con rejillas de 5 ó 10 km
- Áreas administrativas, como un municipio o condado
- Límites geológicos como el tipo de roca o el tipo de suelo.

Conclusiones

Presentación de resultados

- Medias geométricas
- Porcentaje de la medición por encima de un valor de umbral.
- Predicción del modelo
- Característica común: áreas de potencial de radón que se expresan "bajo", "medio" y "alto".

Validar los mapas existentes:

Verificar la exactitud de los mapas de predicción basado en parámetros geológicos mediante la realización de mediciones de radón en el interior.

Conclusiones

Los mapas de radón son utilizados por:

- Autoridades municipales para destacar las zonas de alto potencial de radón y alentar a la población para llevar a cabo mediciones de radón.
- Orientación de las futuras estudios de medición de radón para aumentará las posibilidades de encontrar viviendas con altas concentraciones de radón.
- Para destacar las áreas de alto potencial de radón en las que sería prudente incorporar medidas de prevención de radón en los edificios nuevos

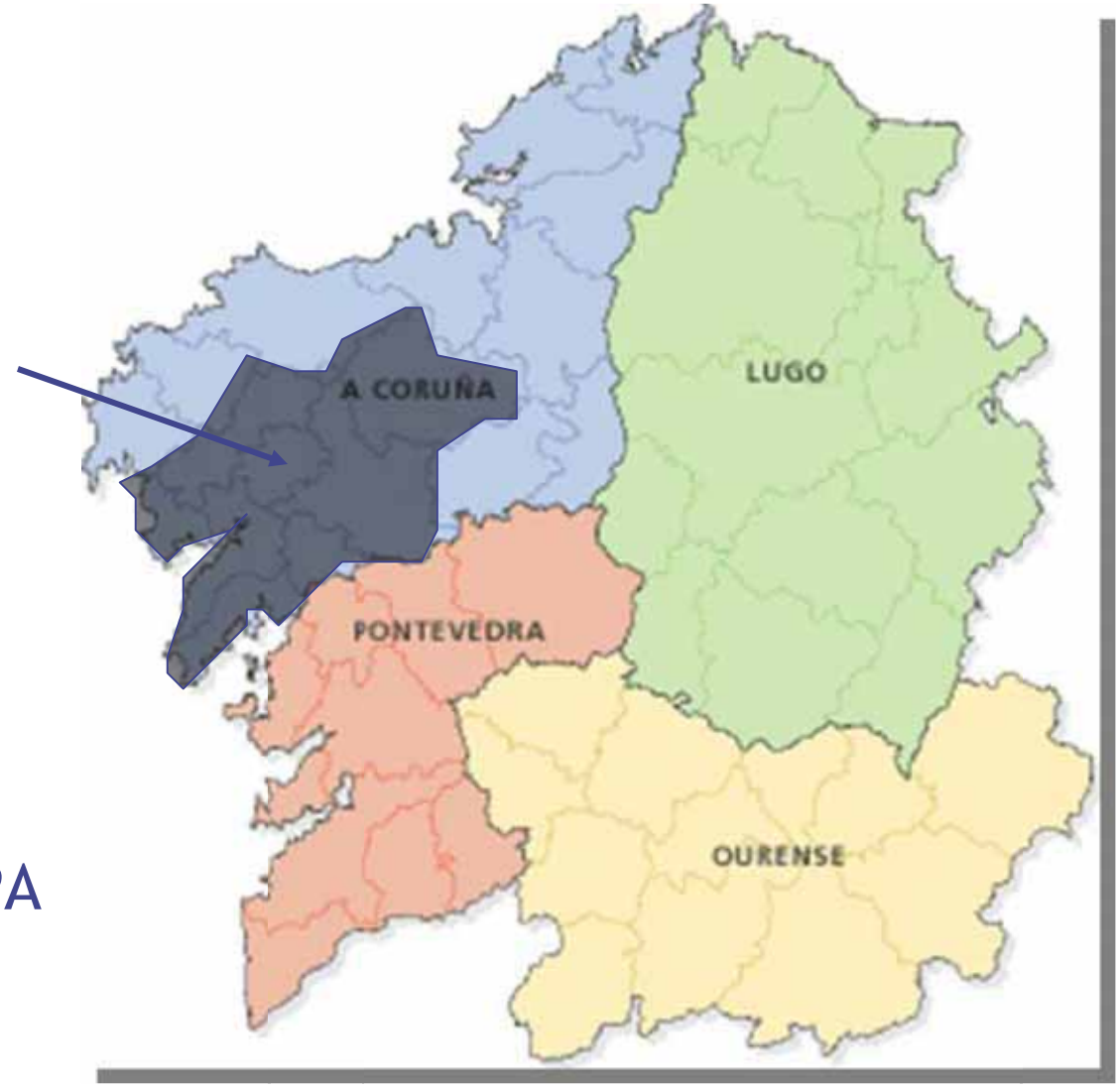
¿Y en Galicia...?

ESTUDIO PREVIO

¿Radón en domicilios en Galicia...?

ESTUDIO PREVIO

- 404 domicilios
- 25% concentraciones superiores a las recomendadas EPA



Estudios realizados en Galicia (I).

- Estudio de casos y controles sobre radón y cáncer de pulmón (1992-1994).
  - FIS-Dirección Xeral de Política Universitaria. 1992.
  - Diseño: estudio de casos y controles de base poblacional
  - Controles: seleccionados por muestreo aleatorio estratificado.
  - Casos: incidentes, ingresados o diagnosticados en el CHUS.
  - Criterios de inclusión: mayores de 35 años, no haber padecido neoplasias previas. Llevar residiendo al menos cinco años en el mismo domicilio. Consentimiento.
  - Total de participantes: 163 casos y 241 controles (404).

Estudios realizados en Galicia (I).

- Estudio de casos y controles sobre radón y cáncer de pulmón.
  - Resultados descriptivos: los niveles de radón residencial en el área a estudio son elevados (75 y 66 Bq/m^3).
  - Aquellos sujetos con niveles superiores a 37Bq/m^3 en su domicilio duplican su riesgo de cáncer de pulmón. El riesgo es algo superior para niveles de radón más elevados.
  - Existe una fuerte interacción con el hábito tabáquico.

TABLE 2. Effect of radon concentration on the risk of lung cancer, Spain, 1992–1994

Radon concentration*		No. of subjects		Crude analysis		Adjusted analysis†	
Bq/m³	pCi/liter	Cases	Controls	OR‡	95% CI‡	OR	95% CI
0–36.9	0.0–0.9	28	73	1.00	1.15, 3.75	1.00	1.21, 6.18
37.0–55.1	1.0–1.4	43	54	2.08	1.05, 3.34	2.73	1.12, 5.48
55.2–147.9	1.5–3.9	46	64	1.87	1.30, 4.36	2.48	1.29, 6.79
≥148.0	≥4.0	42	46	2.38	1.30, 4.36	2.96	1.29, 6.79

* Categorized in quartiles for all subjects and expressed in Bq/m³ and pCi/liter.
† Adjusted for age, sex, family history, and lifetime tobacco consumption (measured in packs and categorized in quartiles).
‡ OR, odds ratio; CI, confidence interval.

TABLE 3. Interaction between exposure to radon and lifetime tobacco consumption, Spain, 1992–1994

Lifetime tobacco consumption	Radon concentration		No. of subjects		Adjusted* analysis	
	Bq/m³	pCi/liter	Cases	Controls	OR†	95% CI†
Nonsmokers	0–36.9	0.0–0.9	2	28	1.00	
	≥37.0	≥1.0	11	76	1.81	0.33, 10.09
Smokers	0–36.9	0.0–0.9	24	43	20.16	3.43, 118.55
	≥37.0	≥1.0	118	85	46.45	8.46, 254.85

* Adjusted for age, sex, and family history.
† OR, odds ratio; CI, confidence interval.

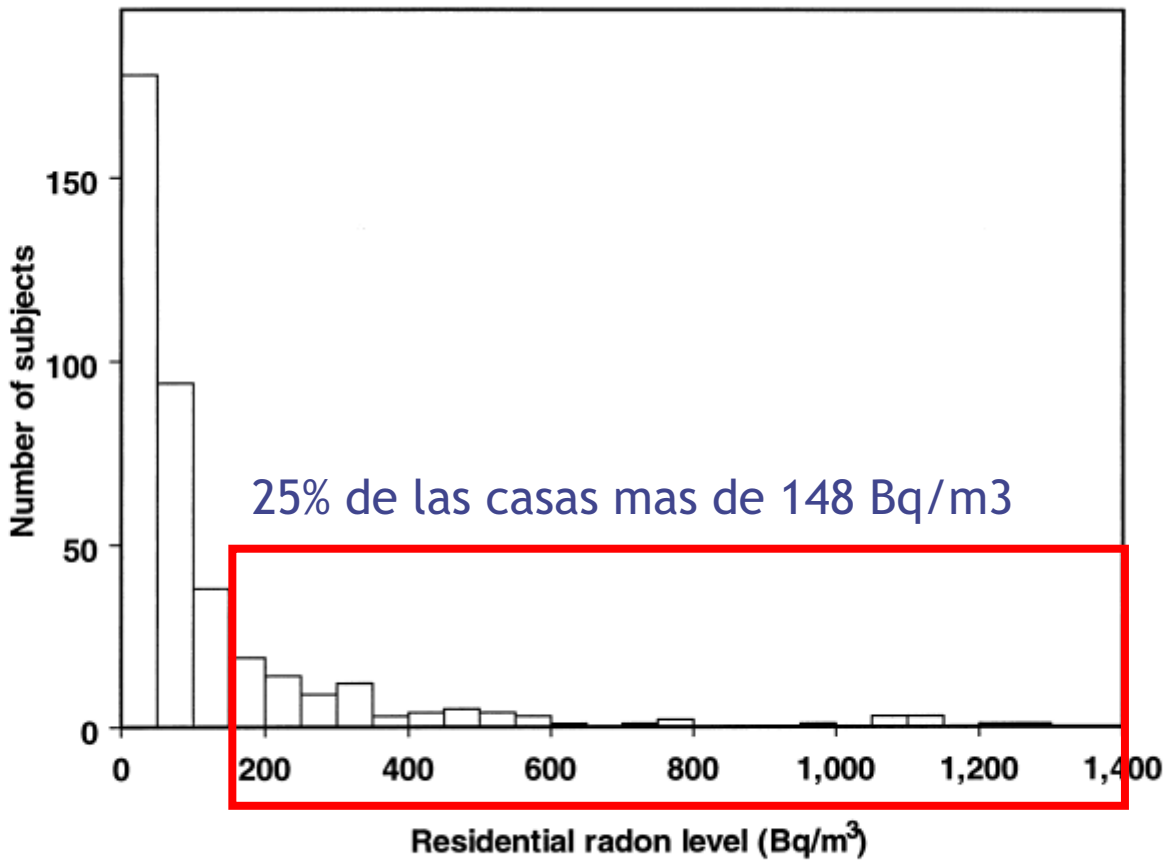


FIGURE 2. Distribution of the study population by residential radon level, Spain, 1992–1994.

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Exposure to Residential Radon and Lung Cancer in Spain: A Population-based Case-Control Study

Juan Miguel Barros-Dios[1,2], María Amparo Barreiro[1], Alberto Ruano-Ravina[1], and Adolfo Figueiras[1]

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[2] Preventive Medicine Unit, Santiago de Compostela University Teaching Hospital, Santiago de Compostela, Spain.

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Although high radon concentrations have been linked to increased risk of lung cancer by both experimental studies and investigations of underground miners, epidemiologic studies of residential radon exposure display inconsistencies. The authors therefore decided to conduct a population-based case-control study in northwest Spain to determine the risk of lung cancer associated with exposure to residential radon. The study covered a total of 163 subjects with incident lung cancer and a population sample of 241 cancer-free subjects since 1992–1994. Odds ratios for radon were estimated using logistic regression adjusted for sex, age, lifetime tobacco use, family history, and habitat. The adjusted odds ratios for the second, third, and fourth quartiles of radon (breakpoints: 37.0, 55.2, and 148.0 Bq/m^3) were 2.73 (95% confidence interval (CI): 1.12, 5.48), 2.48 (95% CI: 1.29, 6.79), and 2.96 (95% CI: 1.29, 6.79), respectively. An additive synergic effect between radon and tobacco was found. The results from this study suggest that, even at concentrations far below official guideline levels, radon may lead to a 2.5-fold rise in the risk of lung cancer. Furthermore, the synergy found between smoking and radon may prove useful when it comes to drafting public health recommendations. *Am J Epidemiol* 2002;156: 548–55.

case-control studies; lung neoplasms; radon

Abbreviation: CI, confidence interval.

Pooling europeo.

- Puesta en común, con cesión de todos los datos, de los 13 estudios europeos realizados sobre radón domiciliario.
- Resultados descriptivos:

  - ✓ Concentración media en los controles: 94Bq/m^3; 11%> 200Bq/m^3, 4% > 400Bq/m^3
  - ✓ Por cada aumento en 100Bq/m^3 el riesgo de cáncer de pulmón aumenta un 16% (IC 5% a 31%).

Papers

Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies

S Darby, D Hill, A Auvinen, J M Barros-Dios, H Baysson, F Bochicchio, H Deo, R Falk, F Forastiere, M Hakama, I Heid, L Kreienbrock, M Kreuzer, F Lagarde, I Mäkeläinen, C Muirhead, W Oberaigner, G Pershagen, A Ruano-Ravina, E Ruosteenoja, A Schaffrath Rosario, M Tirmarche, L Tomášek, E Whitley, H E Wichmann, R Doll

Abstract

Objective To determine the risk of lung cancer associated with exposure at home to the radioactive disintegration products of naturally occurring radon gas

Design Collaborative analysis of individual data from 13 case-control studies of residential radon and lung cancer.

Setting Nine European countries.

Subjects 7148 cases of lung cancer and 14 208 controls.

Main outcome measures Relative risks of lung cancer and radon gas concentrations in homes inhabited during the previous 5-34 years measured in becquerels (radon disintegrations per second) per cubic metre (Bq/m^3) of household air.

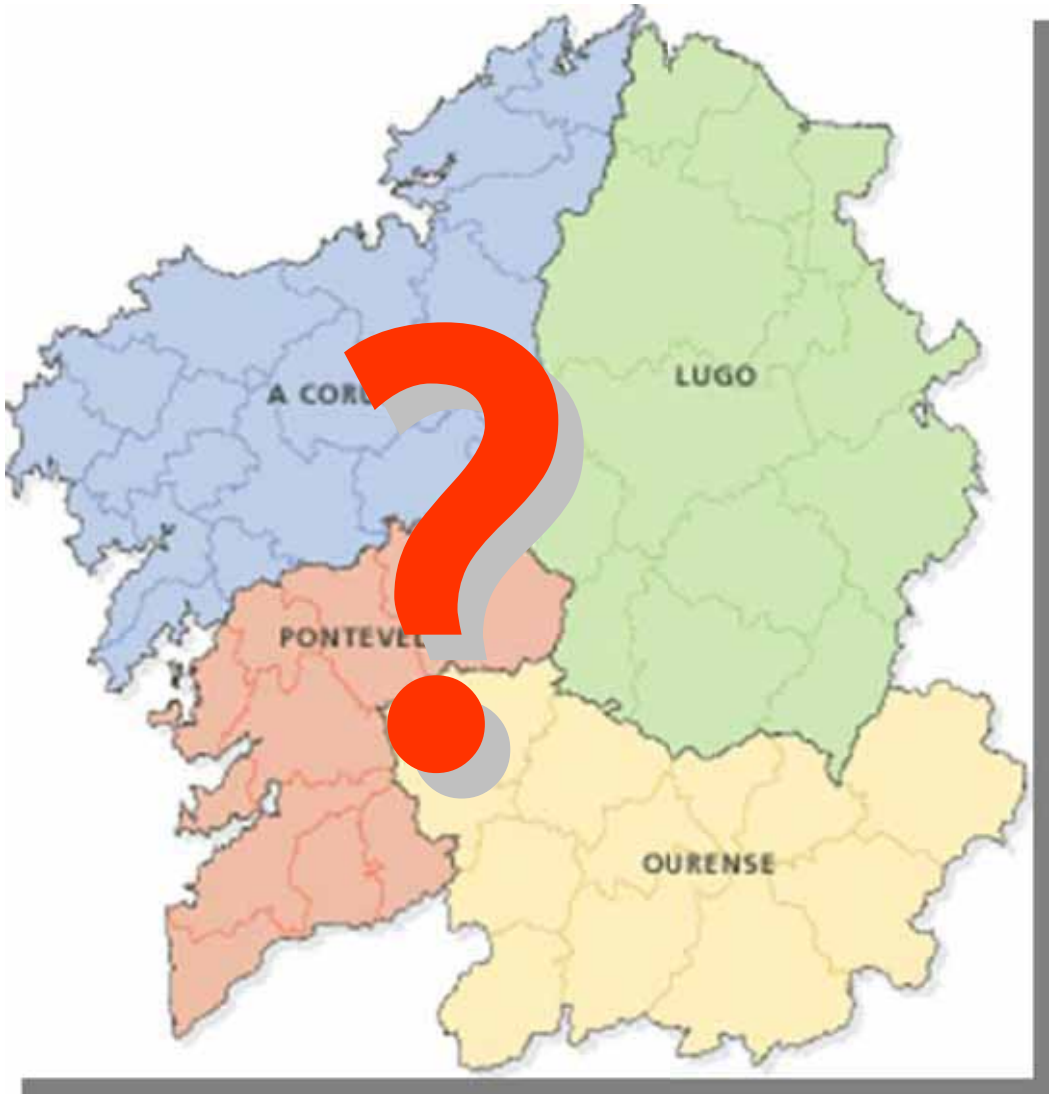
Results The mean measured radon concentration in homes of people in the control group was 97 Bq/m^3, with 11% measuring >200 and 4% measuring >400 Bq/m^3. For cases of lung cancer the mean concentration was 104 Bq/m^3. The risk of lung cancer increased by 8.4% (95% confidence interval 3.0% to 15.8%) per 100 Bq/m^3 increase in measured radon ($P=0.0007$). This corresponds to an increase of 16% (5% to 31%) per 100 Bq/m^3 increase in usual radon—that is, after correction for the dilution caused by random uncertainties in measuring radon

into a series of short lived radioactive progeny. Two of these, polonium-218 and polonium-214, also decay by emitting α particles. If inhaled, radon itself is mostly exhaled immediately. Its short lived progeny, however, which are solid, tend to be deposited on the bronchial epithelium, thus exposing cells to α irradiation.

Air pollution by radon is ubiquitous. Concentrations are low outdoors but can build up indoors, especially in homes, where most exposure of the general population occurs. The highest concentrations to which workers have been routinely exposed occur underground, particularly in uranium mines. Studies of exposed miners have consistently found associations between radon and lung cancer.[2 3] Extrapolation from these studies suggests that in many countries residential radon, which involves lower exposure in much larger numbers of people, could cause a substantial minority of all lung cancers. This is of practical relevance because radon concentrations in existing buildings can usually be reduced at moderate cost—for example, by increasing underfloor ventilation—while low concentrations can usually be ensured at reasonable or low cost in new buildings—for example, by installing a radon proof barrier at ground level. These extrapolations, however, depend on

¿Y en Galicia...?

1. Área catalogada de riesgo por características geológicas
2. Materiales de construcción potencialmente emisores de radón
3. Abundancia de pozos



Objetivos

MAPA DE CONTAMINACIÓN POR RADÓN EN LOS DOMICILIOS GALLEGOS

1. Conocer las concentraciones de radón en los domicilios gallegos.
2. Determinar la proporción de la población gallega que se encuentra expuesta a concentraciones de radón consideradas actualmente de riesgo

Objetivos

3. Valorar qué características de las viviendas (localización, altitud, geología) están asociadas a una mayor concentración de radón.
4. Realizar un mapa de concentraciones de radón por comarcas gallegas.
5. Identificar las zonas de mayor riesgo.

Conclusiones

Fuentes de datos

- Mediciones interiores de gas radón mediante detectores largos
- Información geológica.
- Combinación mediciones de ambas.

Conclusiones

Muestreo:

- Rejillas.
- Municipio o condado
- Límites geológicos como el tipo de roca o el tipo de suelo.

Conclusiones

Presentación de resultados

- Medias geométricas
- Porcentaje de la medición por encima de un valor de umbral.
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- Orientación de las futuras estudios de medición de radón para aumentará las posibilidades de encontrar viviendas con altas concentraciones de radón.
- Para destacar las áreas de alto potencial de radón en las que sería prudente incorporar medidas de prevención de radón en los edificios nuevos

Muchas gracias !!!

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