



## Radon

[See the statistics of the radon section of SINRAD](#)

Radon, in the absence of incidents, represents the main source of exposure to radioactivity for the population. The World Health Organization, through the International Agency for Research on Cancer (IARC), has assessed the carcinogenicity of radon since 1988 and has included it in Group 1 of human carcinogens. Estimates consolidated for decades at a global level attribute to radon the second cause of lung cancer after tobacco smoking with a risk proportional to the concentration. Radon is a radioactive gas produced by the decay of uranium, naturally present in soils and rocks with different concentrations depending on their composition. Radon emitted from soils, in a diversified manner depending on the geology of the territory, is present everywhere in the air we breathe but, while outdoors it disperses without reaching high concentrations, in closed places (indoors - homes, schools, workplaces, buildings in general) it accumulates reaching, in some cases, concentrations that pose a non-negligible risk to health. Some building materials and water are secondary sources of radon. Further causes, such as the construction methods of buildings, with particular reference to contact with the ground, and the lifestyle habits of the occupants, can affect the presence of radon. The combination of these factors, all highly variable, contributes to a highly diversified spatial distribution of the concentration of indoor radon across the territory, mainly governed by local geolithology. Even between single similar and close buildings it is possible to find a strong difference in the concentration of radon.

Legislative Decree of 31 July 2020 n. 101 and subsequent amendments, implementing Directive 2013/59/EURATOM of the European Council, has introduced important innovations, also for radon, in the field of prevention and protection from ionizing radiation, adapting national legislation to what is provided for at European level.

For the first time, in the context of protection from exposure to radon, residential environments (homes) are included in the standard, classified as existing exposure situations on a par with

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workplaces. The maximum reference levels, in terms of the average annual value of the concentration of radon activity in the air, are set at 300 Bq m<sup>-3</sup> for workplaces and existing homes, and at 200 Bq m<sup>-3</sup> for homes built after 31 December 2024. A reference level in terms of annual effective dose of 6 mSv is also set for workplaces.

The provisions relating to radon exposure in the workplace apply to underground workplaces, semi-underground or ground-floor workplaces within priority areas (where the average annual concentration of radon activity in the air is estimated to exceed the reference level in a significant number of buildings), in specific types of workplaces identified by the National Action Plan for Radon, and in spas.

In such workplaces, the operator is required to measure radon using recognized dosimetry services and, if the aforementioned reference level is exceeded, to implement corrective measures to reduce the concentration to the lowest level reasonably achievable. In this context, Legislative Decree no. 101/2020 and subsequent amendments introduces for the first time the professional figure of the expert in radon remediation interventions, who must possess specific requirements in the matter. If, despite the application of corrective measures, the radon concentration remains higher than the reference level, the operator must carry out the assessment of the annual effective doses using the radiation protection expert. If the results of the assessments are higher than the reference level in terms of effective dose equal to 6 mSv/year, the operator is required to apply certain measures provided for in Title XI of Legislative Decree no. 101/2020 "Worker Exposure".

The renewed regulatory framework has provided for the implementation of the National Action Plan for Radon, within which to identify the strategies, criteria and methods of intervention to prevent and reduce long-term risks due to exposure to radon. The National Action Plan for Radon 2023-2032 was adopted with the Prime Ministerial Decree of 11 January 2024, published in the Official Journal no. 43 of 21.02.2024 - SO no. 10. ISIN has guaranteed its institutional role in the development and adoption of this Plan and contributes to ensuring its implementation also through the coordination of the planned activities.

Among the functions that the new decree attributes to ISIN in the field of radon, there is the collection and recording of data produced at a national level by the regional and provincial agencies for environmental protection (ARPA/APPA) and by dosimetry services, within the RADON section in the [SINRAD web portal](#) (National Information System on Radioactivity). ISIN also carries out monitoring and control activities of indoor radon gas through its own measurement surveys.

In the 1990s, ISIN, then ENEA-DISP, and the Istituto Superiore di Sanità (ISS), in collaboration with the regional health departments and the Regional Reference Centers for the Control of Environmental Radioactivity, now merged into ARPA/APPA, conducted a national survey on the concentration of radon in approximately 5,000 homes, from which the national average concentration of radon was estimated to be 70 Bq m<sup>-3</sup>, a value higher than the European average of approximately 55 Bq m<sup>-3</sup> and the world average of approximately 40 Bq m<sup>-3</sup>. The average concentrations measured by the Regions and autonomous Provinces showed values ranging from approximately 25 Bq m<sup>-3</sup> to approximately 120 Bq m<sup>-3</sup>. At a national level, it is estimated that in approximately 2% of homes the average annual concentration of radon is higher than 300 Bq m<sup>-3</sup>.

<b>Regione / Provincia autonoma</b>	<b>Concentrazione media di radon e <i>standard error</i> (Bq m<sup>-3</sup>)</b>
Piemonte	69 ± 3
Valle d'Aosta	44 ± 4
Lombardia	111 ± 3
Bolzano	70 ± 8
Trento	49 ± 4
Veneto	58 ± 2
Friuli Venezia Giulia	99 ± 8
Liguria	38 ± 2
Emilia Romagna	44 ± 1
Toscana	48 ± 2
Umbria	58 ± 5
Marche	29 ± 2
Lazio	119 ± 6
Abruzzo	60 ± 6
Molise	43 ± 6
Campania	95 ± 3
Puglia	52 ± 2
Basilicata	30 ± 2
Calabria	25 ± 2
Sicilia	35 ± 1
Sardegna	64 ± 4
<b>Italia</b> (media pesata per la popolazione regionale)	<b>70 ± 1</b>

Dati ISIN, ISS, ARPA-APPA 1989-1998|

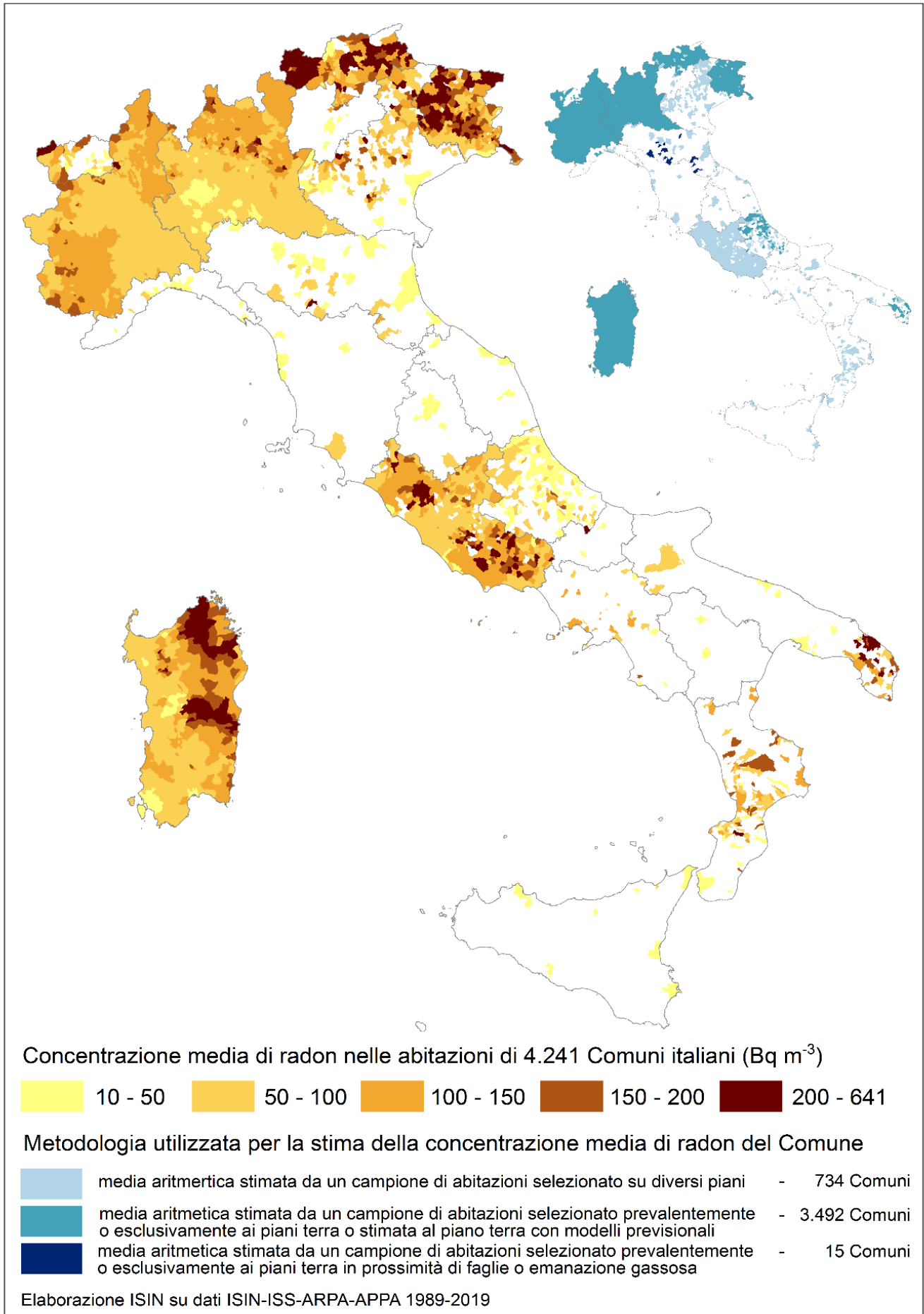
The estimates of the average radon concentrations in the Regions and autonomous Provinces and the average value estimated for Italy from the survey of the 1990s still represent a national reference. Many other surveys were subsequently carried out, in addition to the ISIN, by the Regions, through the ARPA/APPA, not only in homes, but also in schools and workplaces, carrying out tens of

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thousands of measurements of the average annual radon concentration. Taking homes as a reference, it should be noted that the percentage of homes measured is rather small compared to the total number of homes in the national territory.

The regional surveys were carried out using different methods and criteria which, although valid for the purposes of classifying territorial areas, make a direct comparison complicated. In order to undertake a process of harmonization of data at national level, also with the aim of representing in a more homogeneous way among the Regions and autonomous Provinces the spatial variability of radon concentration and to make the information usable, the ISIN has started a collection of estimates of average radon concentrations in Italian Municipalities elaborated by the ARPA/APPA and by the ISIN itself.

From the information received up to 2019, the data on average radon concentrations are available for 4,241 Municipalities, with a territorial coverage corresponding to 53% of Italian Municipalities, but they are fragmented and mostly concentrated in the Regions of Northern and Central Italy. Furthermore, their examination shows some differences in the methods of carrying out radon measurement surveys essentially attributable to two main types of approaches in carrying out measurements in homes: the first for those located exclusively or predominantly on the ground floor; the second for those located on different floors. The estimates of average municipal concentrations obtained from measurements carried out exclusively or mainly on the ground floor concern over 80% of the Municipalities subject to evaluation and over 40% of all Italian Municipalities. On the basis of this information relating to the time interval from 1989 to 2019, ISIN has developed a [thematic map of average municipal radon concentrations](#). The values reported in the thematic map must be consulted taking into account the information returned by the spatial query of the municipal units relating to the type of data used or estimates made. It is also important to remember that the high variability of the radon concentration between different homes, even in the same Municipality, does not allow the value of the municipal average to be used as a reliable indicator of the value of the radon concentration in a specific home located in the same Municipality. The only way to have a reliable estimate of the radon concentration in a specific home is to carry out a direct measurement, which costs approximately a few dozen euros, excluding any inspections.



Further radon data collection and communication activities carried out by ISIN are those carried out

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as a contact point for Italy within the [European Atlas of Natural Radiation](#) – European Indoor Radon Map project, where the Inspectorate ensures support to the European Commission for the processing of spatial statistics of the data requested by the Joint Research Centre, aimed at the creation and continuous updating of the map of radon levels harmonized at European level.

Further insights on the subject of radon are contained in the dedicated chapter within the [ISIN Report Surveillance of environmental radioactivity in Italy 2020](#).

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