HEALTH PHYSICS SOCIETY 2026

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Protecting public health through comprehensive radon monitoring and dosimetry in urban Tbilisi

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Idaho State University

RADON GE რადონი

Radon as a Public Health Hazard

Largest contributor to natural radiation exposure

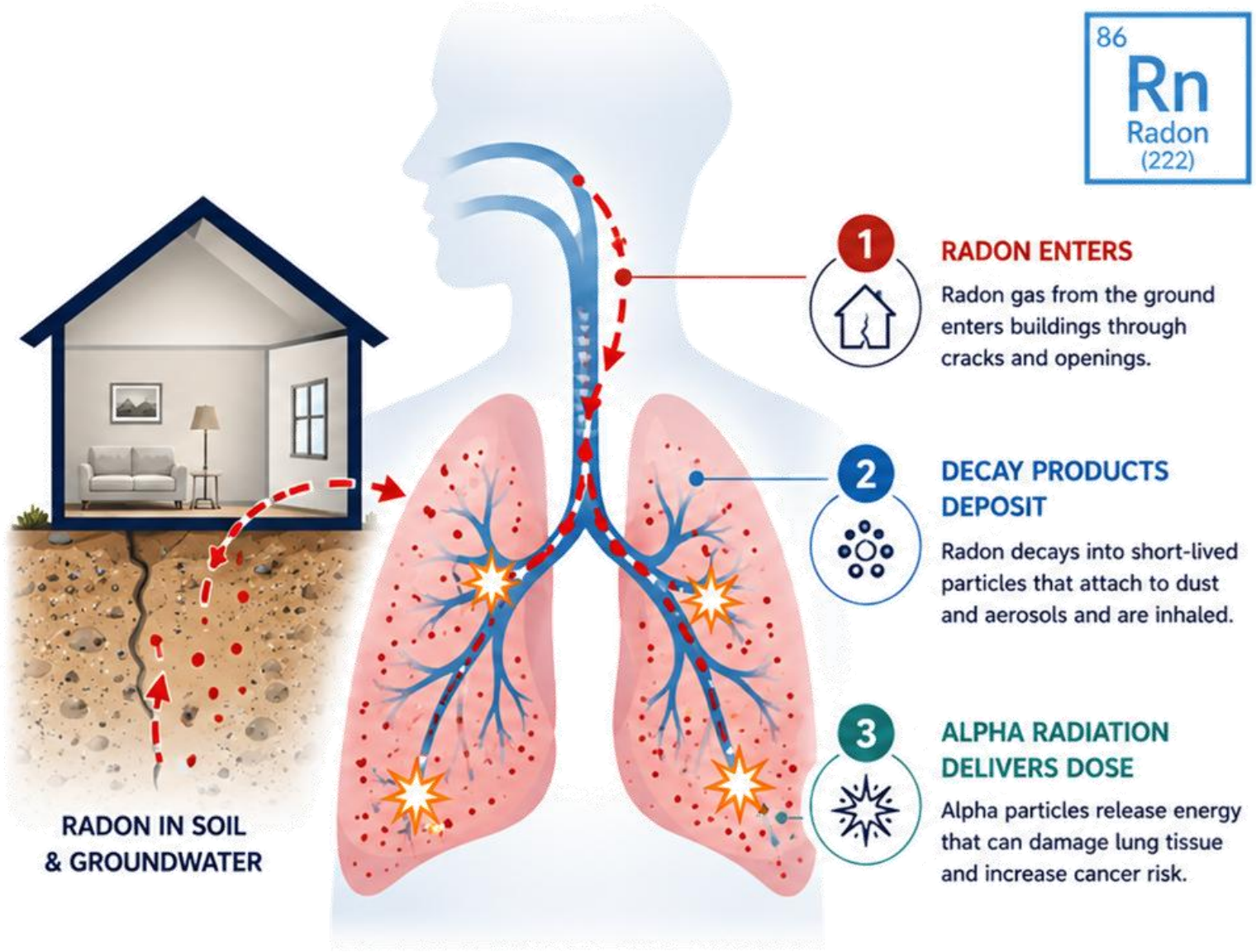
Radon is the largest source of natural background radiation for most individuals.

Second leading cause of lung cancer after smoking

After smoking, radon is the second leading cause of lung cancer.

Testing is the only reliable way

Indoor testing is the only reliable way to identify elevated radon exposure.



Why Georgia? Why Tbilisi?

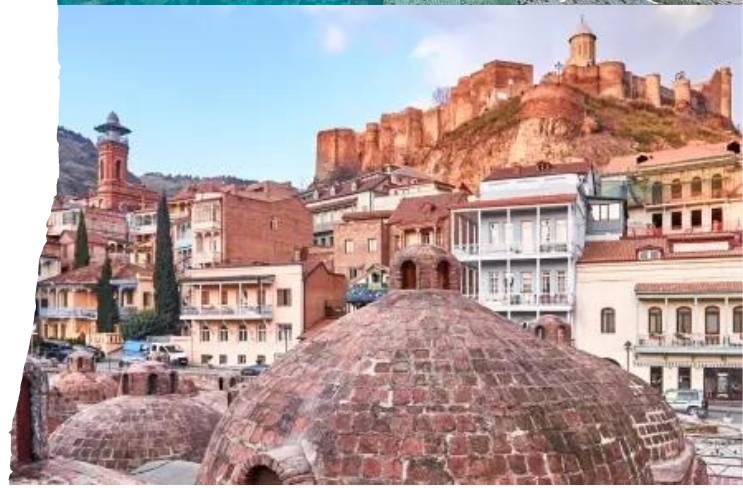
Natural factors

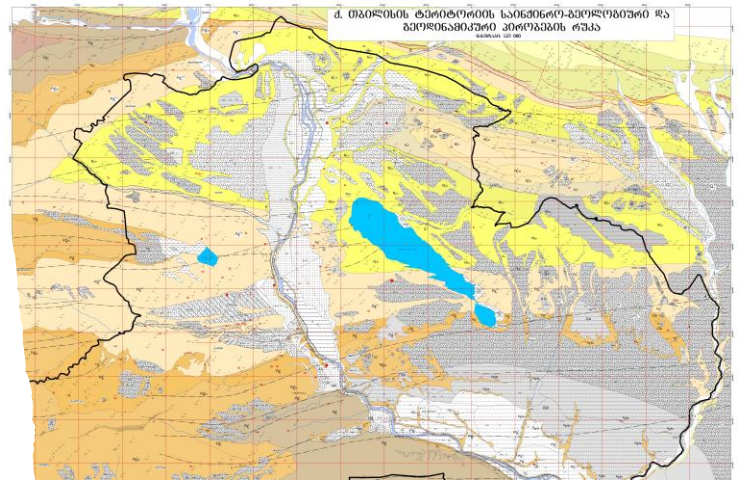
Geology	Diverse lithologies & variable soil permeability
Fault systems	Numerous fault systems & high seismicity
Hydrogeology	Mineral springs, sulfur baths, & artesian waters

Human factors

Population	~1/3 of Georgia's population resides in Tbilisi
Building stock	Diverse residential & public building stock
Dwellings	Numerous basement & semi-basement dwellings







Building on Previous Work

2018

Kindergarten Survey

ALGADE Project – Tbilisi



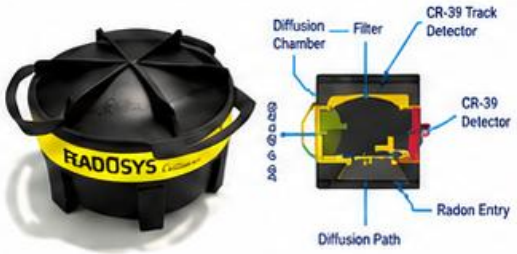


159 kindergartens mapped in Tbilisi Feb – Sep 2018

2021

Radosys™ Detector

Evaluation in Georgia



Development and evaluation of radon track detectors for mapping applications

2023–2024

Public Opinion Survey

STEAM Project



Population awareness and engagement on radon risks and mitigation

2025

Comprehensive Tbilisi Radon Project

Launched

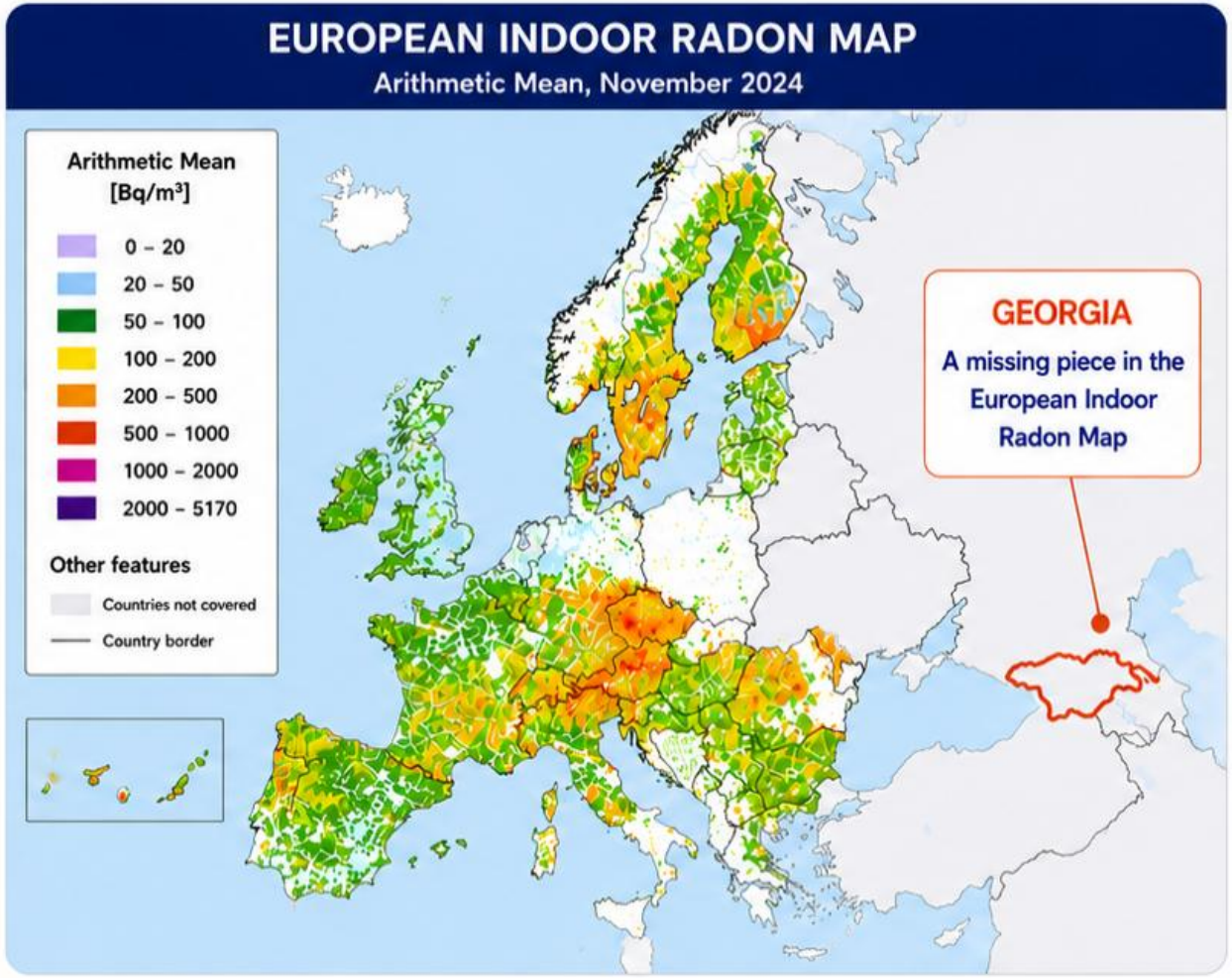


radon.ge

Comprehensive monitoring, dosimetry, GIS mapping, public portal, and European data integration

The current project builds upon nearly a decade of radon research and public engagement in Georgia.

Why This Project?



Source: European Commission, Joint Research Centre (JRC), Directorate G - Nuclear Safety & Security, REMON project

Arithmetic means over 10 km x 10 km cells of long-term radon concentration in ground-floor rooms.
(The cell mean is neither an estimate of the population exposure, nor of the risk.)

1 LIMITED MONITORING

Sparse indoor radon data across Georgia.

2 NEW REGULATION

300 Bq/m³

annual indoor radon reference level

Government of Georgia. Resolution No. 77 (2025)

3 DOSE & RISK ASSESSMENT

Translate radon concentrations into population dose and risk estimates.

4 EUROPEAN INTEGRATION

Georgia is not represented in European radon information systems.

Project Objectives



MONITORING

Representative indoor radon measurements

DOSIMETRY

Convert concentrations to radiation dose

GIS MAPPING

Create concentration, dose and risk maps by district

PUBLIC PORTAL

Open access database, interactive maps and testing requests

DECISION SUPPORT

Evidence-based information for mitigation and policy decisions

EUROPEAN RADON INFORMATION SYSTEMS

Standardize and share data for integration into European databases and maps

Building the foundation for a comprehensive national radon program to protect public health through data, science and collaboration.

Three-Year Project Plan

FY1 Foundation & Data Collection

- Review historical data & literature
- Site selection & survey planning
- Initial short-term & long-term radon measurements
- Public engagement & communication
- radon.ge platform launch
- Data management system setup

FY2 Expansion & Risk Mapping

- Expand measurements to all districts
- Develop district-level radon maps
- Dose estimation & risk assessment (300 Bq/m³ reference level)
- Ongoing public outreach & feedback
- Preliminary results & trend analysis
- Workshops & stakeholder engagement

FY3 Finalization & Integration

- Complete remaining measurements
- Finalize radon & risk maps
- Comprehensive reporting & recommendations
- Mitigation guidance & policy support
- Integration with European radon data systems
- Project evaluation & sustainability plan

Key Milestones

- Website launch (Q2 FY1)
- Initial measurements completed (Q4 FY1)
- District maps available (Q4 FY2)
- Preliminary risk report (Q4 FY2)
- Final maps & report (Q4 FY3)
- Project completion (Q4 FY3)

Radon Monitoring

ACTIVE MONITORING

2 – 7 days
Short-term measurements

Rapid screening
Building and site selection

Real-time results
Immediate decision support

PASSIVE MONITORING

3 – 12 months
Long-term measurements

Annual average
Regulatory compliance

No power required
Passive and reliable

Together, active and passive measurements provide both rapid screening and representative long-term exposure assessment.

ACTIVE DETECTORS



Aranet RN+



AlphaE



RadonEye RD200W

PASSIVE SYSTEM



E-PERM® SPER-1E Voltage Reader



E-PERM® Electrets



E-PERM® Chambers

Site Selection Strategy

PRIORITY I: HIGH

1



Soil & Bedrock

Composition and permeability

HIGH

2



Data Gaps

Limited historical radon measurements

HIGH

PRIORITY II: MEDIUM

3



Fault Systems

Proximity to tectonic structures

MEDIUM

4



Hydrogeology

Wells, springs, geothermal discharge

MEDIUM

PRIORITY III: LOW

5



Geology

Subsurface age and rock units

LOW

6



Population Density

Building and occupancy density

LOW

Priority I: High | Priority II: Medium | Priority III: Low

Priority sites are selected using geological, environmental, demographic, and data-availability criteria.

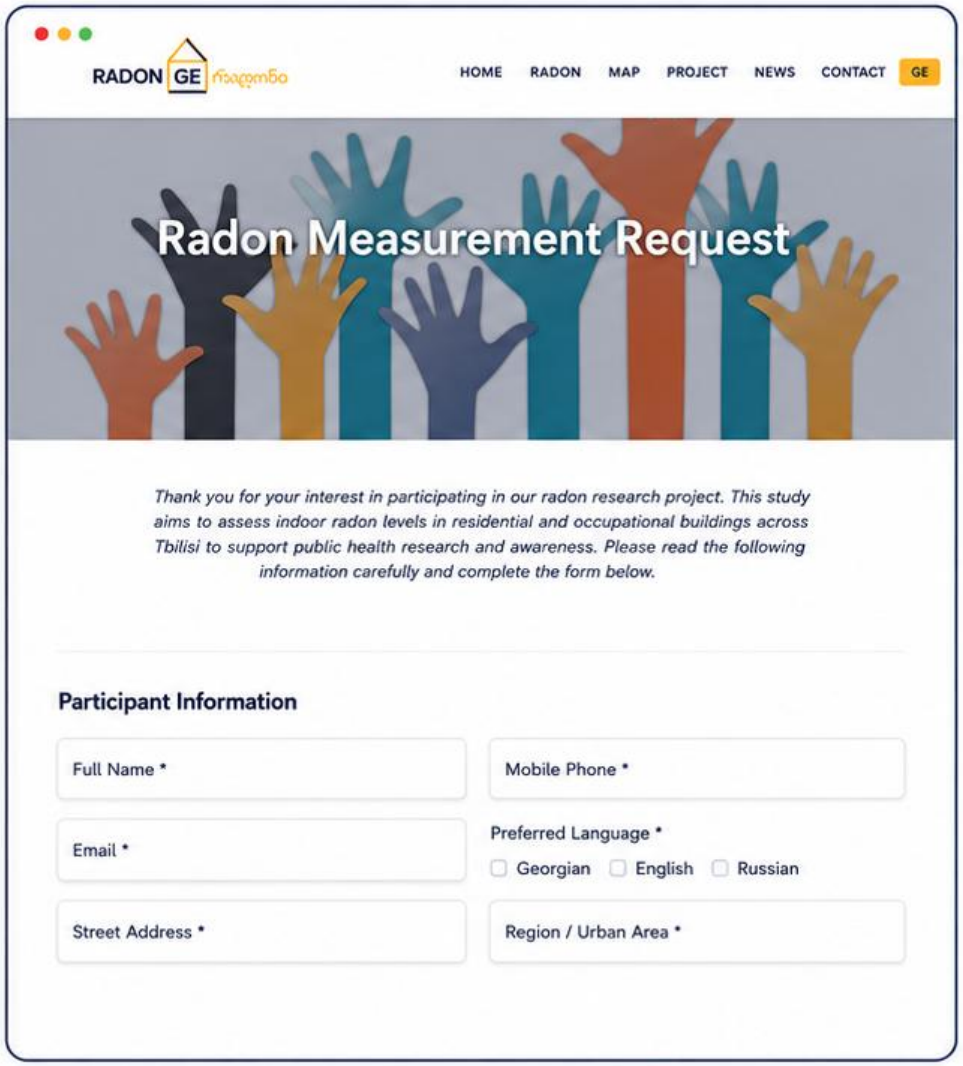
Outreach & Public Participation

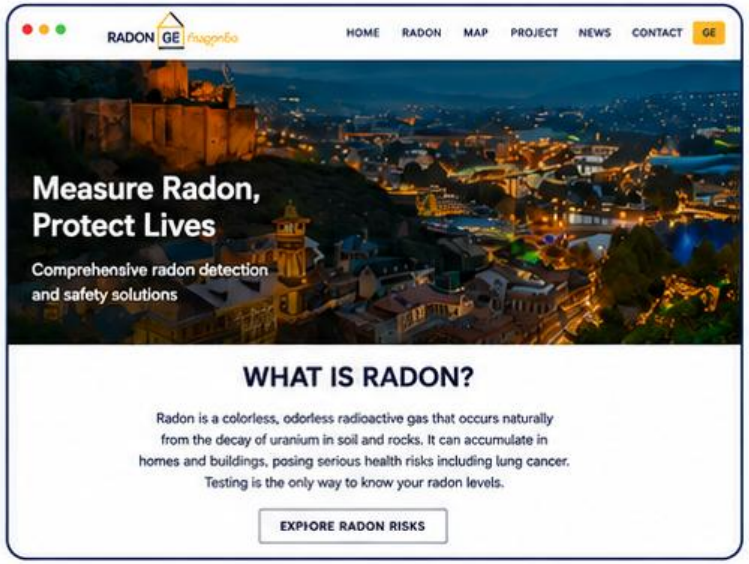
Public information hub
Radon risks, testing guidance, health information, and project updates.

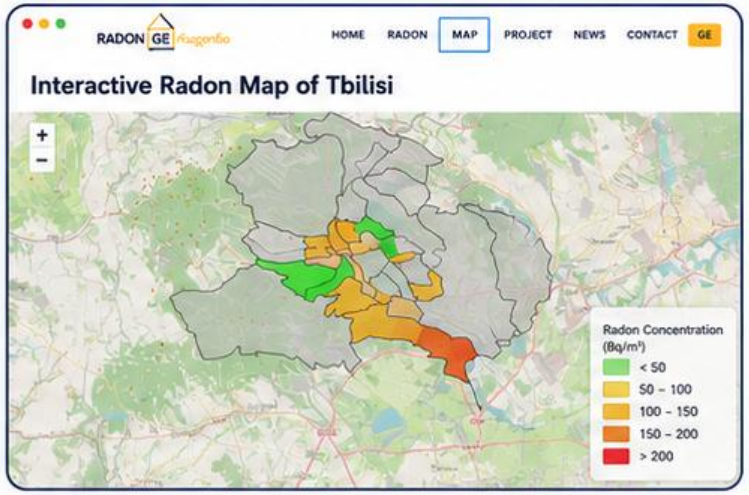
Online request portal
Residents, schools, public buildings, and workplaces can request measurements easily through radon.ge.

Interactive map
Measurement results visualized by area to support transparency and awareness.

Participant feedback
Results are shared with participants and used to inform risk assessment and public reporting.







radon.ge connects outreach, recruitment, measurement requests, and public reporting.

Measurement Campaign

1 Request / Site Enrollment

Requests submitted through radon.ge (homes, schools, public buildings, workplaces)



2 Scheduling & Preparation

Site eligibility confirmed, visit scheduled, and materials prepared



3 Detector Deployment

- Active screening (short-term)
- Passive monitoring (long-term)
- Standard placement protocols



4 Metadata Collection

- Building characteristics
- Floor level
- Ventilation
- Occupancy
- Construction year
- GPS location



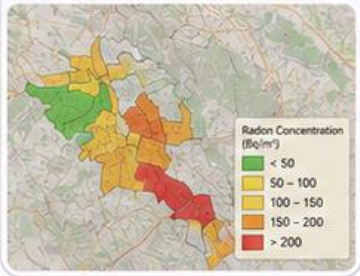
5 Retrieval, QA/QC & Analysis

- Detector retrieval
- Lab readout / analysis
- QA/QC procedures
- Data validation
- Database entry



6 Reporting & Communication

- Results shared with participants
- Data used for mapping, risk assessment, and public reporting



Standardized protocols ensure data quality and comparability

Systematic coverage across districts, building types, and populations

Validated data stored in a centralized project database

Transparent results drive awareness and risk reduction

A coordinated campaign delivering high-quality radon measurements for a healthier Tbilisi.

Data Management and Dose Reporting

RadonCore
Raw data + QA/QC

- Field data intake (Aranet / E-PERM)
- Environmental parameters
- QA/QC & statistics

Google Apps Script automation

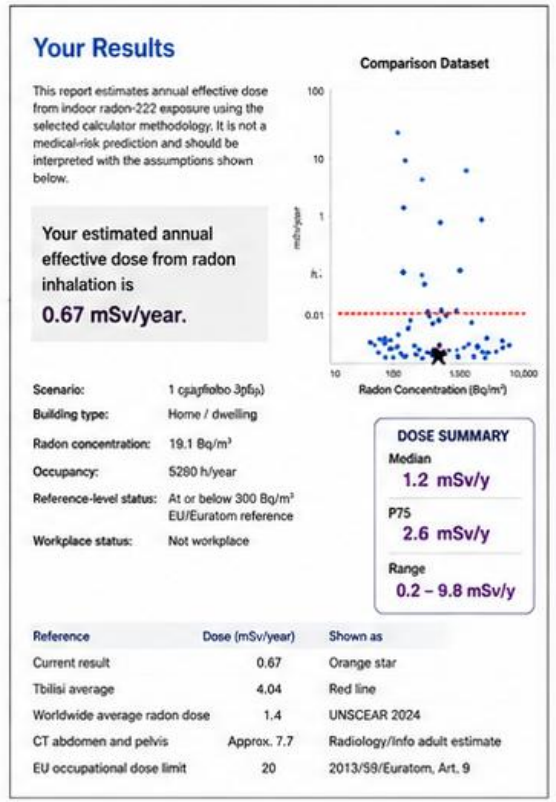
RadonReport
Participant reports

- Clean report template
- Automated PDF generation
- Shared with study participants

Google Apps Script automation

RadonDose
Dose estimates

- Annual effective dose
- Scenario assumptions
- Comparison & interpretation



Google Apps Script connects field measurements, QA/QC, participant reporting, and dose assessment.

Dose Assessment Methodology

1. Radon Concentration



Annual average (Bq/m^3)

2. Occupancy



Time in building (h/year)

3. Equilibrium Factor (F)



Ratio of progeny to radon gas (dimensionless)

4. Dose Coefficient (DCF_{EEC})



ICRP-based progeny dose coefficient ($mSv/(Bq \cdot h \cdot m^{-3}$ EEC))

5. Annual Effective Dose



Estimated dose from radon exposure (mSv/year)

$$E = C \times F \times T \times DCF_{EEC}$$

E = annual effective dose (mSv/year)

E = annual effective dose (mSv/year)

C = radon concentration (Bq/m^3)

F = equilibrium factor (dimensionless)

T = occupancy (h/year)

DCF_{EEC} = dose coefficient for equilibrium-equivalent radon progeny concentration, $mSv/(Bq \cdot h \cdot m^{-3}$ EEC)

DOSE ESTIMATE



Calculated as annual effective dose

mSv/year

REFERENCE-LEVEL STATUS

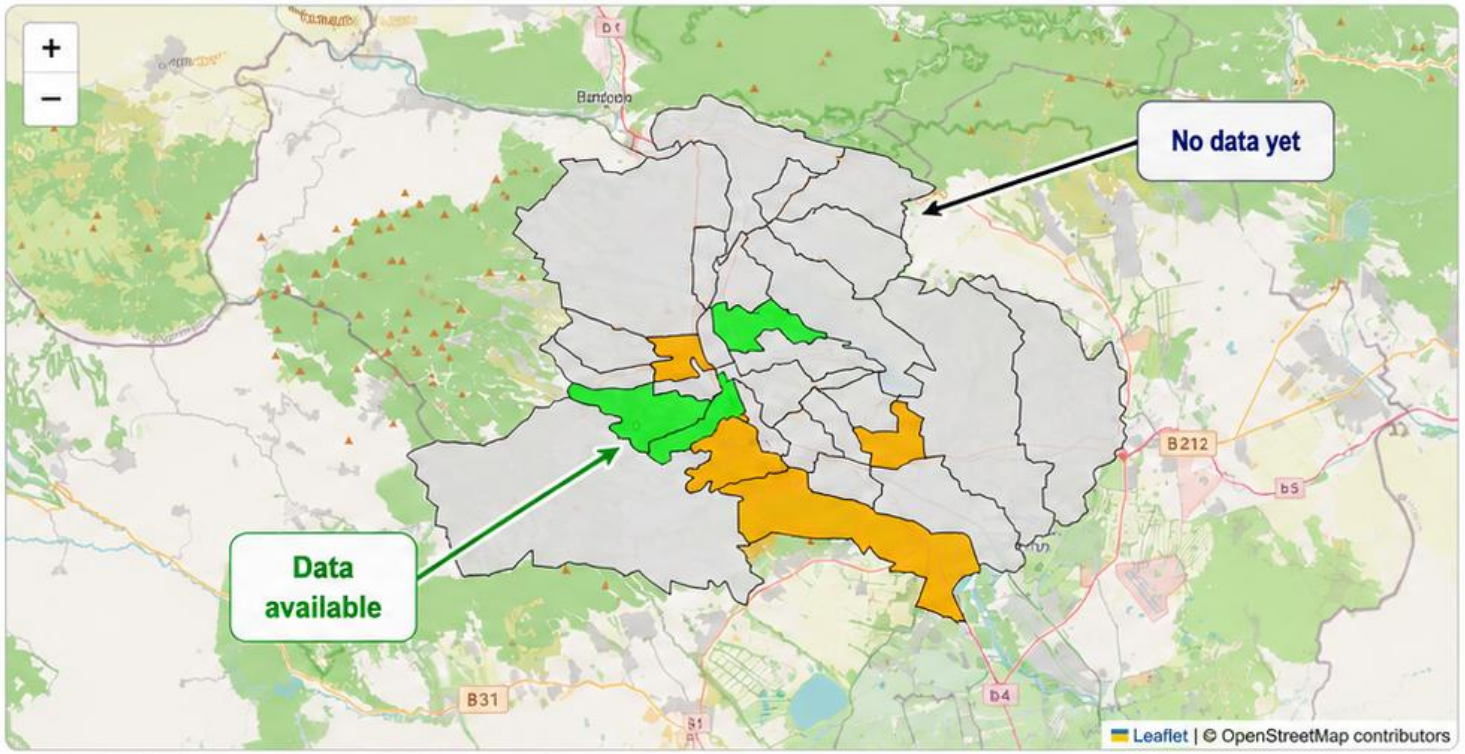


Evaluated separately using indoor radon concentration

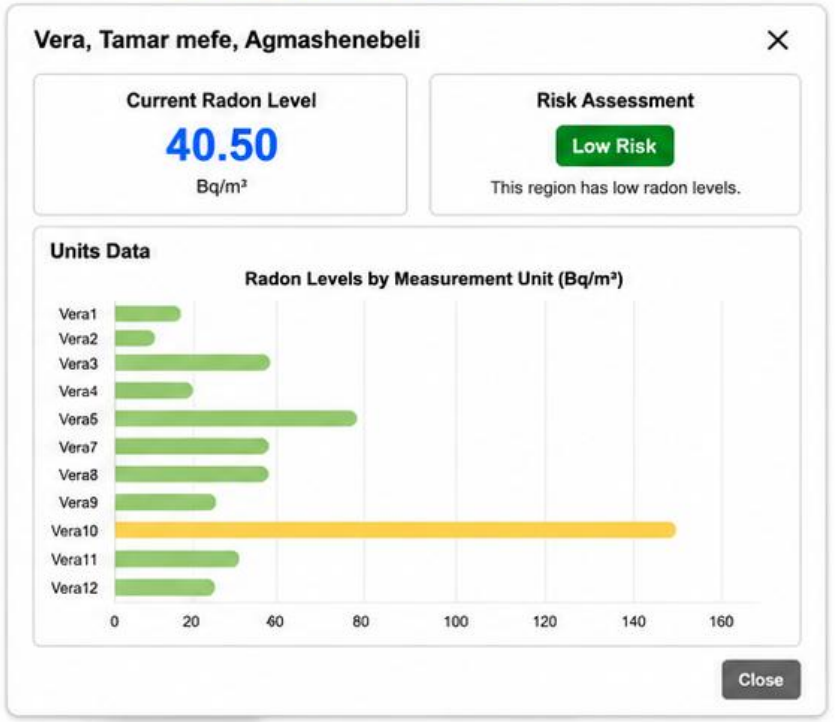
300 Bq/m^3

Radon Mapping

Interactive Radon Map of Tbilisi



Region Details (example)



Historical data → New measurements → Fill data gaps → Updated public map

Region summaries
Current level and risk

Unit-level measurements
Results within each region

Gap prioritization
Focus on grey regions first

Map evolves with new data

Grey = no data yet (not low radon)

Key Takeaways

Tbilisi has important natural and human factors
that justify systematic radon monitoring.

The project combines complementary methods
active and passive measurements, dosimetry,
data analysis, GIS mapping, and public reporting.

The interactive map is updated as new data are received,
with priority given to grey (unmeasured) regions.

Dose estimates and 300 Bq/m³ reference-level status
are reported separately for clarity and transparency.

Public engagement and communication are central
participants receive results and contribute to a shared mission.

The project provides a strong scientific and technical foundation
to support mitigation decisions, policy, and future national initiatives.



This project converts measurements into actionable information
for public health protection, mapping, and evidence-based radon policy.

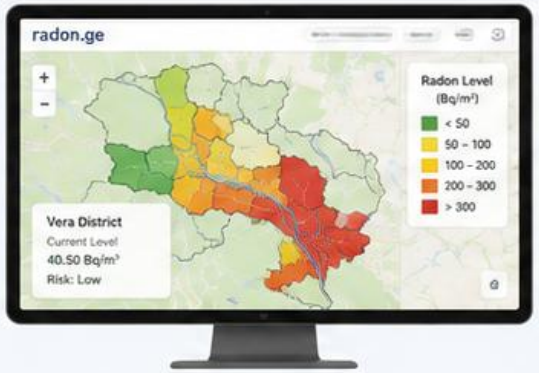
Long-Term Vision

1 Complete Radon Coverage



Fill data gaps across all districts and building types to achieve a representative radon dataset for Tbilisi.

2 Interactive Risk Mapping



Continuously updated maps and risk assessments to identify priority areas and track changes over time.

3 Public Reporting & Outreach



Deliver clear, accessible results to participants and communities and promote radon awareness and prevention.

4 Foundation for National Expansion



Provide the scientific and technical basis for expanding radon monitoring across Georgia, supporting policy, mitigation, and European data integration.

From local measurements to national impact: evidence-based radon protection for a healthier future.

Thank You!











Graphics in this presentation were created with support from AI tools (ChatGPT and Codex).