

# EMPIR



The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

## AN INTRODUCTION TO THE METRORADON PROJECT METROLOGY FOR RADON MONITORING A EUROPEAN RESEARCH PROJECT

H. Wiedner, on behalf of the MetroRadon consortium



**BEV - Bundesamt für Eich- und Vermessungswesen**



The second radon-in-field international comparison for passive measurement devices:  
dwellings and workplaces

# The MetroRadon Project

- Metrology research project: Radon monitoring
- Started 01 June 2017
- Duration: 3 years
- 17 European partner institutions
- EMPIR project
- Organised by EURAMET
- Co-funded by the European Union's Horizon 2020 programme and the EMPIR Participating States

**EURAMET**, as the Regional Metrology Organisation (RMO) of Europe, has 37 member countries. It leads cooperation of National Metrology Institutes (NMI) with nearly 6000 metrologists in the development of the European metrology infrastructure and services. It represents Europe in the international metrology forum of the CGPM (General Conference of Weights and Measures).

[www.euramet.org](http://www.euramet.org)



**Our vision is to be the leader in the development and application of measurement enabling Europe to be competitive, healthy and sustainable through innovation.**

**Mission:**

- Develop and disseminate an appropriate, integrated and cost effective measurement infrastructure for Europe taking into account the needs of end users in industry, business and Government
- Ensure that the European measurement infrastructure is internationally competitive and recognised, and is based on robust and high quality science and R&D
- Support members in meeting their own national requirements through collaboration and a balanced European measurement infrastructure

# European Metrology Programme for Innovation and Research



The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

part of Horizon 2020, the EU Framework Programme for Research and Innovation

**EMPIR calls (2014 - 2020): total budget of 600 M €** (300 M € from the participating states and up to 300 M € from the European Commission using Article 185 of the European Treaty)

EMPIR Joint Research Projects (JRPs) from these calls will focus on priority areas, known as Targeted Programmes (TPs), to address the EU's Grand Challenges in **Health, Energy, Environment and Industry**, and to progress fundamental measurement science.

<http://msu.euramet.org/>

## EMPIR Work Programme Call Scope – Metrology for Environment (2016)

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This Call again focuses on metrological research to improve the quality of data to stimulate technological innovation, and to disseminate traceability to, and make traceable measurements in, the field. It also aims to underpin other environmental research initiatives through collaborative metrological research and development. It addresses both local environmental challenges such as those related to:

- contamination of water, air and soil
- radiation measurement and protection, and acoustic noise
- local pollutions and emissions measurements
- monitoring of key parameters to detect local climate evolution

and global metrological challenges for climate monitoring such as those related to:

- the essential climate variables of the atmosphere, land and water, including their constituents, contamination, transport and other parameters, and their time evolution and comparability
- emission control; measurement of gases and particles that have an effect on climate and health
- validated remote sensing data and products for environmental and climate monitoring, taking into account ground based instrumentation networks
- measurements in extreme environments and challenging conditions

# Needs for the project

- ***European Council Directive 2013/59/EURATOM (EU-BSS)***
- The EU member states
  - are required to ensure that levels of relevant activity concentration laid down in the EU-BSS do not exceed 300 Bq/m<sup>3</sup>
  - obliged to transpose the EU-BSS into national legislation by 2018
  - have to consider several items when preparing their national radon action plan
  - define approaches, data and criteria to be used for establishment of radon priority areas
- **Reliable calibration and measurement methods** of activity concentrations between about 100 Bq/m<sup>3</sup> and 300 Bq/m<sup>3</sup>
- Significant improvement of the **metrological infrastructure** for calibrations in Europe
- **Harmonisation** of radon concentration measurements
- Different methods to define the geogenic radon potential of an area need to be **compared and standardised**

# Scope

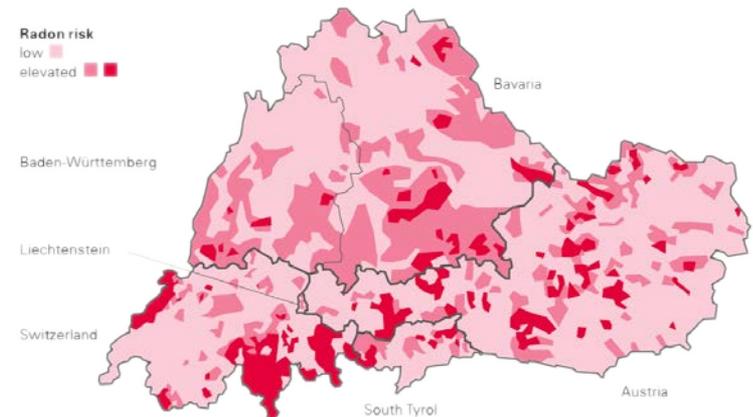
- **EURATOM-BSS:**
  - requires developing Rn action plans whose aim is reduction of Rn exposure
  - includes, among other, reference values and delineation of Rn priority areas
- **This implies QA**, in, among other:
  - measuring Rn (+Tn) concentrations incl. calibration in order to be able to verify **compliance with reference levels**;
  - methodology of determination of quantities which serve as geogenic **radon potential** or its proxies;
  - methodology of determination of **radon priority areas**.

## **Put together:**

QA of “consumer end products” (compliance with rules, assignment of areas to degree of Rn priority, etc.) implies QA of the “supply chain” which leads to them (calibration, measurement etc.)

# Main goals of the JRP

- Creation of a **coordinated metrological infrastructure** for radon monitoring and radon mapping in Europe suitable for the requirements of the **radon action plan** requested by the new European Directive
- Enable **SI traceable monitoring** of radon at low radon activity concentrations ( $\leq 300 \text{ Bq/m}^3$ ), including calibration and radon mapping, essentially facilitating the **harmonised implementation of the new EU-BSS in Europe**
- Investigation of the **influence of thoron** on radon measurements and calibrations
- **Harmonisation** of indoor radon and soil exhalation radon measurements
- Development of new methodologies for identification and characterization of radon priority areas in Europe



Relative radon risk map of Austria, Liechtenstein, Switzerland and parts of Germany and Italy.  
Source: Swiss Confederation

# Work beyond the state of the art

- A **traceability validation of existing European radon calibration facilities** will be performed. At present, secondary standards are calibrated at relatively high activity and are not adequately traceable to one primary radon gas standard
- The JRP will carry out **traceable inter-comparisons** on the quantities surface soil radon exhalation rate and radon concentrations in soil gas
- **Development of a unified index of geogenic Rn hazard:** consistent picture of susceptibility to geogenic Rn across Europe
- As a novelty, **methods for retrospective radon measurement by compact discs (CDs) and DVDs will be evaluated** for their potential to define radon priority areas.
- **New techniques** for measurement of radon exhalation from soil based on liquid scintillation counting of polymers and track-etching of CDs for indoor air retrospective radon measurement will be developed and evaluated
- **Evaluation of the sensitivity of radon monitors and detectors to thoron** with traceability to a primary thoron standard

# Impact

- **Improvement of radiation protection and public health** due to reliable radon measurements as a basis for effective radon risk mitigation and prevention against radon progeny induced lung cancer in Europe and, therefore, **decreasing the lung cancer risk due to radon in Europe**
- The JRP will help to **establish** a basic European **metrological infrastructure** so that sound monitoring of radon becomes possible
- Provision of **harmonised metrological standards** for radon monitoring and radon protection in Europe, thus allowing comparison and merging of data sets
- **Provision of reliable radon mapping** methods for the **delineation of potential radon priority areas** in Europe
- **Enhance competitiveness of European building industry**
- **Coordination** of European calibration facilities regarding knowledge exchange
- **Development of the lead of European metrological facilities** in low-level radon monitoring and air-borne radon activity concentrations measurements
- **Development of advanced radon instrumentation**, resulting in a world-wide technological lead of European manufacturers

# Internal funded partners

**National Metrology Institutes and Designated Institutes**, from countries that have made a financial commitment to the Programme

no.	Participant Type	Short Name	Organisation legal full name	Country
1	Internal Funded Partner	BEV-PTP	Physikalisch-Technischer Pruefdienst des Bundesamt fuer Eich- und Vermessungswesen	Austria
2	Internal Funded Partner	BFKH	Budapest Főváros Kormányhivatala	Hungary
3	Internal Funded Partner	CEA	Commissariat à l'énergie atomique et aux énergies alternatives	France
4	Internal Funded Partner	CMI	Cesky Metrologický Institut	Czech Republic
5	Internal Funded Partner	IFIN-HH	Institutul National de Cercetare-Dezvoltare pentru Fizica si Inginerie Nucleara "Horia Hulubei"	Romania
6	Internal Funded Partner	PTB	Physikalisch-Technische Bundesanstalt	Germany
7	Internal Funded Partner	STUK	Sateilyturvakeskus	Finland
8	Internal Funded Partner	VINS	Institut Za Nukleame Nauke Vinca	Serbia

# External funded and unfunded partners

External funded partners: All other legal entities established in:

- The Member States of the European Union, including their overseas departments
- The Overseas Countries and Territories (OCT) linked to Member States
- The countries automatically eligible for Horizon 2020 funding
- The countries associated to Horizon 2020

9	External Funded Partner	AGES	Oesterreichische Agentur fuer Gesundheit und Ernaehrungssicherheit GmbH	Austria
10	External Funded Partner	BfS	Bundesamt fuer Strahlenschutz	Germany
11	External Funded Partner	CLOR	Centralne Laboratorium Ochrony Radiologicznej	Poland
12	External Funded Partner	IRSN	Institut de Radioprotection et de Surete Nucleaire	France
13	External Funded Partner	JRC	JRC - Joint Research Centre - European Commission	European Commission
14	External Funded Partner	SUBG	Sofiiski Universitet Sveti Kliment Ohridski	Bulgaria
15	External Funded Partner	SUJCHBO	Státní ústav jaderné, chemické a biologické ochrany, v.v.i.	Czech Republic
16	External Funded Partner	UC	Universidad De Cantabria	Spain
17	Unfunded Partner	METAS	Eidgenössisches Institut für Metrologie METAS	Switzerland

# The MetroRadon Consortium

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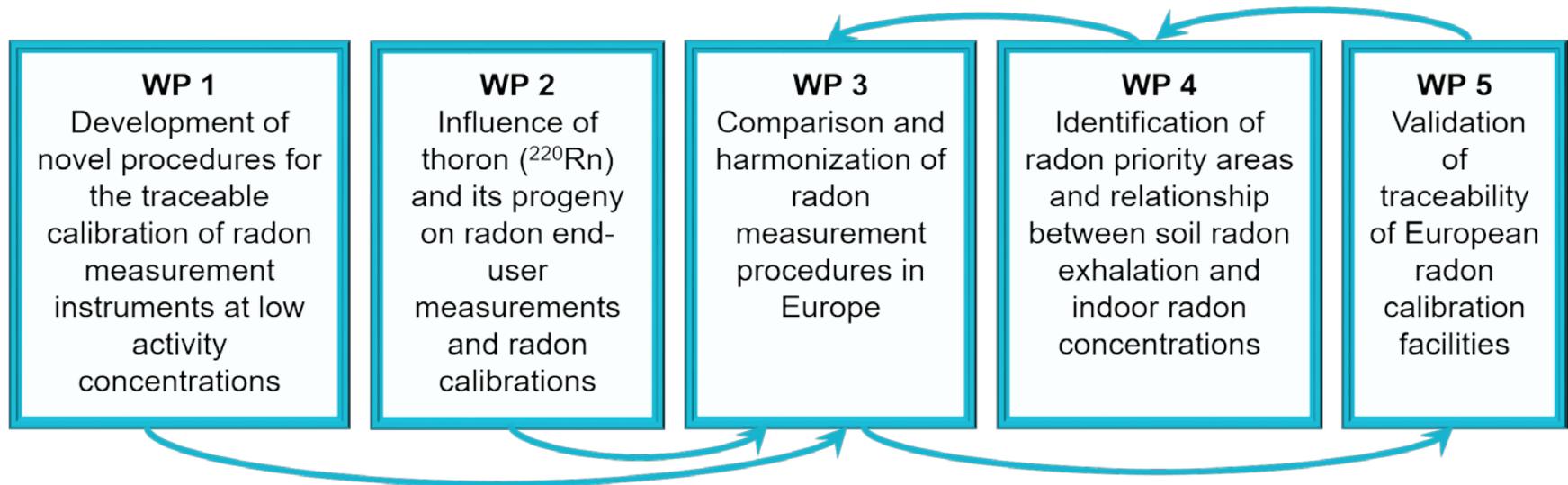
# The MetroRadon Consortium



# MetroRadon – main objectives

- Novel procedures for the **traceable calibration** of radon ( $^{222}\text{Rn}$ ) measurement instruments from  $100 \text{ Bq/m}^3$  to  $300 \text{ Bq/m}^3$  with **relative uncertainties  $\leq 5 \%$  ( $k = 1$ )**
- New radioactive **reference sources** with stable and known radon emanation rates
- **Influence of thoron ( $^{220}\text{Rn}$ ) and its progeny on radon end-user measurements and radon calibrations**
- **Comparison of existing radon measurement procedures in different European countries**
- **Optimisation the consistency of indoor radon measurements and soil radon exhalation rate** measurements across Europe
- Analysis and development of methodologies for the **identification of radon priority areas**
- Development of the **concept of a Radon Hazard Index (RHI)**
- Relationship between **soil radon exhalation** rates and **indoor radon concentrations**
- Validation of the **traceability of European radon calibration facilities**
- To publish **guidelines and recommendations** on metrologically sound calibration and
- Measurement procedures for the determination of **radon concentration in air**

# MetroRadon Work Package Structure



# WP 1

## ***Development of novel procedures for the traceable calibration of radon ( $^{222}\text{Rn}$ ) measurement instruments at low activity concentrations (100 Bq/m<sup>3</sup> to 300 Bq/m<sup>3</sup>) with relative uncertainties $\leq 5\%$ ( $k=1$ )***

- Task 1.1: Development of new  $^{222}\text{Rn}$  and  $^{220}\text{Rn}$  radioactive reference sources with stable and known radon emanation capacity
- Task 1.2: Comparison of existing radon gas primary standards at European NMIs/DIs in the few kBq range
- Task 1.3: Establishment of constant  $^{222}\text{Rn}$  radon activity concentrations in reference chambers and calibration of radon measurement instruments

# WP 2

## ***Influence of thoron ( $^{220}\text{Rn}$ ) and its progeny on radon end-user measurements and radon calibrations***

- Task 2.1: Ensuring traceability of the secondary thoron reference instruments used in the experimental research to the primary thoron measurement system at IRSN
- Task 2.2: Investigation of the influence of thoron on radon measurements and calibrations
  - because Tn can introduce errors in Rn determination in certain techniques
- Task 2.3: Development of techniques to reduce the influence of thoron on radon measurements and calibrations

# WP 3

## ***Comparison and harmonisation of radon measurement methodologies in Europe***

- Task 3.1: Overview and analysis of indoor radon surveys in Europe
- Task 3.2: Overview and analysis of geogenic radon surveys in Europe
- Task 3.3: Comparison of indoor radon and geogenic radon measurements under field conditions - different protocols and procedures exist
- Task 3.4: Development of options for harmonisation of indoor and geogenic radon data including practical examples to ensure comparability between data generated following different methodology

# WP 4

## ***Radon priority areas (RPAs) and the development of the concept of a “geogenic radon hazard index” (RHI)***

- Task 4.1: Evaluation of the concepts for the definitions of radon priority areas
  - different concepts have been proposed and partly implemented
- Task 4.2: Relationship between indoor radon concentration and geogenic radon
  - as a base to classify Rn priority areas based on geogenic quantities
- Task 4.3: New developments in estimation of radon priority areas
  - performance of CDs for measurement of geogenic Rn, classification questions, uncertainty etc.
- Task 4.4: Harmonisation of radon priority areas across borders
  - how to deal with inconsistencies resulting from different Rn priority area definitions

# WP 5

## ***Validation of traceability of European radon calibration facilities***

- Task 5.1: Selection and evaluation of European radon calibration facilities for validation of traceability
- Task 5.2: Validation of traceability, performance and precision of European radon calibration facilities in the range from 300 Bq/m<sup>3</sup> to 10 000 Bq/m<sup>3</sup>
- Task 5.3: Validation of traceability of European radon calibration facilities at stable radon atmospheres in the range from 100 Bq/m<sup>3</sup> to 300 Bq/m<sup>3</sup>

# WP 6: Creating Impact

Task 6.1 Knowledge transfer

Task 6.2 Training

Task 6.3 Uptake and exploitation

## **Improvement of radiation protection and public health**

**Aim: decrease the lung cancer risk due to radon**

- establishment of a basic European metrological infrastructure
- improved coordination of European calibration facilities
- harmonized metrological standards for radon monitoring and radon protection
- reliable radon mapping methods for the delineation of potential radon priority areas
- enhance competitiveness of European building industry
- development of European metrological facilities in low-level radon monitoring and air-borne radon activity concentrations measurements
- development of advanced radon instrumentation, resulting in a world-wide technological lead of European manufacturers

**End users: regulators, radiological protection bodies and policy makers**

**standards developing organisations: ISO/TC45, CEN/TC351, ISO/TC85, CENELEC/TC 45, IAEA**

accredited **laboratories** and instrumentation **manufacturers**

# Work Package Summary

WP No	Work Package Title	Active Partners (WP leader in bold)	Months
WP1	Development of novel procedures for the traceable calibration of radon ( $^{222}\text{Rn}$ ) measurement instruments at low activity concentrations (100 Bq/m <sup>3</sup> to 300 Bq/m <sup>3</sup> ) with relative uncertainties $\leq 5\%$ ( $k=1$ )	<b>PTB</b> , BFKH, CEA, CMI, IFIN-HH, BfS, IRSN, JRC, SUJCHBO, METAS	148.6
WP2	Influence of thoron ( $^{220}\text{Rn}$ ) and its progeny on radon end-user measurements and radon calibrations	<b>SUBG</b> , BEV-PTP, CEA, STUK, IRSN	31.6
WP3	Comparison and harmonisation of radon measurement methodologies in Europe	<b>JRC</b> , BFKH, VINS, AGES, BfS, IRSN, SUBG, UC	24.9
WP4	Radon priority areas (RPAs) and the development of the concept of a "geogenic radon hazard index" (RHI)	<b>BfS</b> , BFKH, VINS, AGES, IRSN, JRC, SUBG, UC	32.3
WP5	Validation of traceability of European radon calibration facilities	<b>CMI</b> , BEV-PTP, BFKH, IFIN-HH, STUK, BfS, CLOR, IRSN, JRC, SUJCHBO, UC	53.9
WP6	Creating impact	<b>AGES</b> , all partners	32.7
WP7	Management and coordination	<b>BEV-PTP</b> , all partners	30.8
<b>Total months</b>			<b>354.8</b>

# Thank you for your attention!

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