LIFE-Respire

Radon r**E**al time monitoring **S**ystem and **P**roactive **I**ndoor **Re**mediation - LIFE16 ENV/IT/000553

Website: www.liferespire.eu, www.liferespire.it

6th Newsletter, January 2021

The LIFE-RESPIRE (**R**adon r**E**al time monitoring **S**ystem and **P**roactive **I**ndoor **Re**mediation) project, which started in September 2017, is approaching the end of its first year. The project is realized with the financial contribution of the European Union LIFE programme (LIFE16 ENV/IT/000553).
The main objective of the project is **to demonstrate in 4 areas** (Caprarola, Celleno, and Ciampino in Italy and Jalhay in Belgium) characterised by different Geogenic Radon Potential (GRP), a cost-effective and eco-friendly solution for Rn real-time measurement and remediation **to keep indoor Rn levels below 300 Bq/m³** (as indicated in European Directive 2013/59/EURATOM). The RESPIRE project will implement an intelligent, adaptable and versatile hybrid Rn remediation system composed of sensors, an Air Quality Balancer (SNAP) and an external additional fan-system (eolian and/or electric) working on positive pressure method. A control model based on a IoT protocol will be also implemented.

The LIFE-RESPIRE geodatabase, consisting of collected continuous and discrete Rn measurements coupled with other geological, geochemical and building characteristics data, will be linked to a WebGIS for easy data management, analysis and visualization by the consortium, and available to the local authorities for land use planning and health risk assessment, helping to prepare relevant national action plans (see Articles 54, 74 and 103 in 2013/59/EURATOM).

This newsletter highlights the main actions conducted in the 5th semester of the project and lists some of the dissemination activities at conferences. Some of the mentioned material is available to the public on the Document section of the LIFE-Respire website.

Any interest and collaboration with the LIFE-Respire Group is appreciated, please contact us!

More information about the purposes of the project can be found on the LIFE-RESPIRE website.

LIFE-Respire Consortium

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CNR-IGAG: Institute of Environmental Geology and Geoengineering of the National Research Council, Rome, Italy

INGV: National Institute of Geophysics and Volcanology, Rome, Italy

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IN THIS ISSUE

1. Respire Final Event

Rome, 10 May 2022 - The results of the "Life Respire" project (Life of the month of January on the website of the Ministry of Ecological transition) and the proposal of the National Action Plan for of Radon, edited by the Mild and the Ministry of Health , on Monday 9 May in Rome, in the Senate's Zuccari room, as part of the conference "Radon from geology to indoor risk management".

Three objectives achieved by the "Life Respire" project: monitoring of the radon concentration; a map of the geological characteristics of the territory from which to obtain the presence of radon in the ground of the involved municipalities (Caprarola, Celleno and Ciampino in Lazio, Ardenne in Belgium); territorial planning thanks to a series of documents that local authorities will be able to use.

The proposal of the National Action Plan for Radon was drawn up thanks to the commitment and collaboration of experts of the competent ministries, the ISIN (Ispettorato Nazionale per la Sicurezza Nucleare), ISS (Higher Institute of Health) and the Regions. In addition, the activities started by ISPRA, MITE and ministry of health were illustrated pending adoption of the plan, which consist in the definition of geological criteria and indicators to support the identification of the priority areas, in harmonization and coordination of the interventions and policies related to radon with those aimed at the energy efficiency of buildings and the improvement of indoor air quality and in the construction of web pages aimed at citizens and businesses, effective and interactive for a knowledge of the radon and projects theme of Citizen Science.

Figure 1. Dr. Giorgia Cinelli, invited speaker as representative of the Joint Research Centre of the EU, reported the European activities about indoor radon and presented the new European Atlas of Natural Radiation.

2. Geogenic Radon Potential Maps

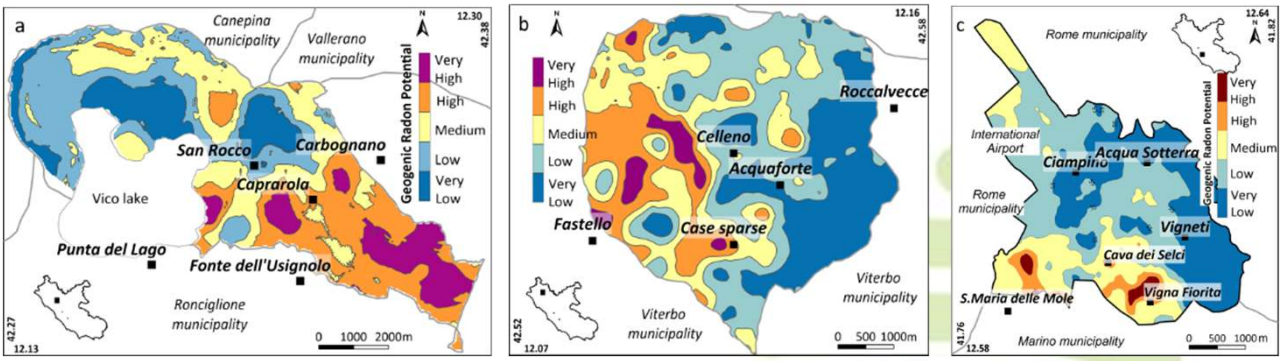


Figure 2. Maps of the Geogenic Radon Potential of the Respire municipalities: a) Caprarola, b) Celleno and c) Ciampino.

LIFE-RESPIRE created Geogenic Radon Potential maps for the three Italian Municipalities. This document required the construction of datasets filled with geological and geochemical parameters linked to radon production in the soil. The maps highlighted the strong difference in radon risk potential coming from the local geology of the Italian sites, with Caprarola having the highest due to the type of volcanic rocks present in the area, Celleno having intermediate levels, and Ciampino the lowest.

The construction of GRP maps is an important tool for the analysis of the hazard and for the identification of Radon Priority Areas. These maps are fundamental: for land-use planning by national and local authorities, for the organization of indoor investigations (for risk prevention), and for remediation actions. The maps in figure 2 were depicted on the 1:25000 scale topographic map and given to representatives of the municipalities involved in the Respire project (example of figure 3).

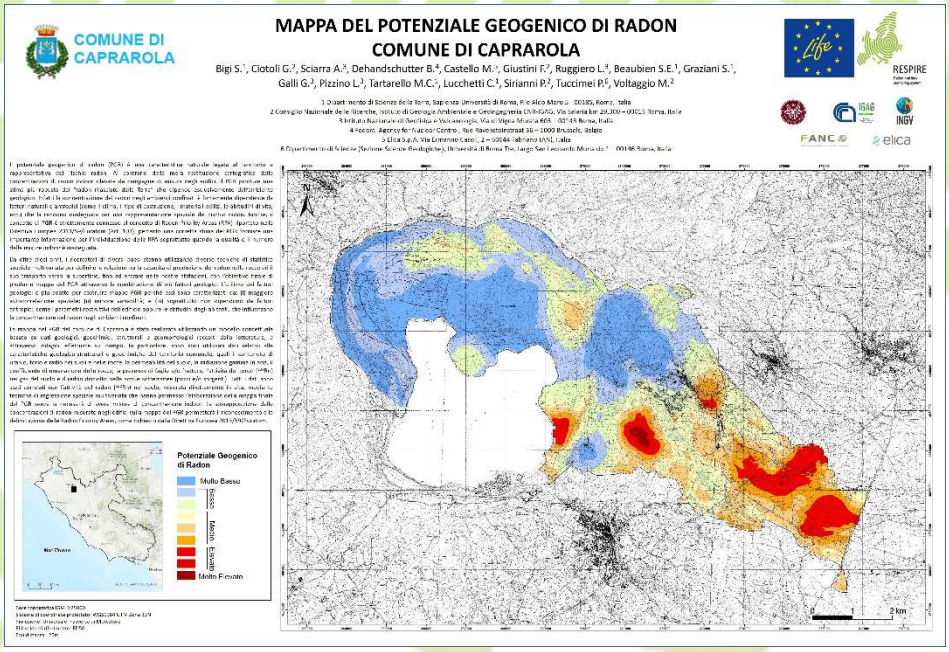
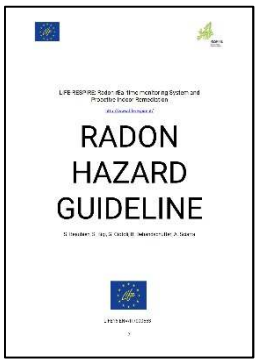


Figure 3. Geogenic Radon Potential maps of the municipality of Caprarola, the map was given to representatives of the municipalities involved in the Respire project.

3. Radon Guidelines



The LIFE-Respire Radon Hazard Guidelines examines the different topics starting from legal framework of indoor radon at international and national level, and through a description of the processes that generate radon in the natural environment and regulate its accumulation to buildings, we arrive at indoor monitoring techniques and protocols established by world, national and regional health bodies, and finally to a description of some of the remediation techniques used to reduce concentrations in private and public housing.

Chapter 1 is focused on the European Directive 20213/59/Euratom, which laid out the background and requirements for member states to develop national laws related to ionizing radiation (including indoor radon). The EU Directive is used to introduce the present regulations that exist in Italy and Belgium that define acceptable dwelling and workplace radon concentrations, responsibilities, and penalties.

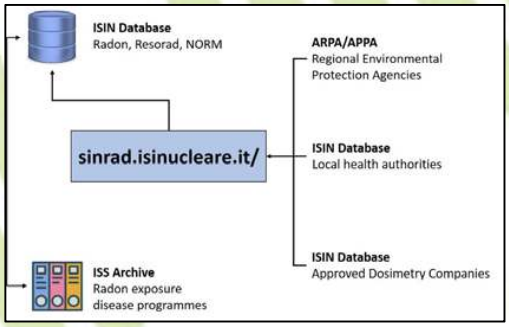


Figure 4. Flow chart showing the Italian national, regional and local authorities involved in the regulatory framework.

Chapter 2 describes how and where radon is formed and outlines the ways that it can enter and accumulate within indoor environments. The three main sources of soil, tap water and building materials are explained, given that the source pathway is critical to understand to choose the best and most effective remediation strategy.

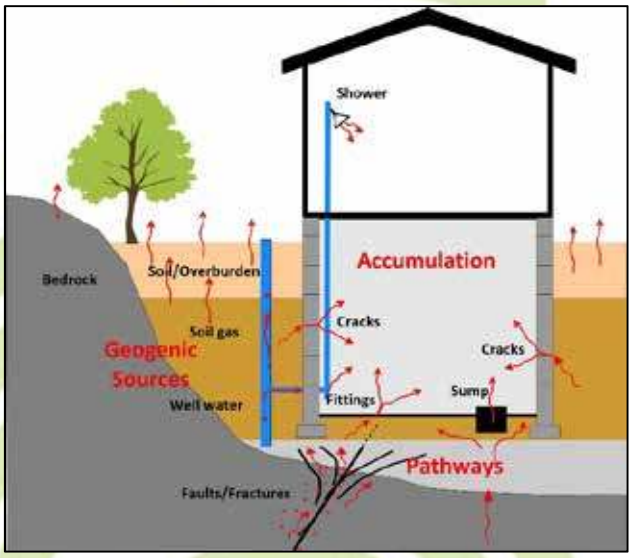


Figure 5. Main routes for radon entry the buildings.

Monitoring methods are reviewed in chapter 3, techniques that are important not only to understand if an indoor radon problem exists but also to monitor how values change as a function of any installed remediation system. Cumulative or dose integrating sensors are shown to be inexpensive, simple to use and effective for long term monitoring that assesses yearly dosage, while continuous or instantaneous radon detectors are more expensive but show how radon levels change as a function of occupant activities, environmental conditions, or other factors. Monitoring protocols established by world, national and regional health bodies are also described to illustrate how these sensors should be used to provide the most reliable results (considering the strong variability of indoor radon values).

4. Layman Report

The Layman report can be downloaded from the Respire project website at www.liferespire.it/download, under "Generic Documents"

5. Afterlife activities and events

In 2022, an agreement with **traceRadon** project (http://traceradon-empir.eu/) funded from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 R&I programme was finalised. The main topic of this collaboration concerns activities to develop improved methods and geospatial models for the elaboration of Geogenic Radon Potential maps and identification of Radon Priority Area (RPAs) using outdoor radon activity concentration data, radon flux data and radon flux maps.

After-life activities also included participation in the following conferences:

International Conference on Radiation Applications RAP 2022 will be held from 6th - 10th June 2022, Thessaloniki, Greece.

Goldschmidt Conference, 10-15 July 2022, Honolulu, Hawai (USA). The Conference will host a session "Radon: geogenic sources, hazard mapping, and health risk" chaired by the Respire Consortium

European Geosciences Union-General Assembly 2023 (EGU), Vienna (23-28 April 2023) which will host a session on "Radon and natural radioactivity: implications from the geogenic sources to the human health risk (NH8.2)".

6. Publications

Research and networking activities conducted as part of the Respire project contributed to the following publications:

Benà E., Ciotoli G., Ruggiero L., Coletti C., Bossew P., Massironi M., Mazzoli C., Mair V., Morelli C., Galgaro A., Morozzi P., Tositti L., Sassi R. (2022). Evaluation of tectonically enhanced radon in fault zones by quantification of the radon activity index. Scientific Reports, 12, 21586. https://doi.org/10.1038/s41598-022-26124-y

Čeliković I., Pantelić G., Vukanac I., Nikolić J.K., Živanović M., Cinelli G., Gruber V., Baumann S., Ciotoli G., Quindos Poncela L.S., Rábago D. (2022). Overview of Radon Flux Characteristics, Measurements, Models and Its Potential Use for the Estimation of Radon Priority Areas. Atmosphere, 13, 2005, doi: 10.3390/atmos13122005