

Long Term Testing of Consumer Grade Radon Monitors at High Concentrations

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Slides are available on the WPB-Radon website

Nine different Consumer Grade Radon Monitors (CGRMs) were tested

Four each
of these
CGRMs were
tested:

AranetRN
Corentium
EcoBlu
EcoQube
Luft



Three older
RadonEyes were
tested

One each of
these was
tested:

Wave
View Plus
Safety-Siren Pro4

All except AranetRn were older units

The market is flooded with CRGMs online at Walmart or Amazon



**Priced from
\$50 to \$200**

**SafetySiren CRGM
arrived 30 years ago!**



Canada C-NRPP
has a list of
recommended
and not
recommended
CGRM

Is it time for
NRPP and NRSB
to do the same?

	Airthings Corentium Home	±10% (after 7 days at 200 Bq/m3), ±5% after 2 months of monitoring	12 hours 24 hours 7 days (first reading will take 24 hrs)	Short-term and long-term average shown on monitor display.	Battery	APPROVED 
	Airthings View	After 30 days at 200 Bq/m3, ±10% on the 7 day average and +/- 5% on the 2 month average	Hourly	Short-term average shown on monitor display; long-term average shown on app.	Battery or plug in (USB-C)	APPROVED 
	Aranet Radon Plus Home	±8% Accuracy of 24 h, 7 d, 30 d averages	Can be adjusted to show 10 min, 24h, 7 d or 30d	Display on device shows either short-term or long-term level depending on setting. Long-term shown on app.	Battery	APPROVED 
	Ecosense EcoQube	±10% at 370 Bq/m³ after 10 hours of measurement	Takes measurements every 10 minutes; displays an	Hourly levels are displayed on LED; short-term	Plug in	APPROVED 

Manufacturer / Brand		Model / Link to Health Canada recall (when applicable)	NOT APPROVED
	Air Steward	Recalled by Health Canada	
	Bootu	RN-80	
	Boyd Gresham	Radon Detector – Recalled by Health Canada	
	CRADTEC	PRM-02H	
	CRADTEC	PRM-03H	
	Funny Kitchen	HRDM-02 - Recalled by Health Canada	
	HAKINAKU	Smart Radon Gas Detector	
	Hanchen	Home Radon Detector- Recalled by Health Canada	
	INKBIRD	Home Radon Meter	

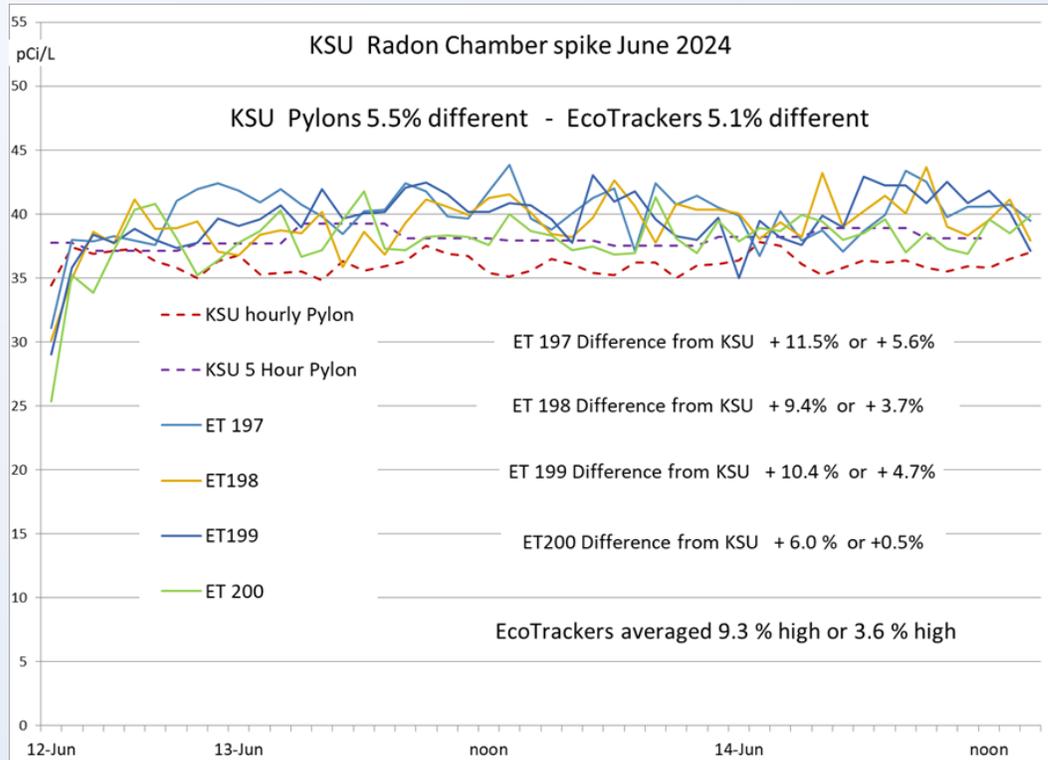
Questions to be Considered

- 1) Can CGRMs (Consumer Grade Radon Monitors) be trusted?
- 2) Does the CGRM performance change over long exposures?
- 3) Should we develop a certification for CGRMs?
- 4) Should there be a requirement to re-check CGRM calibration?

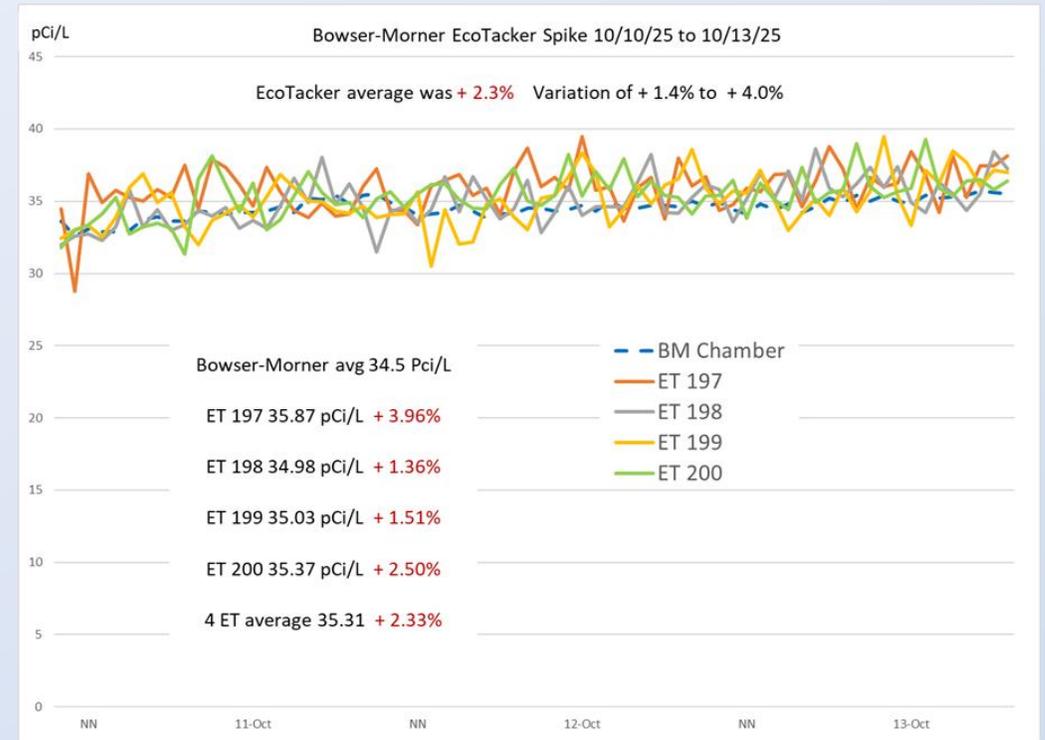
Study Considerations

- 1) Five separate week-long average Comparison Tests at 10 pCi/L to 16 pCi/L.
- 2) Exposures for shorter periods or levels closer to 4.0 pCi/L were not tested.

KSU spike before the Study



Bowser-Morner spike after the Study



KSU reported two Pylon values **5.5% different**
 4 EcoTrackers averaged either **+ 9.3% or + 3.6%**

Three RadonEyes calibration
 was reset to June 2024 KSU spiking

EcoTrackers averaged **+ 2.33%**

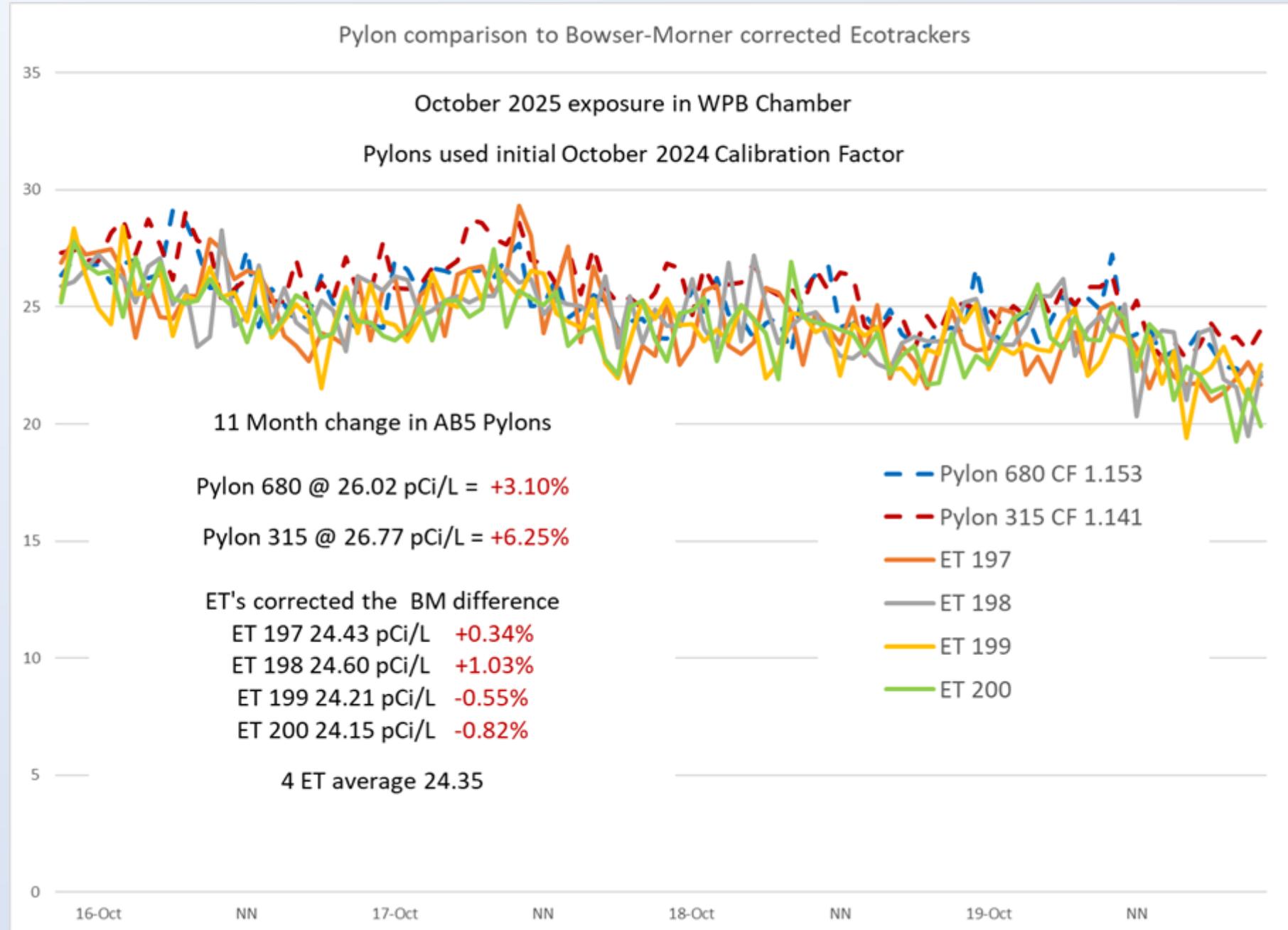
**The decision was made
 to use BM spike results**

Pylon calibration cross-check

Bowser-Morner corrected EcoTrackers used as reference

Two Pylons cross checked with corrected EcoTracker results

Over 11 months, Pylon calibration needed 3% to 6% adjustment from KSU spiking



All 26 CGRMs were in the Radon Chamber for 11 months

Small DC fan circulates air in the chamber



A delay chamber excludes Thoron from Rock Sources

Two AB5 Pylons were used to determine chamber levels
During the five CGRM week-long testing

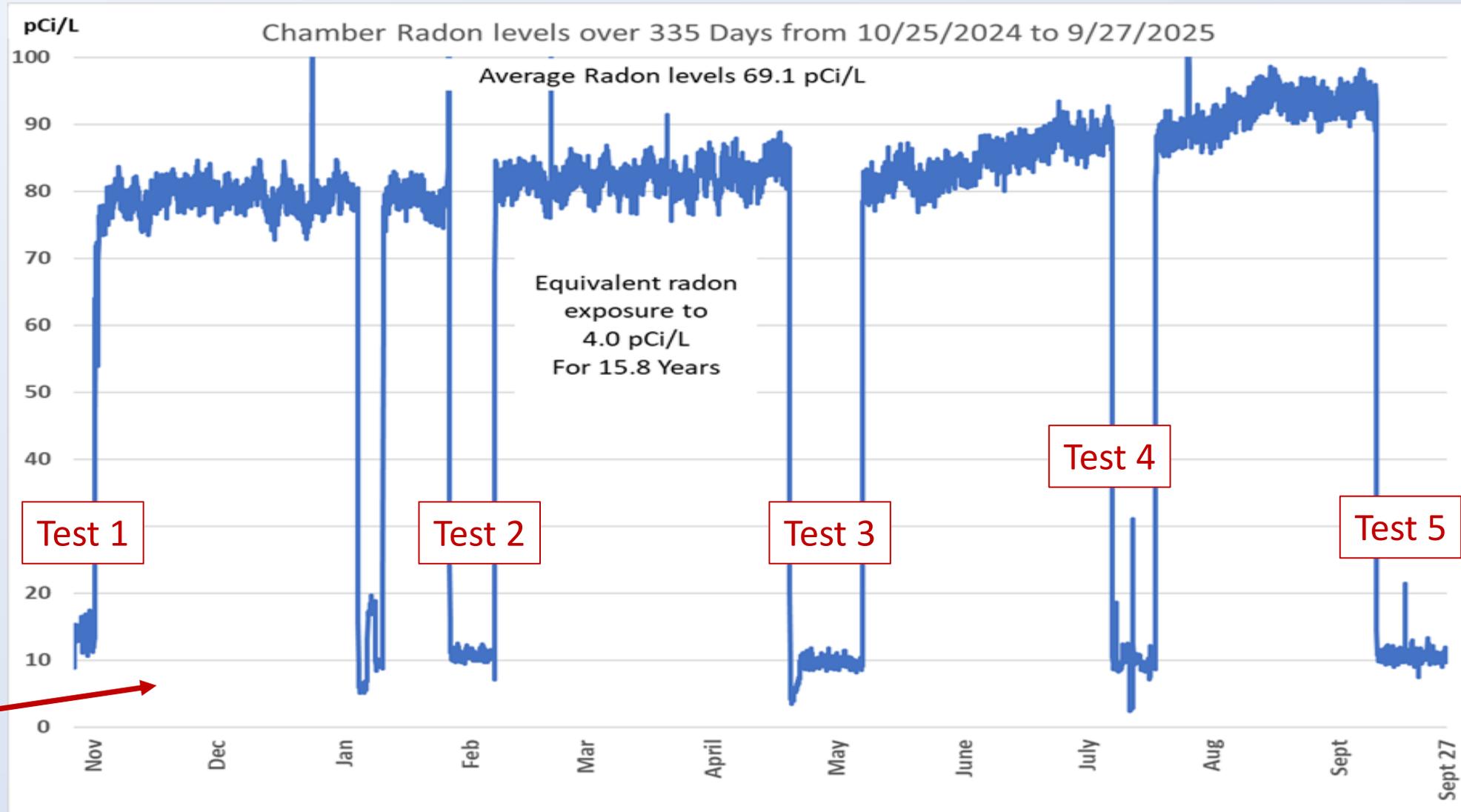
Radon Levels were reduced to about 10 pCi/L four out of five times to measure the **Week-Long Average**

Total Exposure was equal to 4.0 pCi/L for 15.8 years

Primary Exposure was 80 to 90 pCi/L

Test 1 at 16 pCi/L

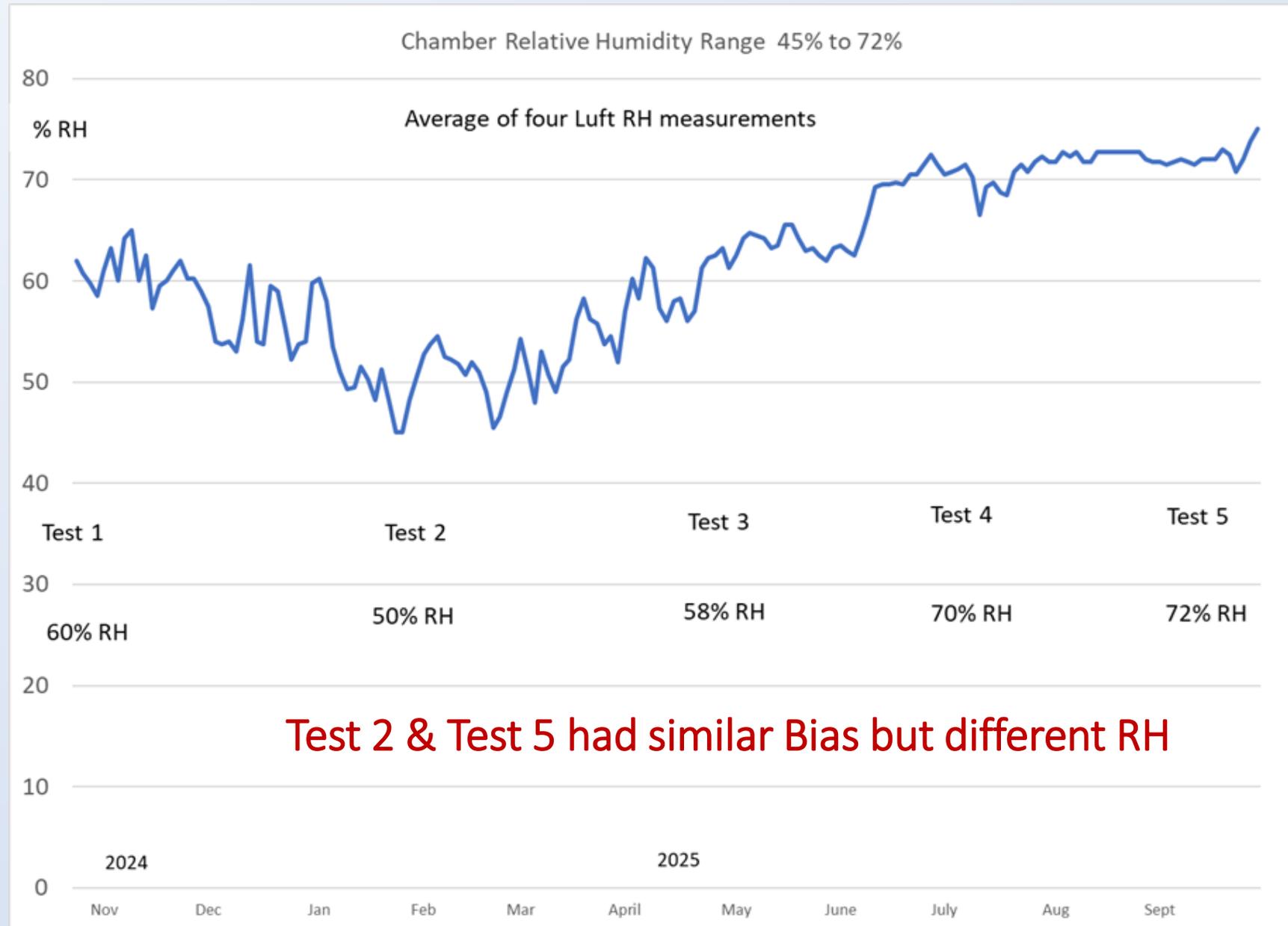
Test 2 to 5 at 10 pCi/L



Luft CGRMs recorded the Relative Humidity

Humidity in the chamber varied from 45% to 72%

No change in performance from this range of Humidity was observed



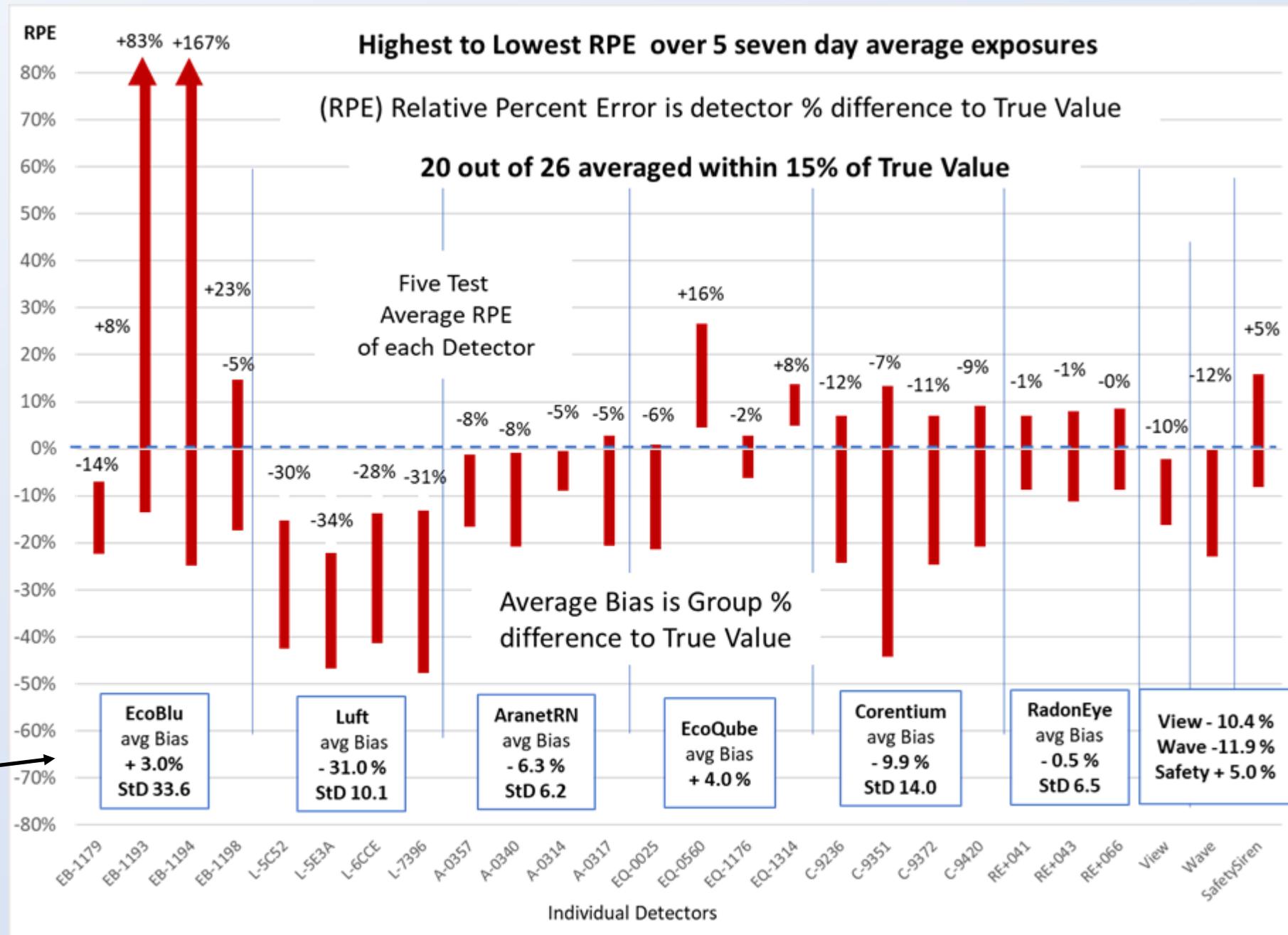
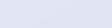
Each CGRM
5 Test average

The shorter
the bar length,
the greater
the Precision

Similar Bar grouping
equals consistency
between
similar detectors



Overall Bias average
of each detector group
is less valuable
if Bias spread
is great

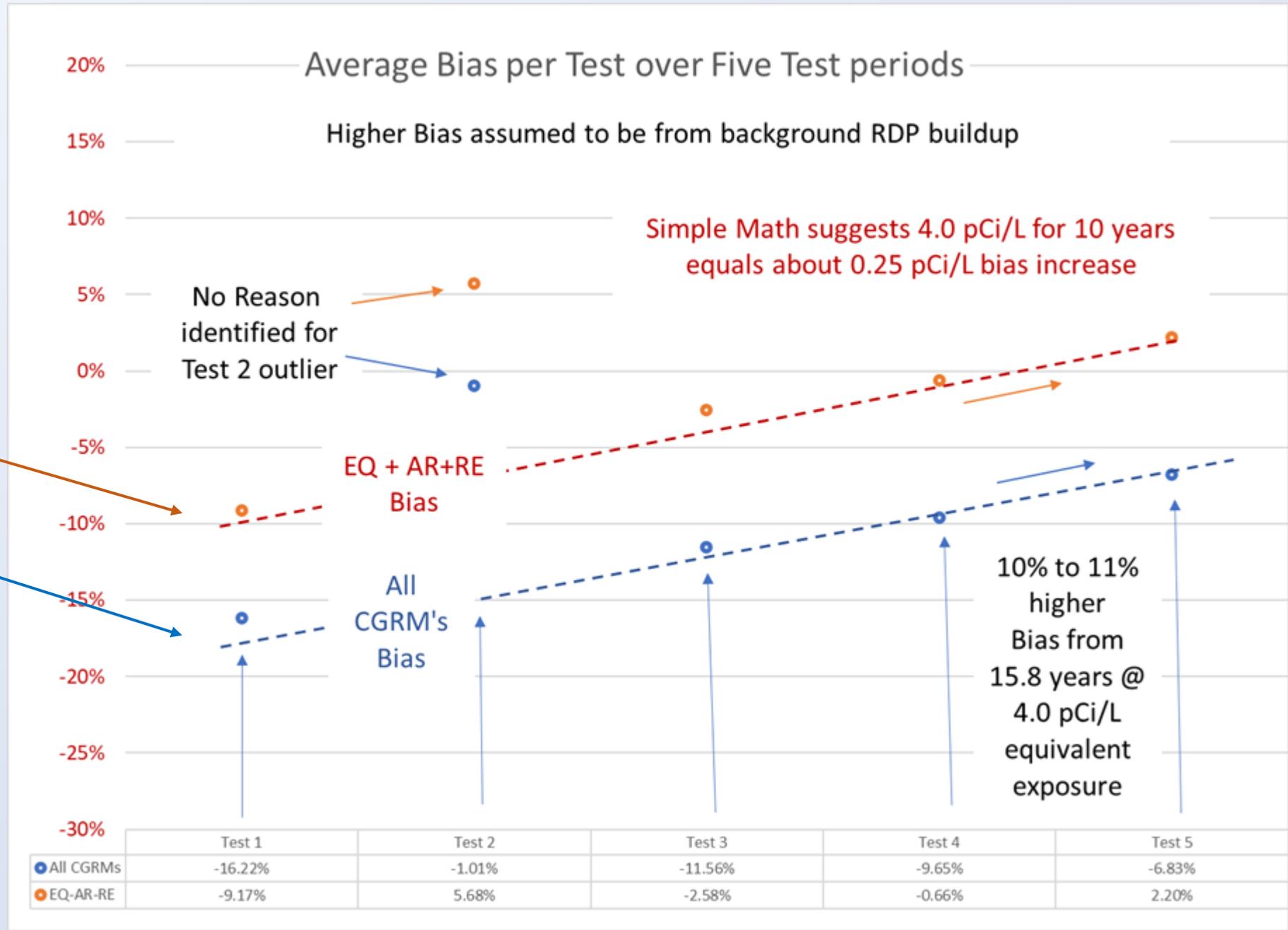


Average Bias for each Test Period

Radon Exposure was equal to 15.8 years at 4.0 pCi/L

Similar sloped line of higher bias for EQ, AR, RE CGRMs and all CGRMs

Simple math using a 10% Higher Bias would equal 0.25 pCi/L increase in 10 years at 4.0 pCi/L exposure



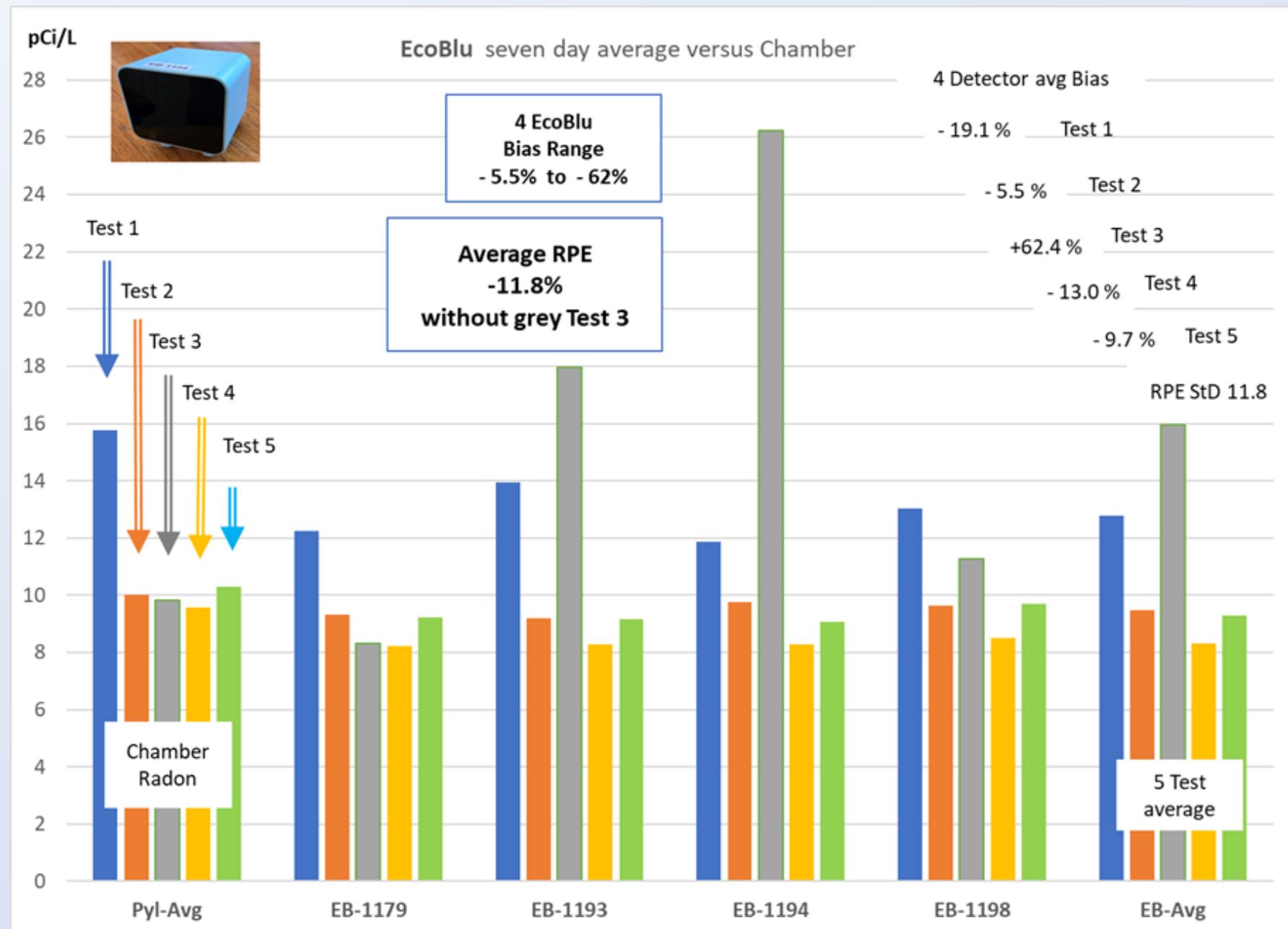
EcoBlu Radon results (plugs in)

LCD display of
hourly, daily,
week-long, and
total averages

No Cell app
or data transfer

Loses data if a power loss

Two EcoBlu results had
large outliers in Test 3



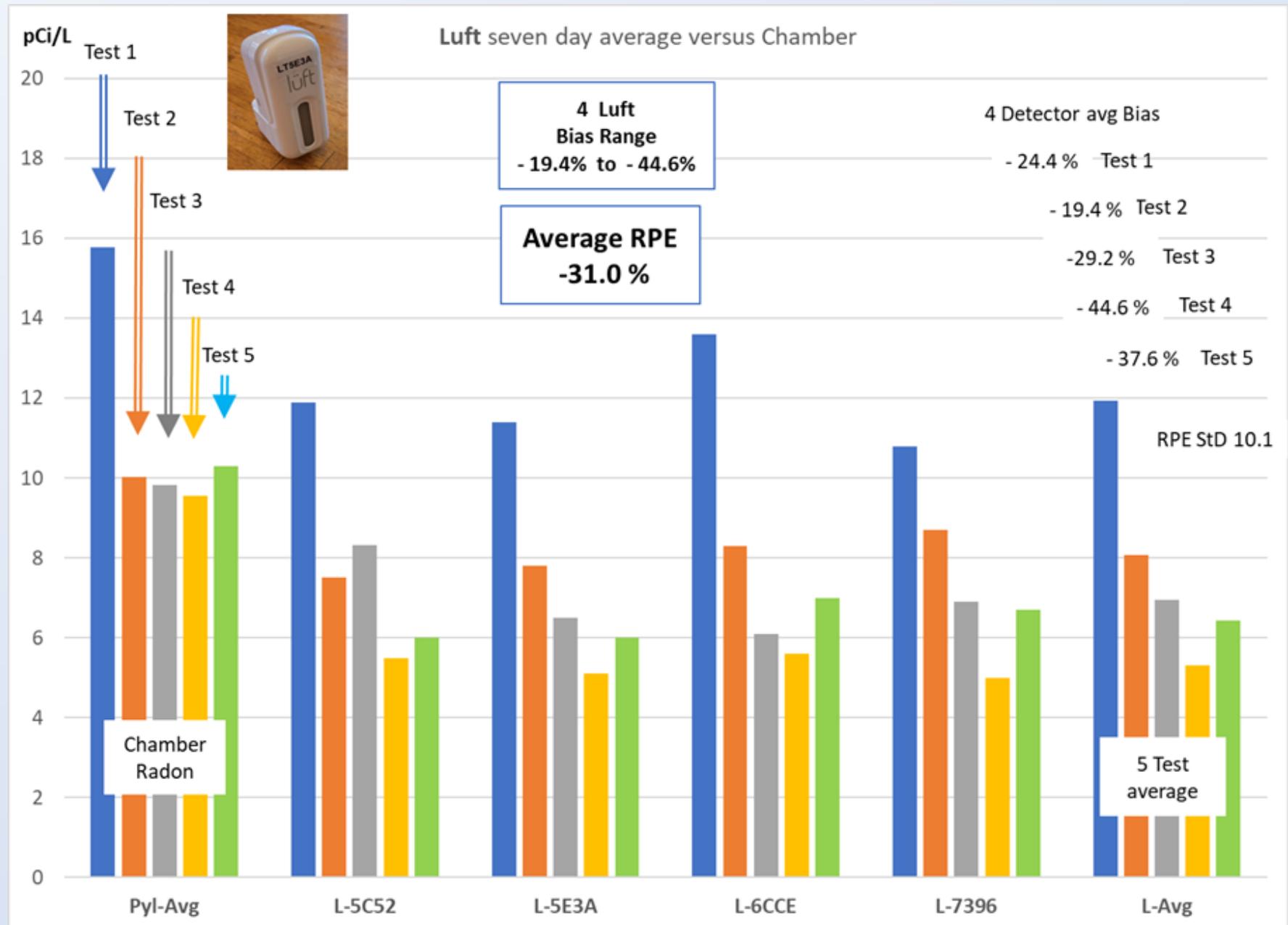
Luft

Radon results
(plugs in)

Changing color display
indicates high levels

Cell app displays
Radon graph,
CO2, VOC, RH,
Temperature, BP

Can download data
as 4-hour averages



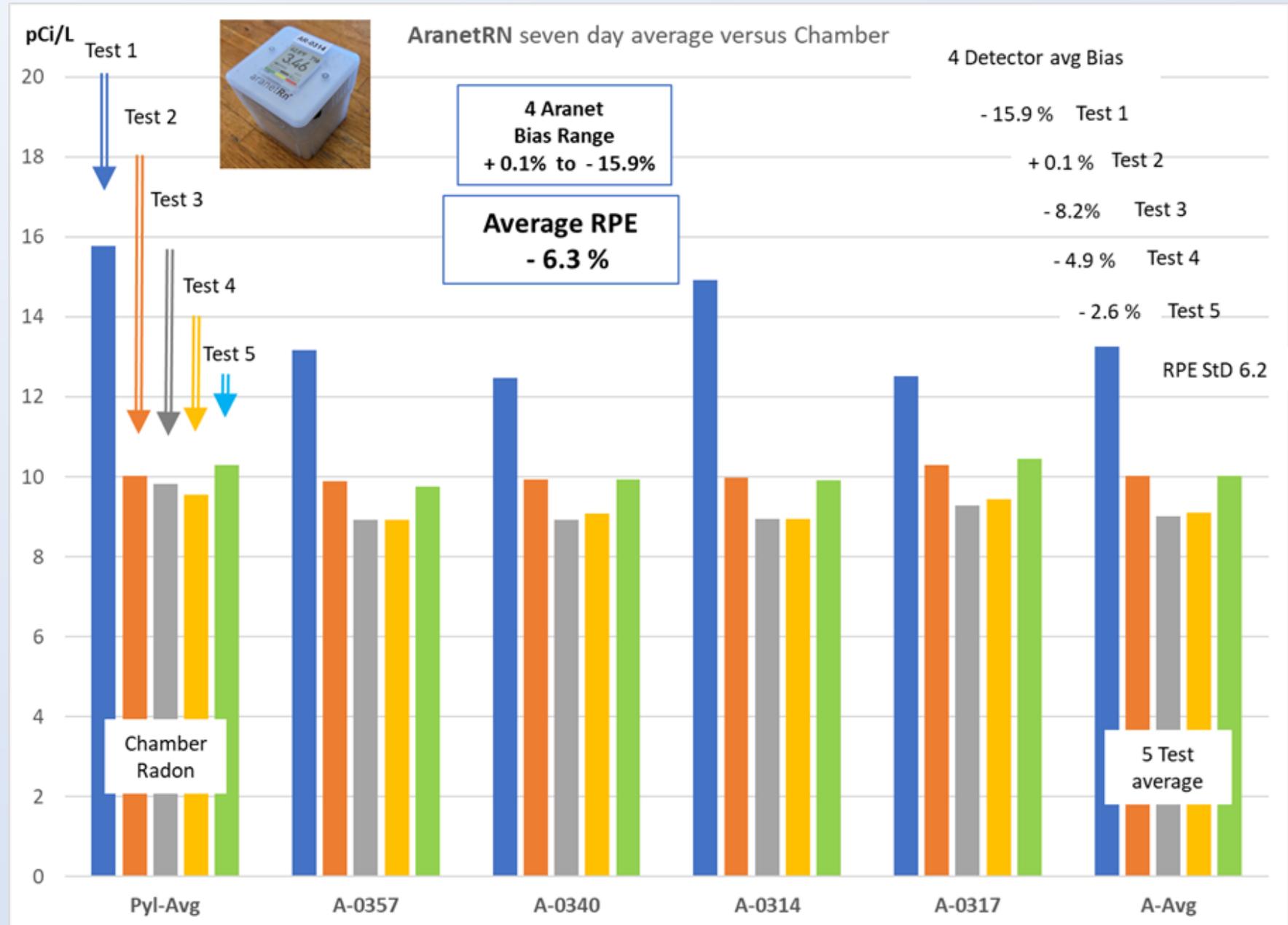
AranetRN

Radon results (battery)

LCD display of hourly, daily, week-long, and total averages

Cell app displays graph of all data Radon, RH, Temperature, BP

Maximum 30 days of data in 10-minute rolling average.



EcoQube

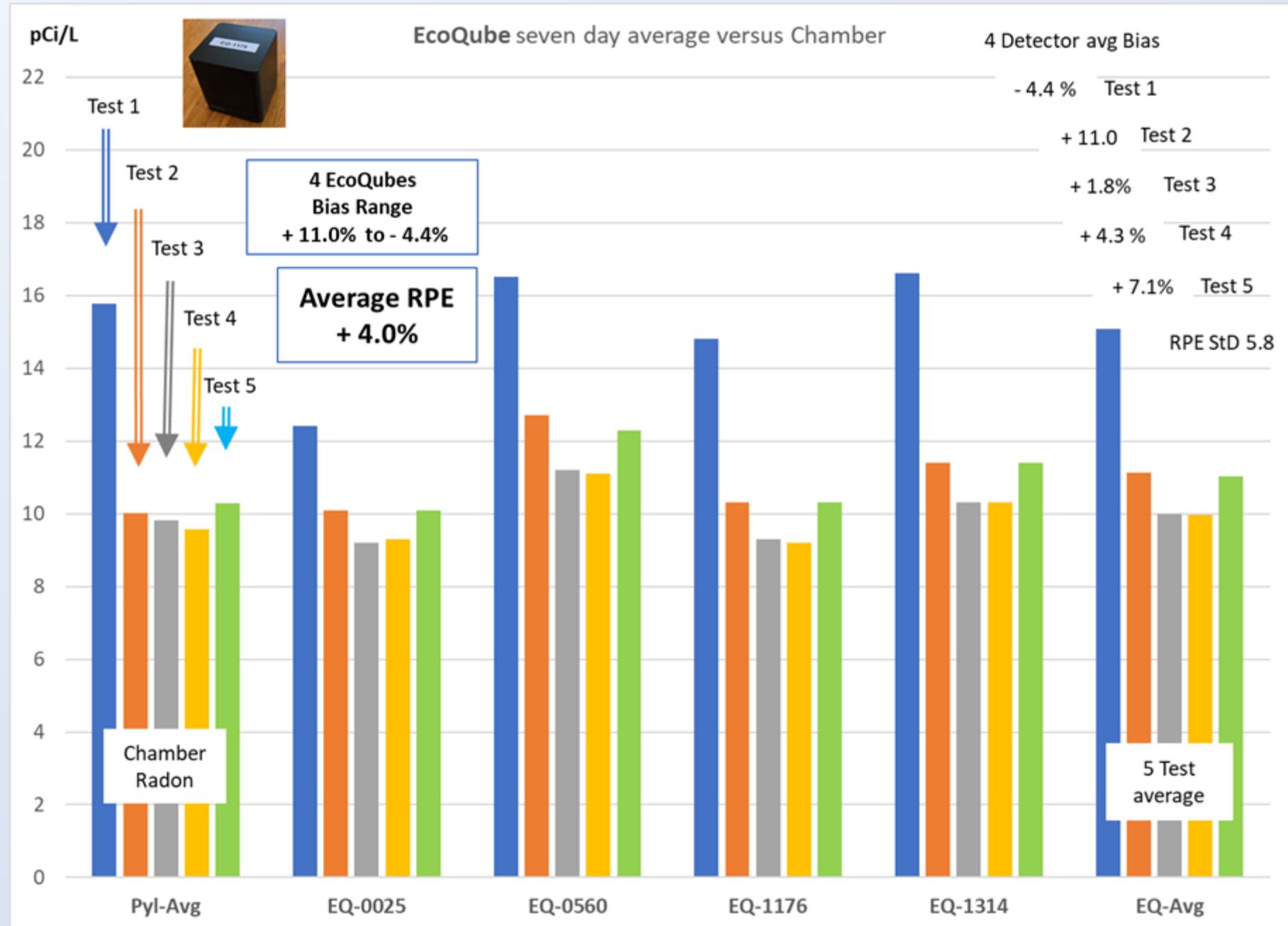
Radon results (plugs in)

A small colored light indicates higher levels

Cell app displays graph of hourly, daily, week-long, and total averages

Can download hourly averages for entire exposure period.

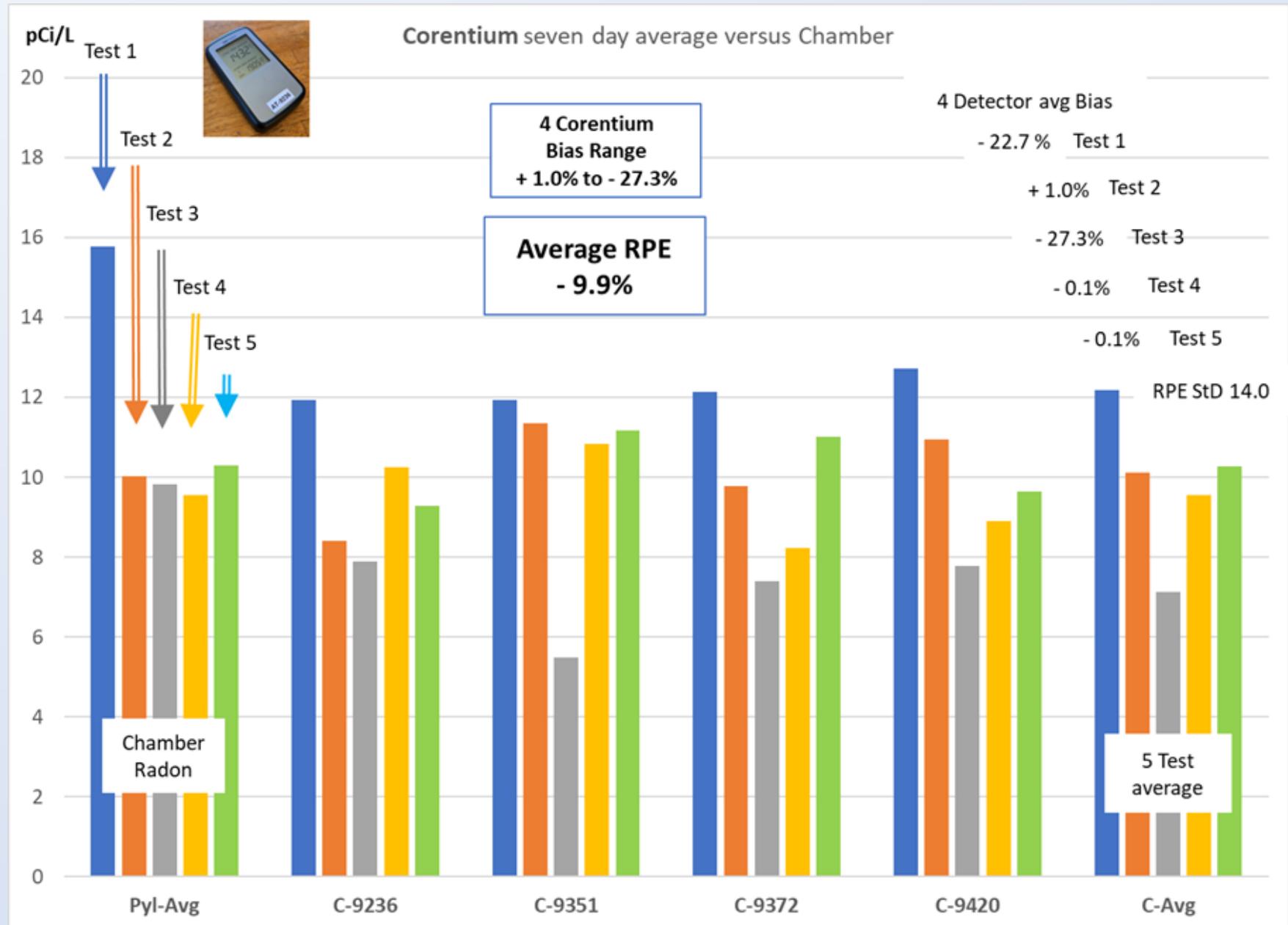
EcoQubes were exposed previously for 1 year



Corentium Radon results (battery)

Displays

1 day
&
7-day
average



RadonEye

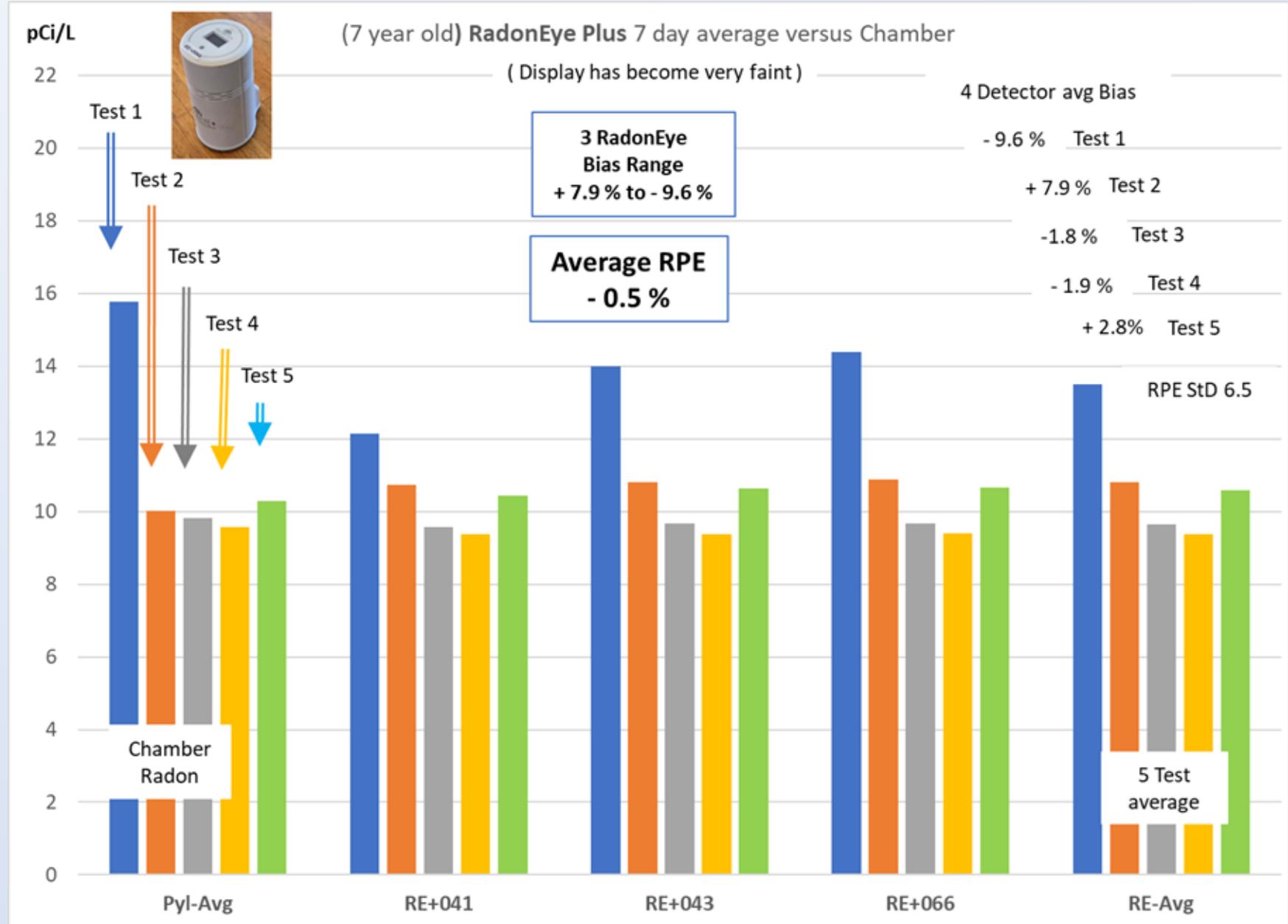
Radon result
(plug in)

Displays current Radon

After 6 years,
display is
too dim to see

Cell app displays
hourly, daily,
week-long, and
total averages
and a
graph

Calibration set in June 2024



Single CGRMs

View Plus (battery)
Displays current radon

Cell app displays graph of all data
Radon, RH, Temperature, BP, BM

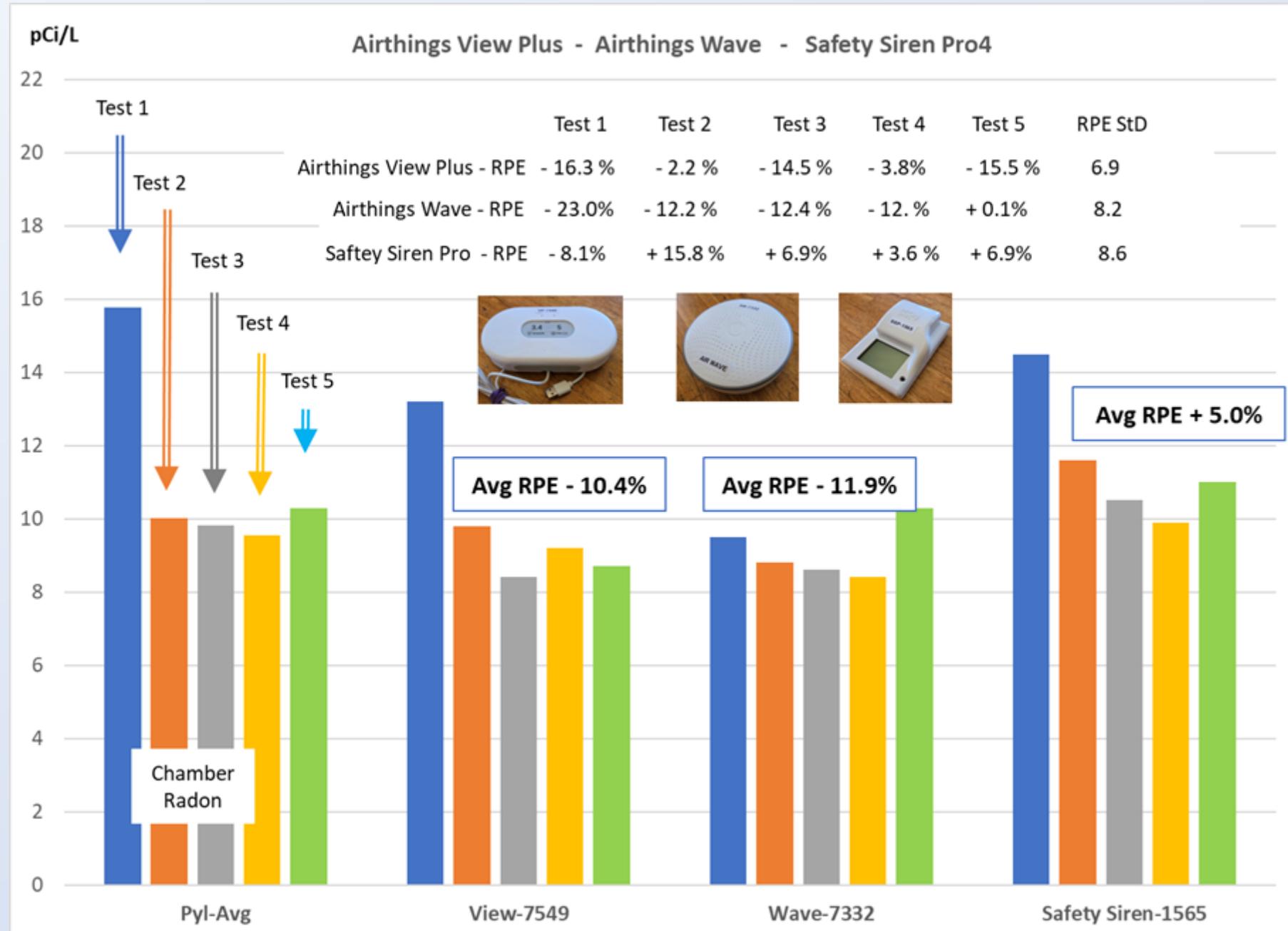
Wave (battery)
Has colored indicator

Cell App has Temperature and humidity.

Both Airthings can download data

SafetySiren Pro4 (plug in)

Has short term & Long term display

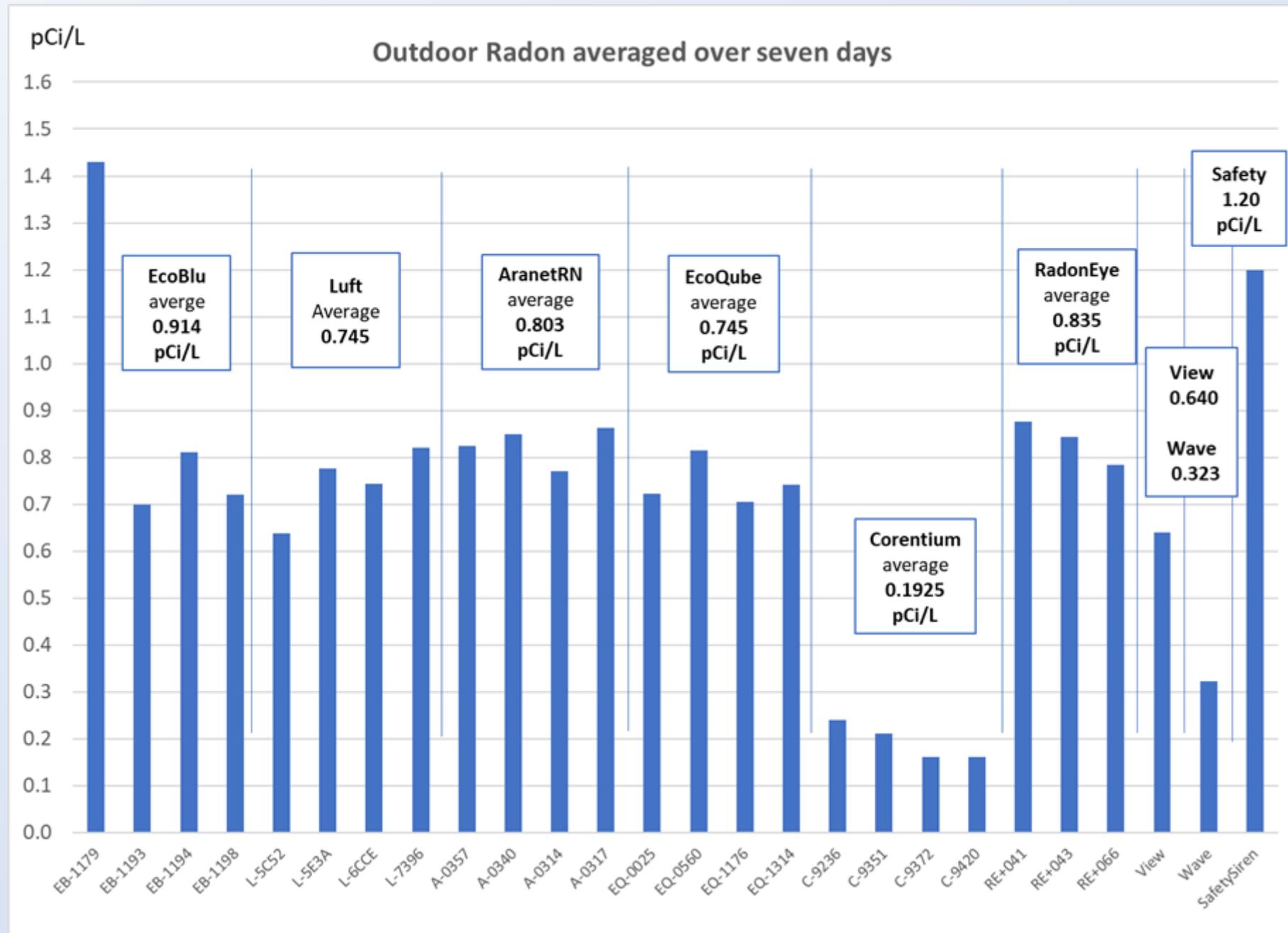


All the detectors were placed outdoors for seven days

In general, they all averaged around **0.65 to 0.85 pCi/L**

except:

Wave
Corentium
Safety Siren

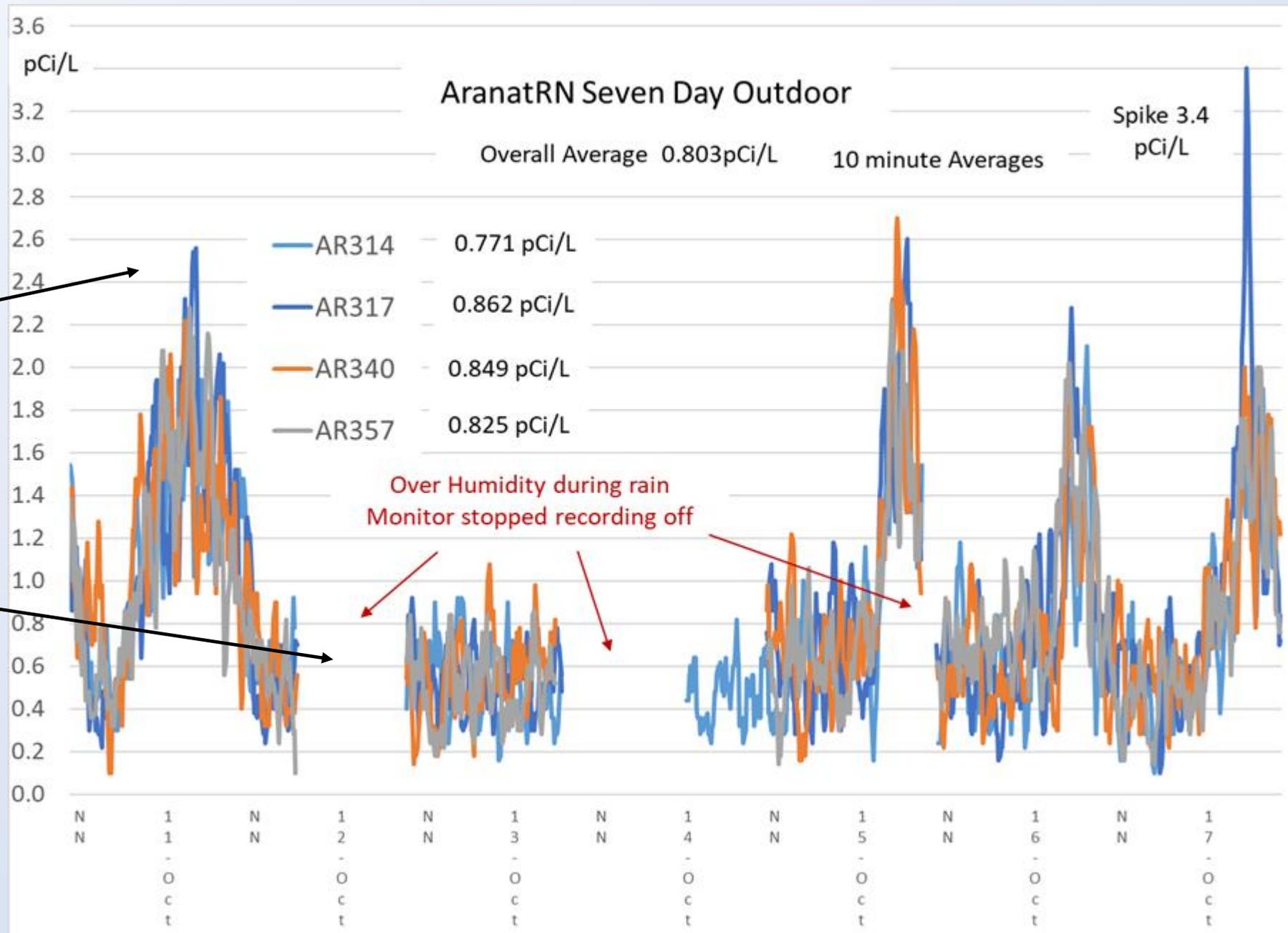


AranetRN Outside

Four
Early AM mornings
levels spiked
to
2.0 + pCi/L

AranetRN stopped
recording during rain
when humidity
reached 100% RH

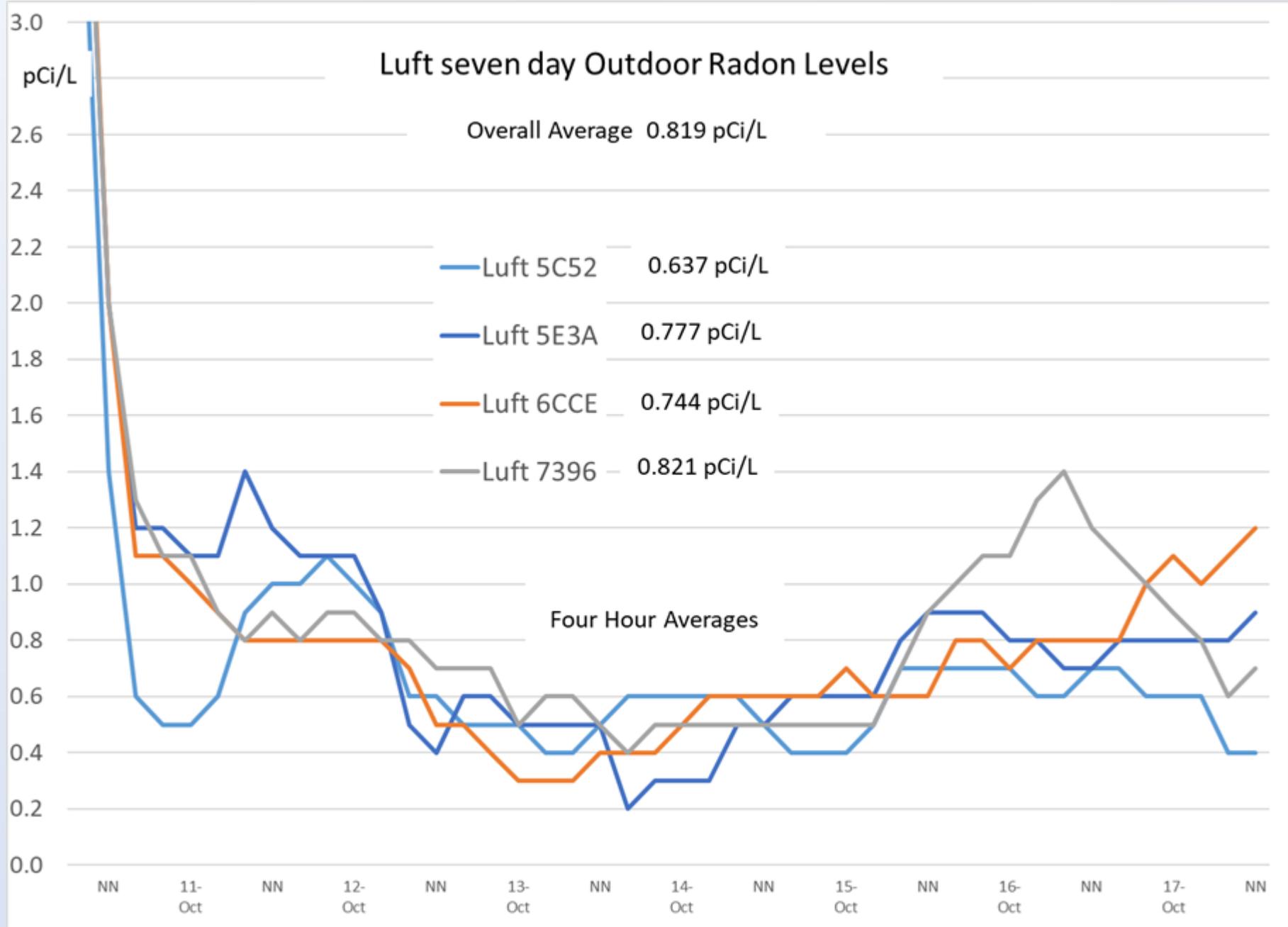
My backyard is
not the best place
to test background!



Luft Outdoor

Lufts had four hour averages and slow response to radon level change

Spikes in outdoor radon did not show up



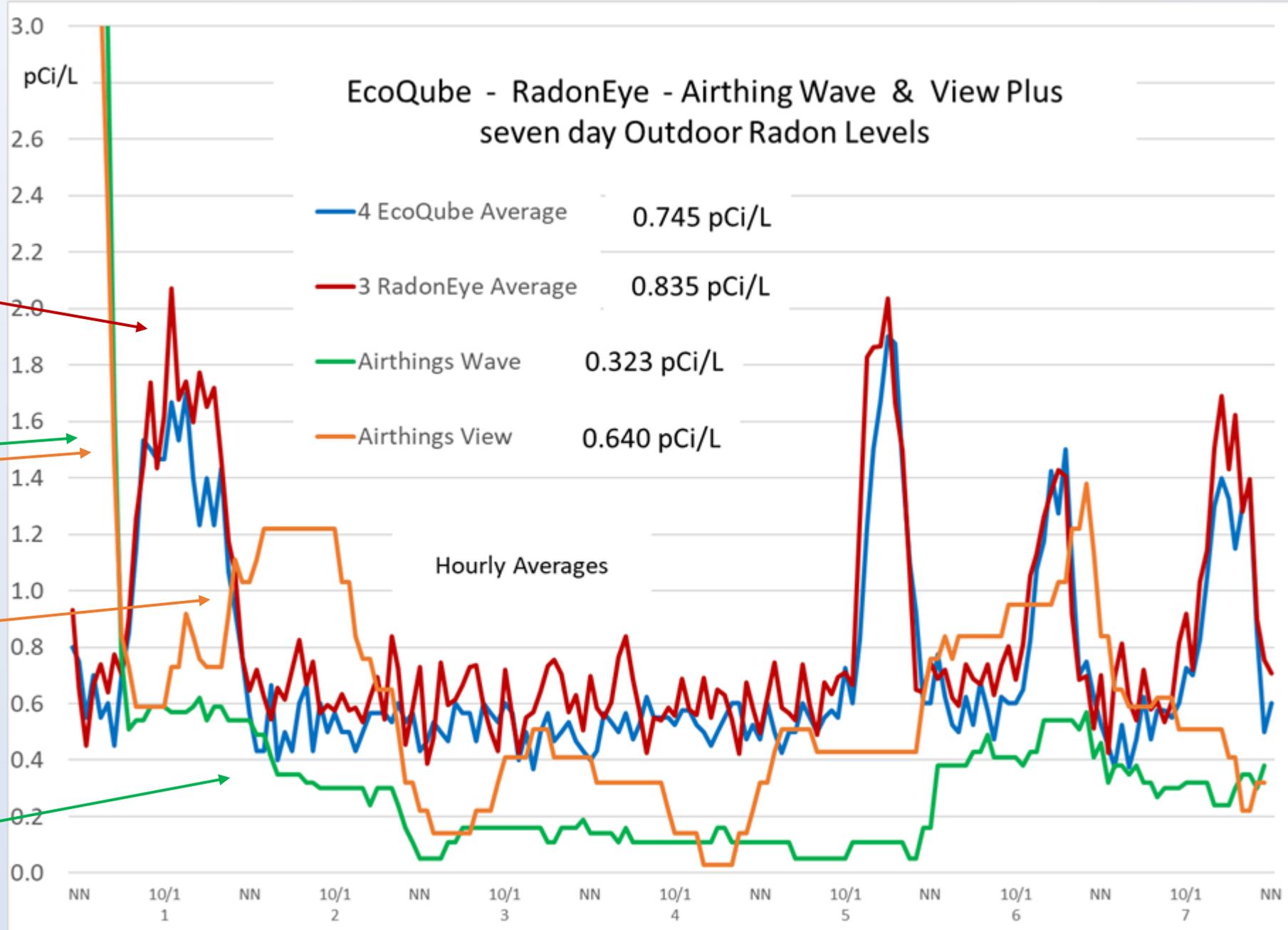
EcoQube & RadonEye View+ & Wave

EQ & RE showed
nighttime spikes
similar to Aranet

Airthings
delayed response

View showed
delayed spikes
two of four nights.

Wave gave the
lowest hourly levels



89% - 116 of 130 measurements average better than 25% RPE

65% - 84 of 130 had results better than 15% RPE

If Calibration was closer to the True Value, then 97% would be under 15% RPE

Number of results closer than 15% RPE



EcoBlu
14 / 20



Luft
2 / 20



AranetRn
17 / 20



EcoQube
17 / 20



Corentium
11 / 20



RadonEye
15 / 15



View Plus
3 / 5



Wave Plus
4 / 5



SafetySiren Pro4
4 / 5

What did this Study demonstrate?

- Week-long averages of CGRMs are predominantly within 25% at radon levels at 10 pCi/L
- If the CGRM had correct calibrations, almost all measurements would be within 15%.
- CGRMs exposed for **10 years at 4 pCi/L might shift up 0.25 pCi/L** .
- Creating a certification for CGRMs by NRPP or NRSB should be a consideration.
- Is it time to **reconsider** Professional Radon Monitors minimum certification requirement of only Plus or Minus 25%.
- This study did not measure at 4.0 pCi/L for periods less than 7 days