

---

# Study on the seasonal variation of indoor radon levels across Canada

**Hailey Adams  
Health Canada**

**Canadian Association of Physicists 2026  
June 23rd, 2026**

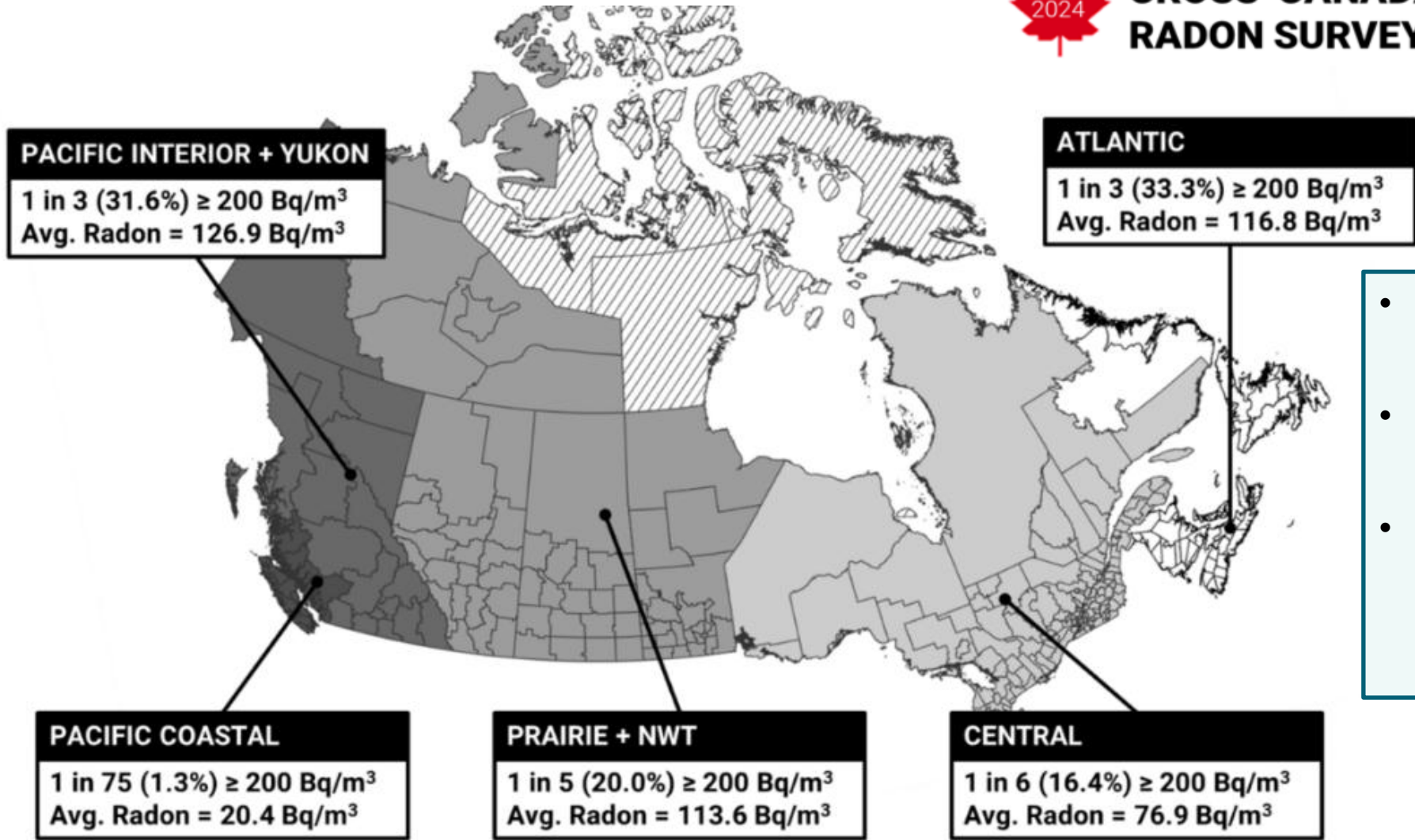


# Radon in Canada



## CROSS-CANADA RADON SURVEY

**1 in 5**   
in Canada  
Have High Radon



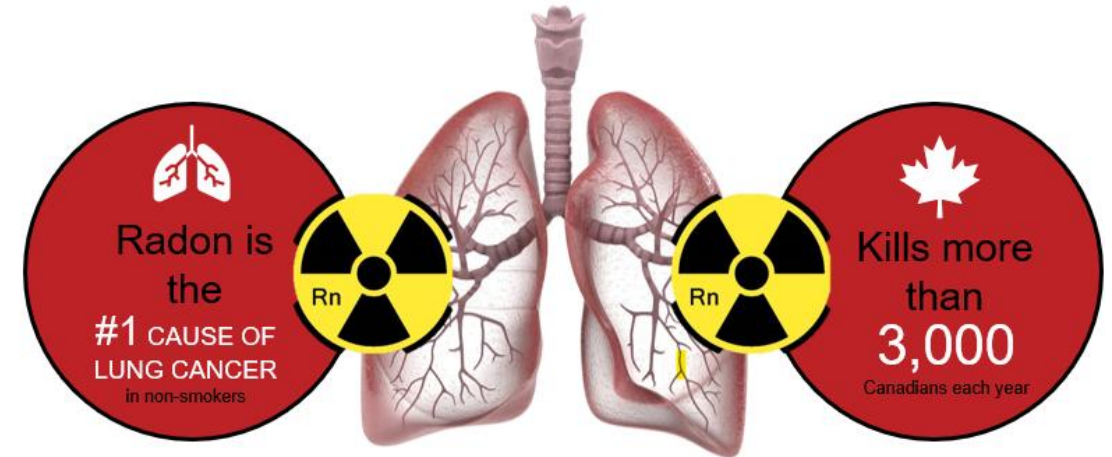
- Health Canada Guideline is **200 Bq/m<sup>3</sup>**
- There are **no radon-free areas** in Canada
- Radon levels in Canada have **increased over the last decade**

<https://crosscanadaradon.ca/survey/>

# Why radon matters

Health Canada estimates that radon contributes to **more than 3000** lung cancer deaths a year

- equivalent to **more than 8 people a day**.



Radon is a known carcinogen (Group 1)

Route of exposure:  
**Inhalation**

**Most expensive particle detector of all!**

The energy released causes damage to the lung cell tissue resulting in an increased risk of **lung cancer**

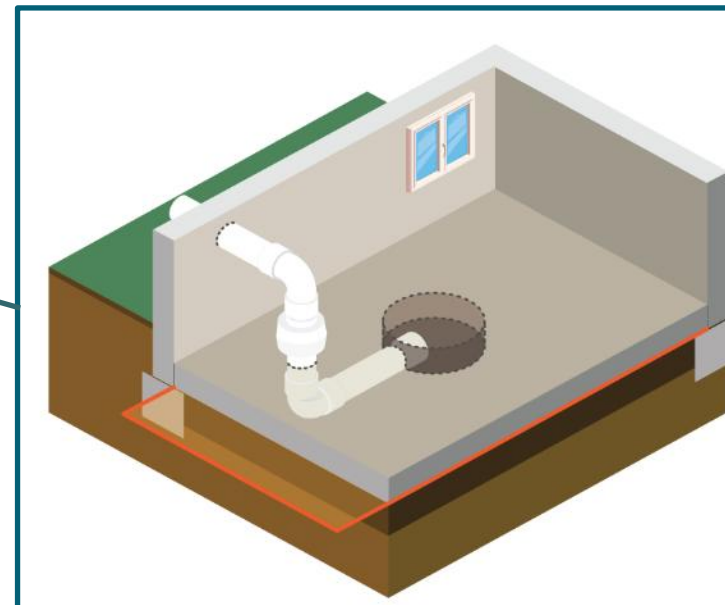
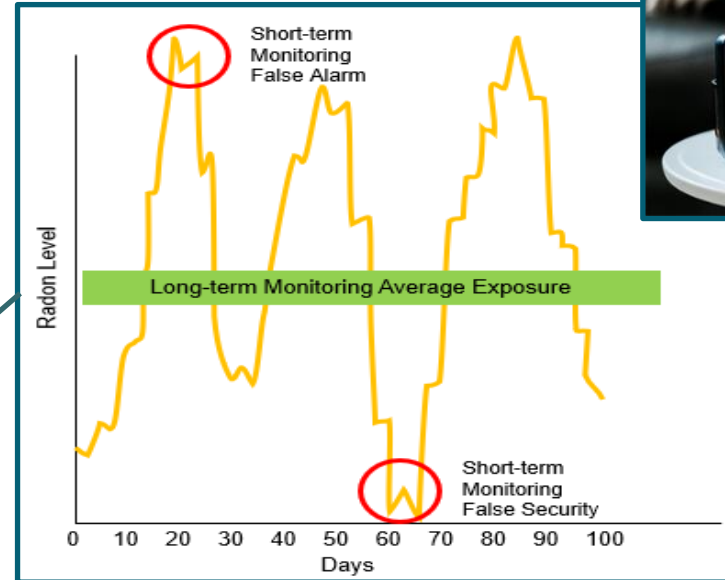
Radon's radioactive properties mean that it spontaneously changes and releases energy

Health risk from radon is long-term. Depends on 3 things:

- How **high** the radon level is
- How **long** you are exposed
- **Smoking** status

# Testing for and reducing radon

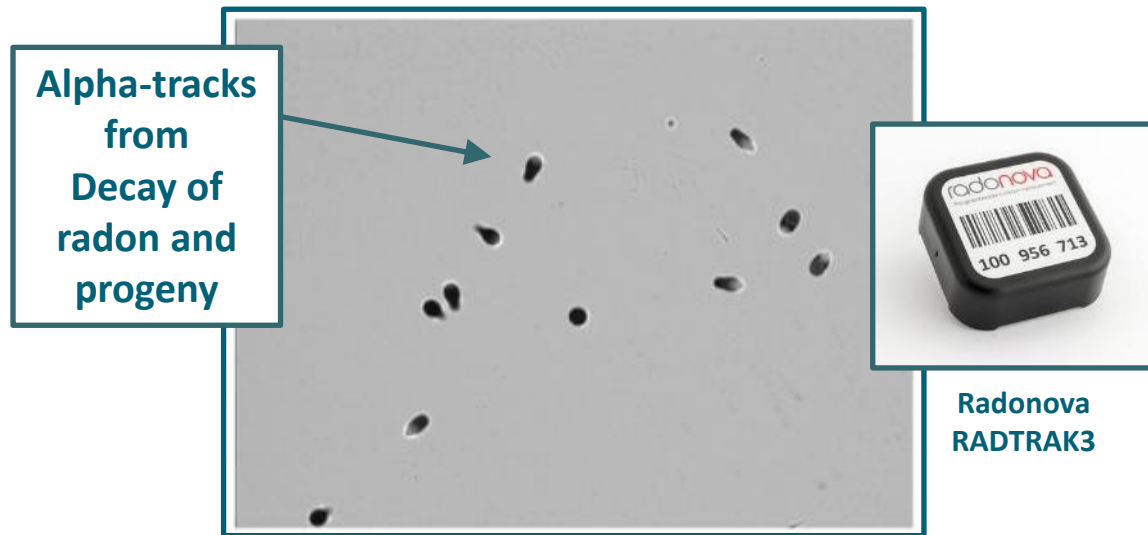
- Homeowners can **easily test for radon** to know their level
- Traditionally recommend testing for **91-days during the heating season**
- Radon test results in Canada reported in Bq/m<sup>3</sup> (pCi/L in USA)
- Health Canada recommends radon levels above **200Bq/m<sup>3</sup>** be reduced within 1 year
- A radon mitigation system can be **installed in a day** and **reduce the radon level by 90% or more**



# Measurement devices

Health Canada recommends testing for radon using a device approved by the Canadian – National Radon Proficiency Program (C-NRPP). The [C-NRPP approved list](#) includes devices that employ a variety of detector technologies. Examples of those used in this study shown below.

## Alpha track detectors (ATDs) (Solid State Nuclear Track Detectors)



Alpha particles released in the ATD from the decay of radon damage the plastic or film inside the device leaving damage tracks. The number of tracks correlates with the integrated radon level over the test period.

## Electronic radon monitors (ERMs) Ionisation chamber      Silicone (photo)diode



ERMs continuously measure radon levels at regular intervals and display results either directly on a digital screen, through smartphone applications, or through internet dashboards.

# Radon Testing Research: SEARCH STUDY

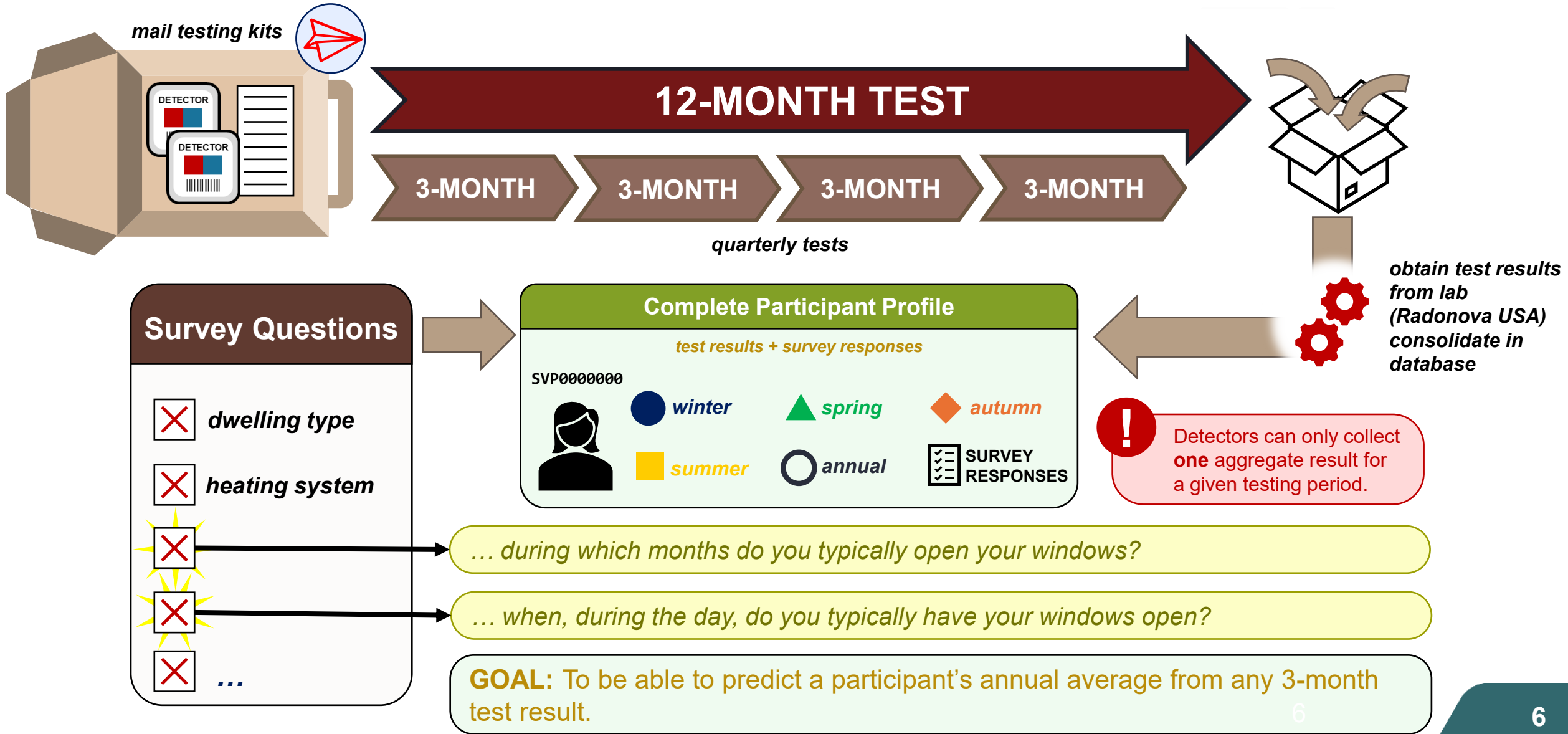
Health Canada continues to challenge assumptions on radon testing to make it **easier** and **more accessible**

Looking to explore the viability of radon testing outside of the heating season. Need to answer:

- **How much do radon levels vary throughout the year, in different locations across Canada?**
- **How well do long-term measurements, collected at different times of the year, approximate the annual average in a home?**

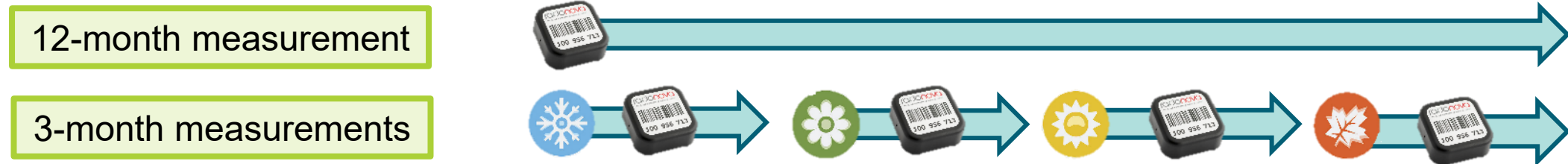


# Seasonal Variation Study Design

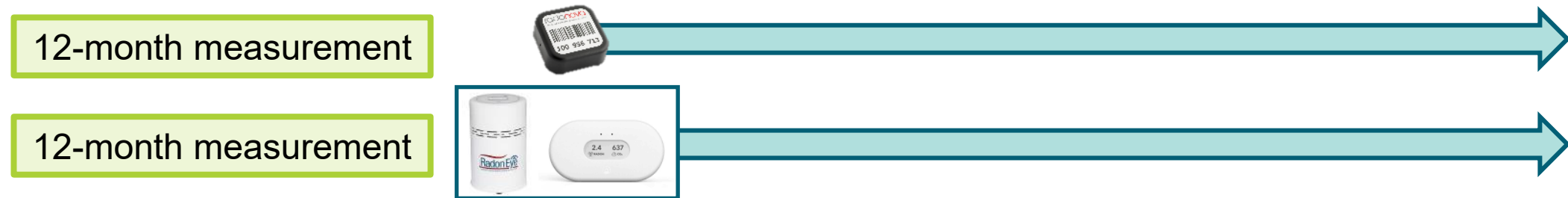


# Seasonal Variation Study Design

**Sep 2023 – Dec 2025** series of quarterly (ATD) measurements and household survey by each participant **directly compared** to a year-long measurement (ATD) alongside.

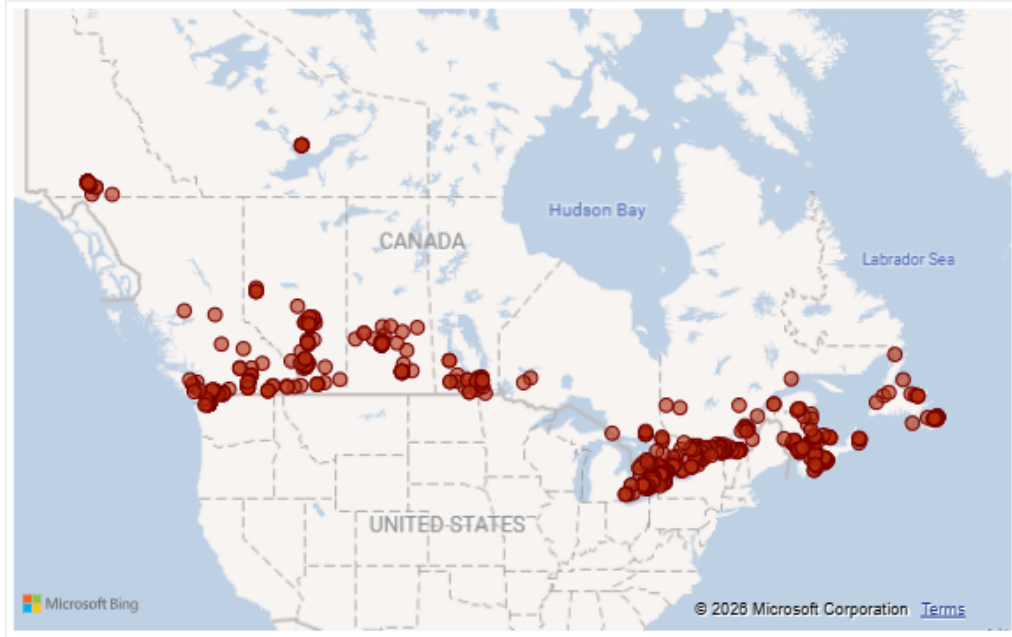


**Presently (Dec 2025 onwards)** continuous (ERM) measurements and household survey by each participant **directly compared** to a year-long measurement (ATD) alongside.



Transition to ERMs allows for hourly measurements, fewer logistical requirements for participants, reduced postage costs, and flexibility on submitting measurements

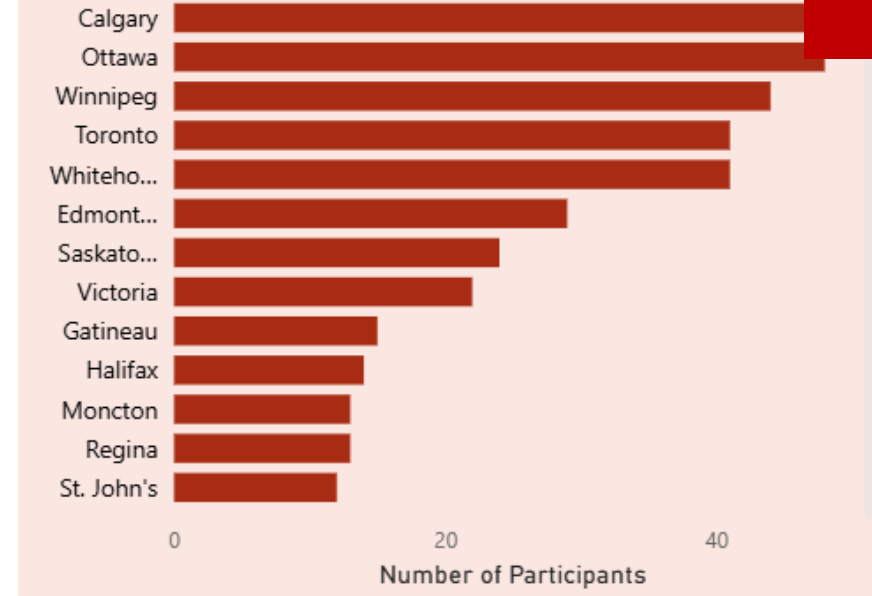
## Seasonal Variation Survey Participation Overview



Province

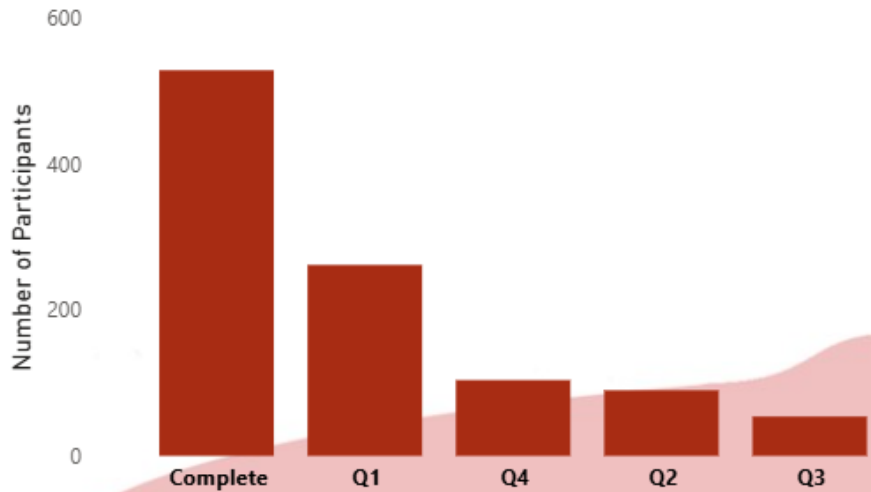
- AB
- BC
- MB
- NB
- NL
- NS
- NT
- ON
- PE
- QC
- SK
- YT

### Number of Participants by Municipality



**June 2026 snapshot**

### Participants Progression in the Survey



**1039**

Number of Participants

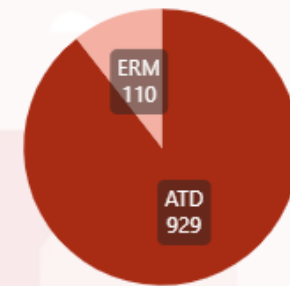
**12**

Provinces and Territories

**420**

Municipalities

### Participant Detector Type



# Seasonal Variation Study: Analysis Variables

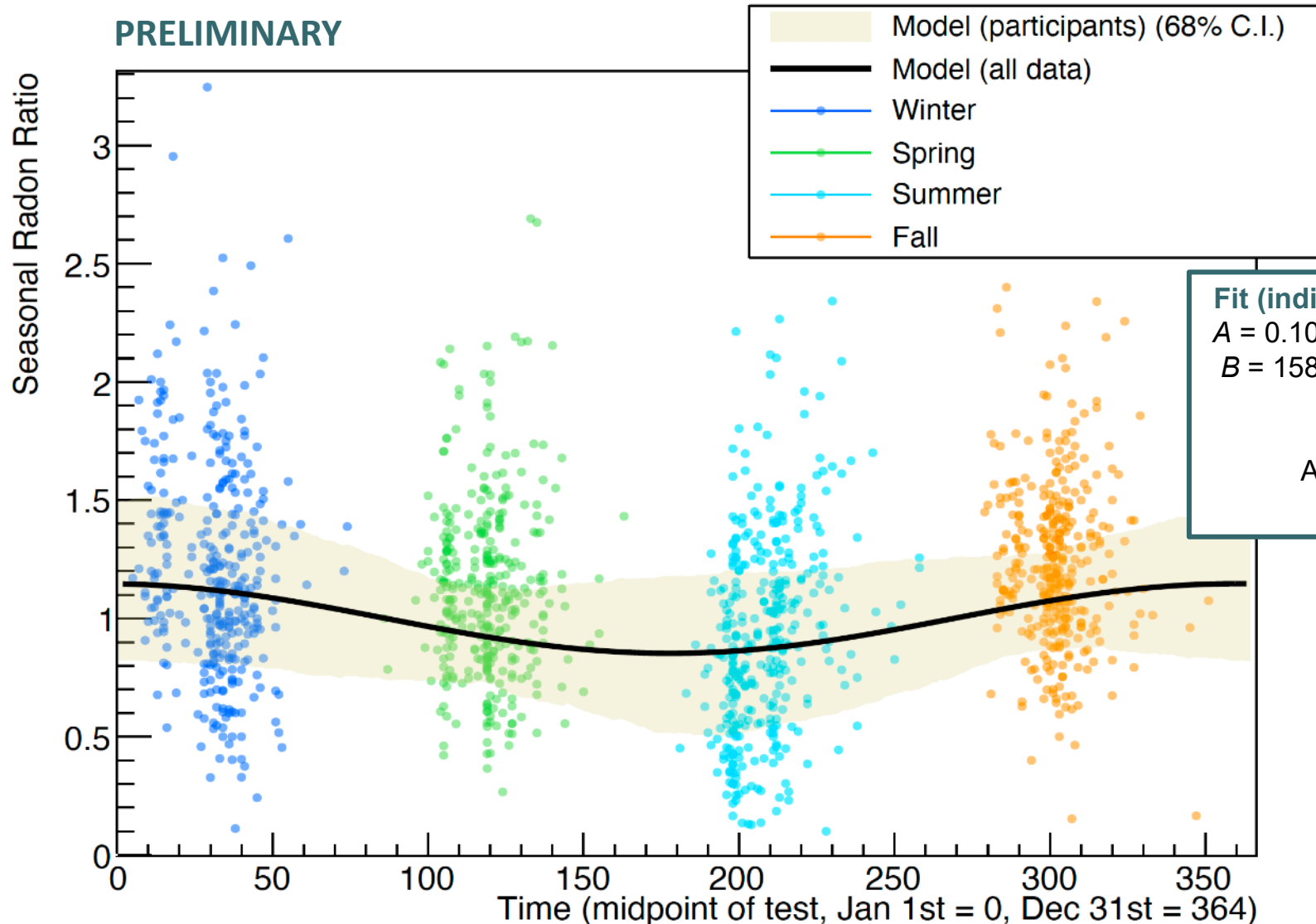
- We are concerned with the **relative change in radon levels** throughout the year.
- Metric of analysis is the **ratio of seasonal 3-month measurement to 12-month measurement** in each individual home.
- Each 3-month test assigned a **season based on** time of year of **test midpoint**.

$$\textit{Seasonal Radon Ratio} = \frac{R_{3M}}{R_{12Month}}$$

Season	Start	End
winter	2024-12-21	2025-03-19
spring	2025-03-20	2025-06-19
summer	2025-06-20	2025-09-21
autumn	2025-09-22	2025-12-20

Seasons based on [definitions outlined by National Research Council Canada](#)

# Seasonal Variation Study: Results



Current **model assumes symmetric variation** between winter and summer (cosine)

$$R(t) = 1 - A \cdot \cos\left(\left(\frac{2\pi}{365}\right) \cdot (t - B)\right)$$

**Fit (individual participants)**

$A = 0.10$  [0.06, 0.14] 68% C.I.

$B = 158$  [123, 183] 68% C.I.

**Fit (all data)**

$A = 0.15 \pm 0.03$

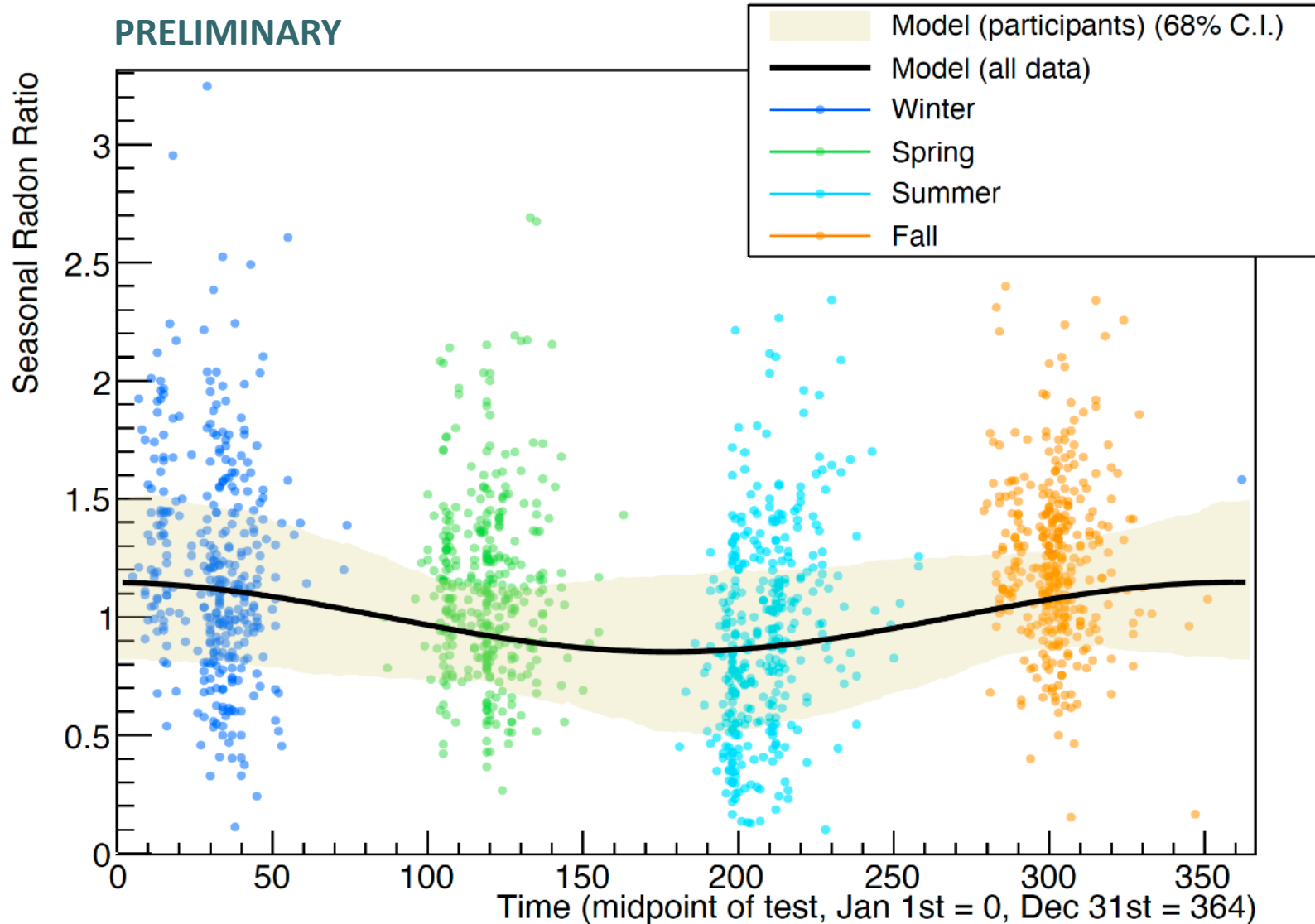
$B = 177 \pm 9$

Model consistency (within error) between individual participant and combined fits

However, 3-month temporal resolution of data is too broad to determine if variation is truly symmetric (likely not).

**Future data from ERMs will provide daily resolution**

# Seasonal Variation Study: Results



## Key observations

Winter testing in Canada confirmed to be a **conservative assumption**

Shoulder seasons (spring and autumn) **show promise** for expanding the testing window

Testing **outside of the heating season** generally underestimates the average annual level

However, radon levels observed above 200 Bq/m<sup>3</sup> during this time are strongly linked to average annual levels exceeding 200 Bq/m<sup>3</sup>

# Seasonal Variation Study: Results in regions

Table 1. Average relative percent differences (RPD) of 3-month radon testing to 12-month radon testing across various seasons and regions in Canada.

Region of Canada	Average radon RPD compared to 12-month measurement				Number of participants
	Winter	Spring	Summer	Fall	
Pacific interior and Yukon (interior BC)	+17%	+6%	-31%	+9%	39
Pacific coastal (coastal BC)	-19%	+7%	-8%	+19%	10
Prairies and Northwest Territories	+9%	-1%	-14%	+6%	90
Central	+2%	-1%	-13%	+12%	169
Atlantic	+13%	+1%	-20%	+6%	69

$$RPD (\%) = 100 \times (R_{3m} - R_{12m}) / R_{12m}$$

$R_{3m}$  - Result of 3-month radon test

$R_{12m}$  - Result of 12-month radon test

A positive RPD (+%) means the result of a 3-month test was higher than the 12-month test result. A negative RPD (-%) means it was lower. This measure tells us exactly how well a 3-month measurement estimated the annual average in that specific home.

Source:

<https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/radon/resources/survey-seasonal-variation-homes.html>

# Seasonal Variation Study: Impact on guidance

**Previously** Recommendation was to make decision on corrective action based solely on **long-term tests** conducted during the **heating season**

## Now

If a measurement is above the Canadian Radon Guideline level, the building owner should take steps to reduce the exposure of all residents. **Health Canada recommends:**

- Individuals mitigate within 1 year for radon levels higher than 200 Bq/m<sup>3</sup>.
- Individuals take action sooner if the radon level is higher.
- Mitigation measures should reduce the radon level in the home to as low as reasonably achievable (ALARA).

These recommendations apply to tests conducted for a duration of 91 days or more **at any time during the year.**

[Guide for radon measurements in homes](#)

## Important Note



If fewer than 91 days of your test occurred during the heating season and you obtained a measurement below 200 Bq/m<sup>3</sup>, it may be underestimating your average annual radon level and you should **re-test during the next heating season.**

# Thank you

## Hailey Adams

Radiation Officer  
Radon Technical Operations  
[hailey.adams@hc-sc.gc.ca](mailto:hailey.adams@hc-sc.gc.ca)

## Dr. Robert Stainforth

Radiation Coordination Specialist  
Radon Technical Operations  
[robert.stainforth@hc-sc.gc.ca](mailto:robert.stainforth@hc-sc.gc.ca)

General

[radon@hc-sc.gc.ca](mailto:radon@hc-sc.gc.ca)

1-833-723-6600

[Canada.ca/radon](http://Canada.ca/radon)

[Canada.ca/le-radon](http://Canada.ca/le-radon)



Participate in a  
Radon Study!



Health  
Canada

Santé  
Canada

# BACKUP: How does radon enter the home?

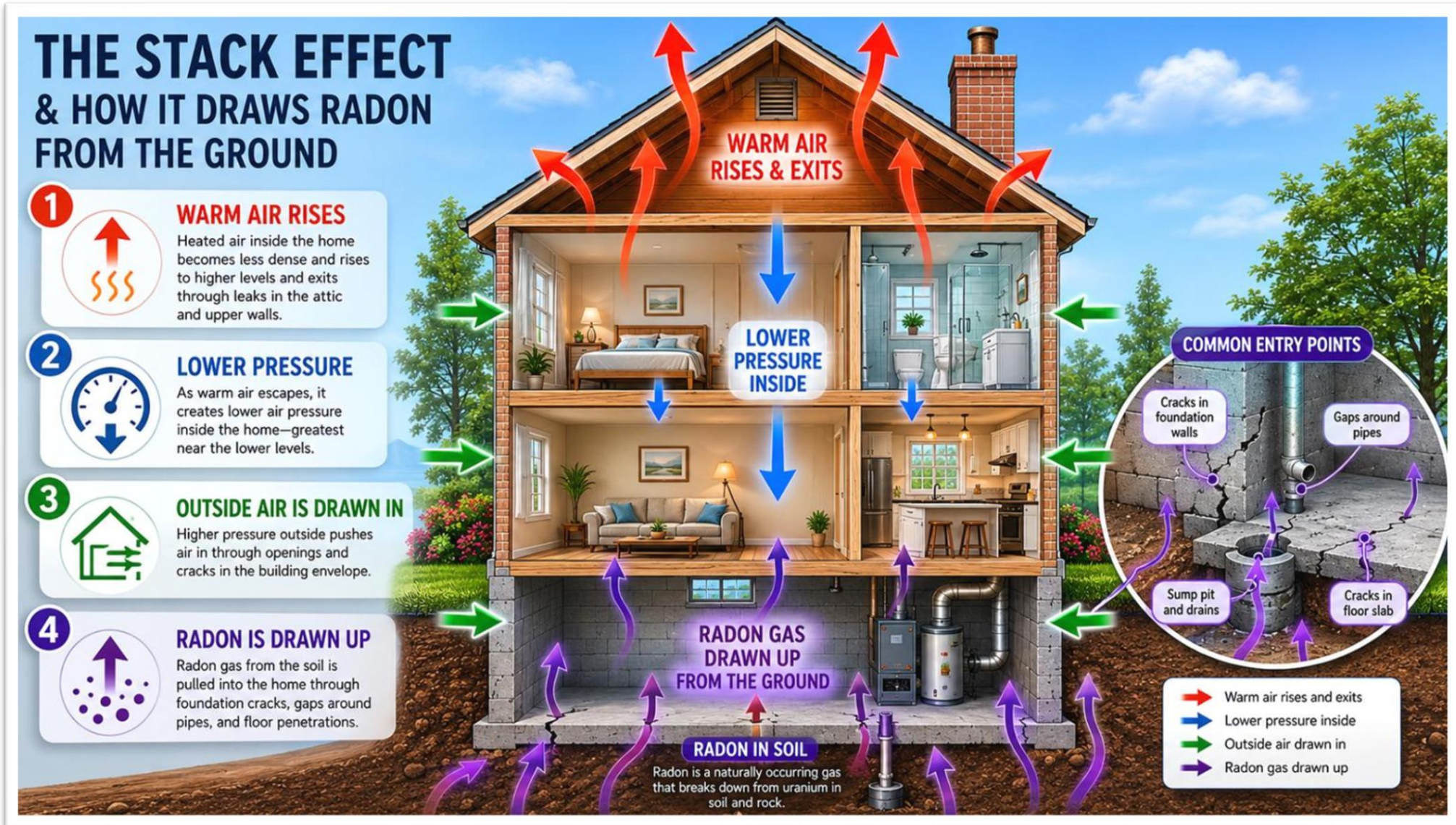


Image generated using ChatGPT 5.5, 2026-05-26 with prompts:

- Create me an image depicting an illustrative diagram of how the stack effect occurs in a home and how it draws up radon from the ground.
- Could you recreate this image for use in a presentation with a 16:9 aspect ratio

# BACKUP: How does radon enter the home?

## HOW RADON ENTERS A HOME

Radon is a naturally occurring gas that can seep into homes from the ground.

### 1 RADON IN SOIL

Radon is produced in soil by the natural breakdown of uranium.

### 2 RADON IN GROUNDWATER





Radon can dissolve in groundwater and be released into the home.

### 3 ENTRY PATHWAYS

Radon enters the home through cracks, openings, and gaps in the foundation and around fittings.

### 4 RADON BUILDS UP

Once inside, radon can build up to dangerous levels, especially in lower levels of the home.

-  Radon movement from soil / groundwater
-  Entry pathways into home
-  Radon movement inside home
-  Water flow

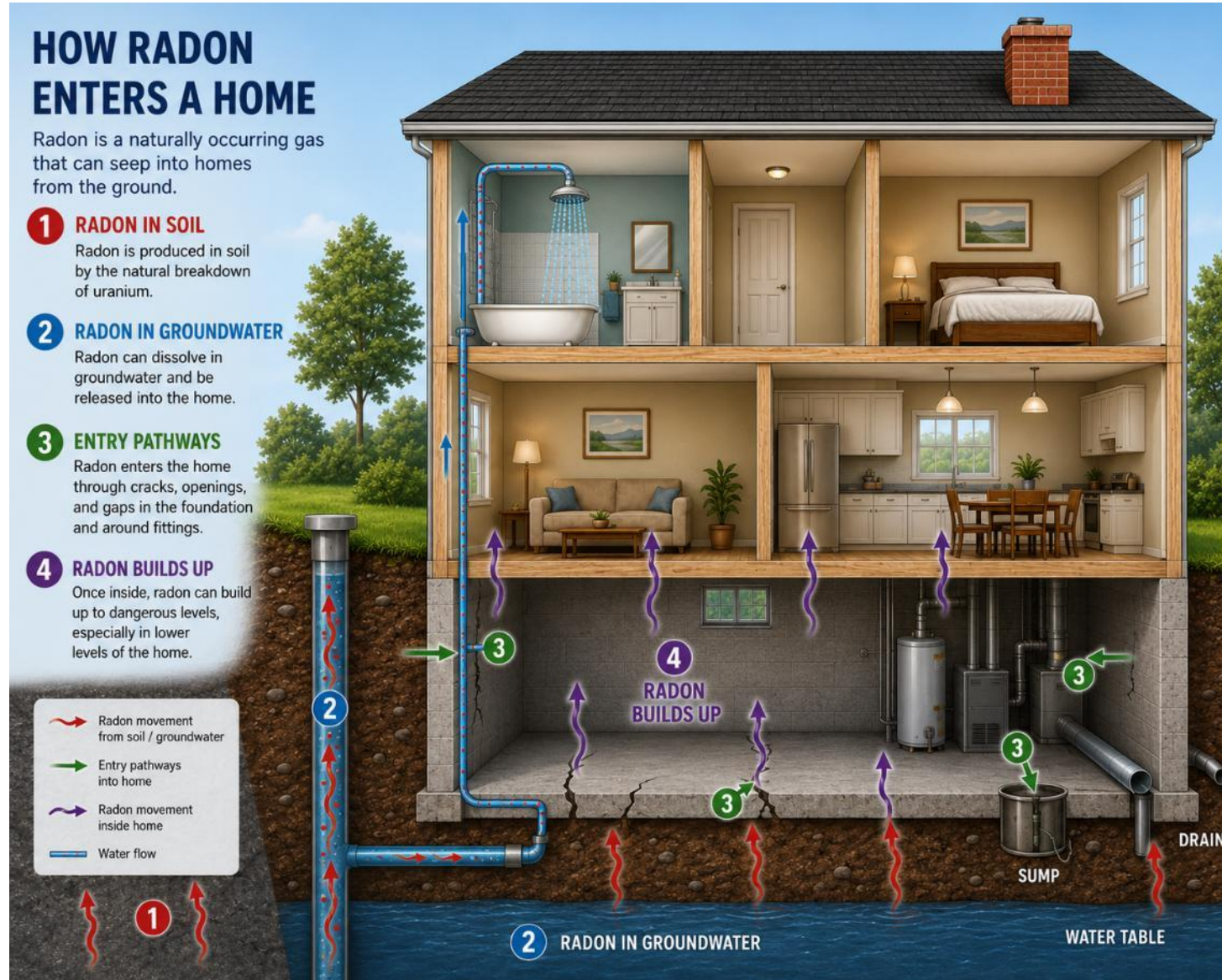
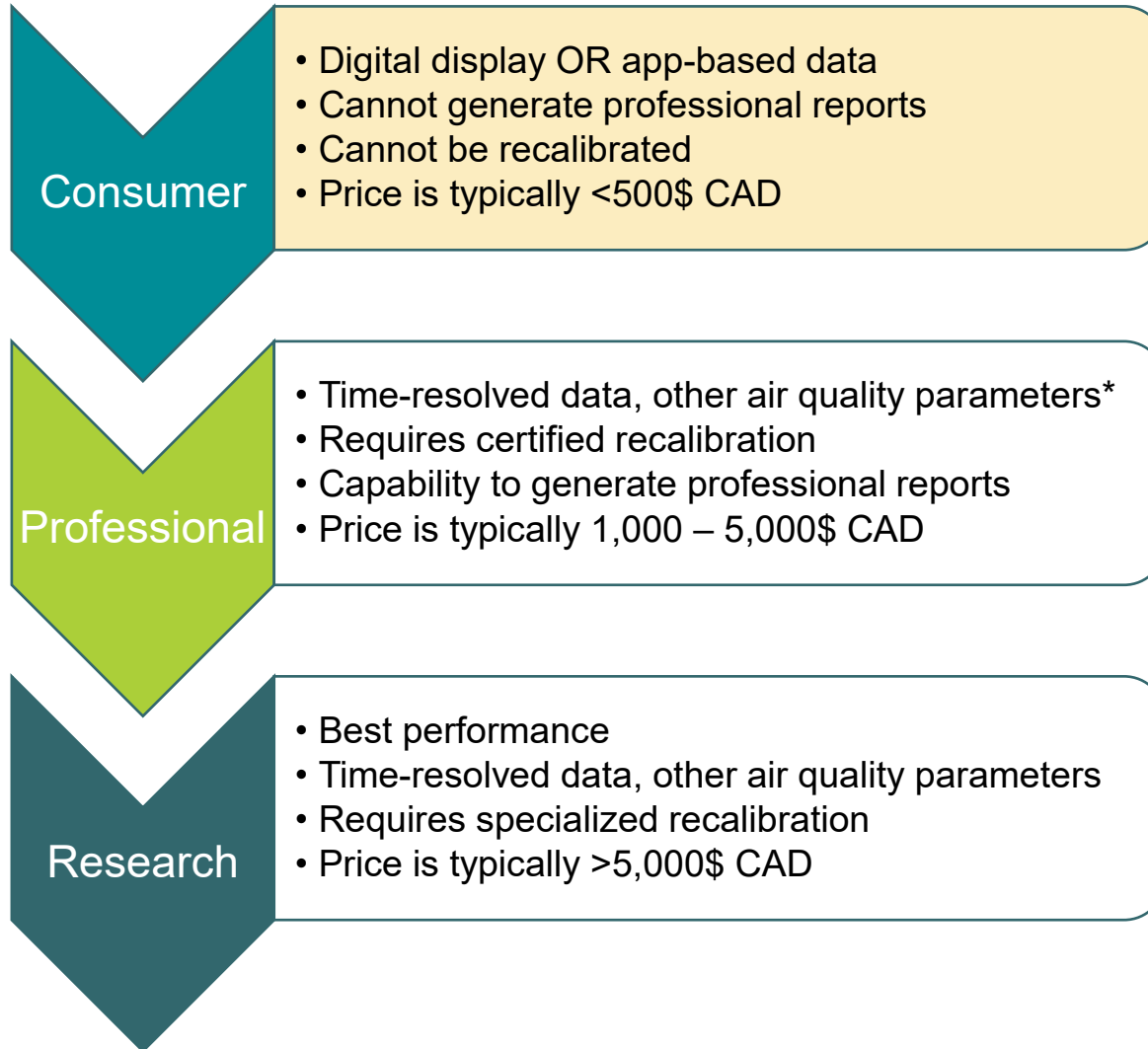


Image generated using ChatGPT 5.5, 2026-06-02 with prompts:

- *Create me an image depicting an illustrative diagram of radon enters the home through different sources*

# BACKUP Electronic Radon Monitors: What is consumer grade?



General performance improvement



# BACKUP Electronic Radon Monitors: What is consumer grade?

## PASSIVE vs. ACTIVE RADON TECHNOLOGIES

Different approaches. Same goal. Measuring radon for a safer home.

Electronic radon monitors (ERMs)

### PASSIVE TECHNOLOGIES

Passive detectors do not require batteries or power during the measurement period. They integrate radon exposure over time and are analyzed after retrieval.

#### ALPHA TRACK DETECTORS



Radon alpha particles leave tracks on a sensitive detector. Tracks are counted in a laboratory.

#### ELECTRETS



Alpha particles change the electric charge of the electret. The charge change is measured after exposure.

#### ACTIVATED CHARCOAL



Radon is adsorbed onto charcoal during exposure and later measured in a laboratory.

VS.

### ACTIVE TECHNOLOGIES

Active detectors use electronic components and require continuous power. They provide real-time or near real-time radon measurements.

#### SEMICONDUCTORS



Alpha particles create electrical pulses in a semiconductor detector that are counted electronically.

#### IONIZATION CHAMBERS



Radon and its decay products ionize the air inside the chamber. The ions collected are measured continuously.

#### ALPHA SCINTILLATORS



Alpha particles produce flashes of light in a scintillator. The light pulses are detected and counted.