Utilizing Thermal Imaging and Blower Door Technology for Mitigation

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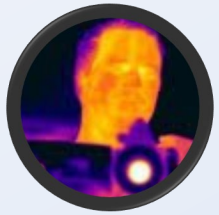
Vice President, United Infrared, Inc.

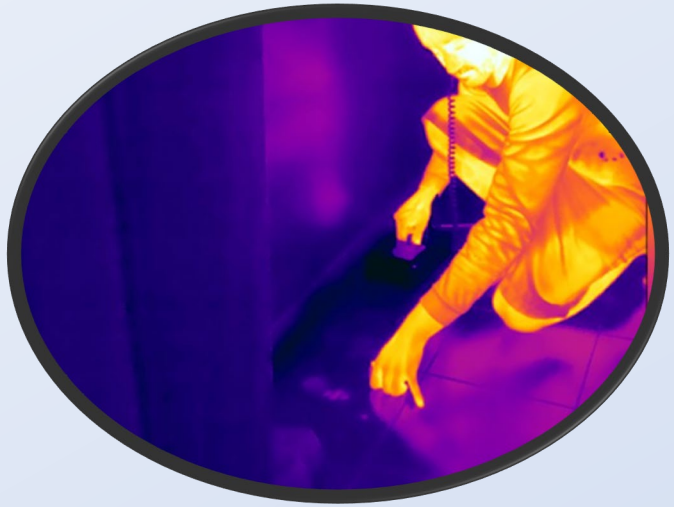
United Infrared, Inc.

Presenter BIO



- **Peter Hopkins**
  - Level III Certified Infrared Thermographer
  - ICC Certified Inspector (5 certifications)
  - Practicing building inspector for over 29 years having personally performed over 9000 building inspections.
  - Principal of InspecDoc Inspection Services, a multi-inspector firm operating in Southern California since 1994
  - Principal of SoCal Infrared, concept in 1999, reality in 2005 due to declining real estate market.
  - Principal of United Infrared, Inc., the worlds largest servicing based IR company currently operating in 44 US states and 9 Countries.

Infrared Training

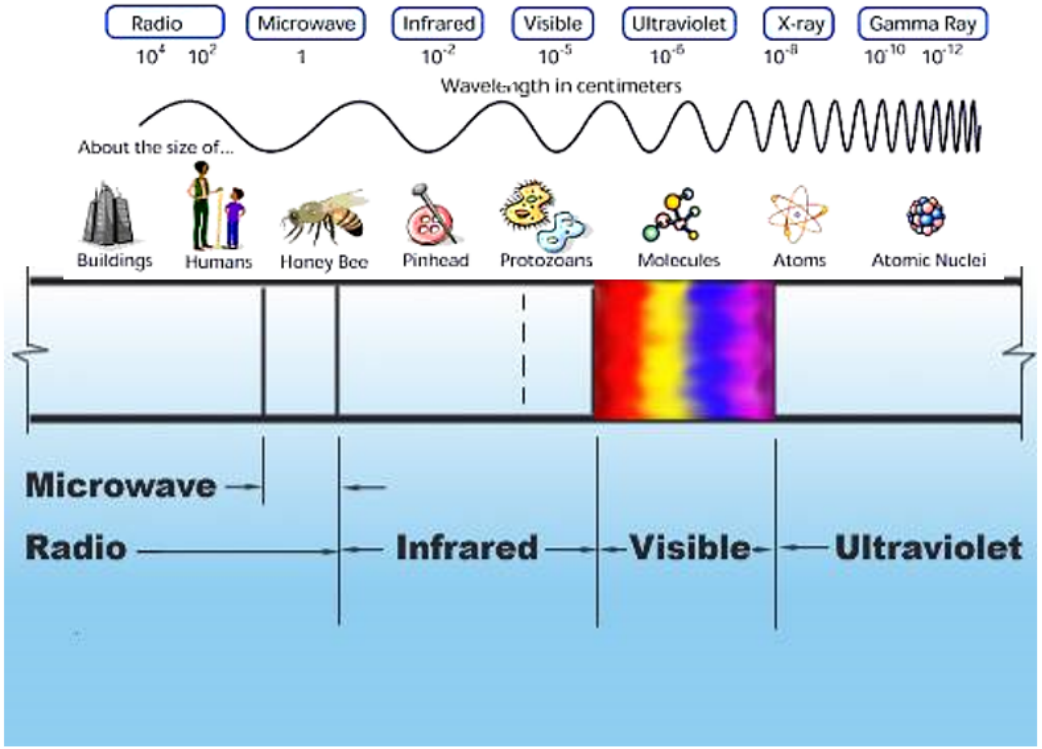


- Goal of class:
  - To give you a good understanding of the IR Basics and how it can be used with other tools to help you understand if it will benefit your business when it comes to radon mitigation.
    - If you already own a camera, you will get tips on how to put it to work and what training is necessary.
    - If you don’t own one, it will give you the basics and the motivation on taking the next step or the know how to hire the appropriate technician.

Infrared Theory and the Basics of IR Thermography

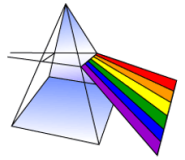
Electromagnetic waves travels at the speed of light(c), and are characterized by frequency (ν) or wavelength (λ) and amplitude. The frequency and wavelength are related by the equation $c = \nu\lambda$. The relationship between energy and frequency is given by Planck's Law, $E = h\nu$, which can be expressed as $E = hc / \lambda$.

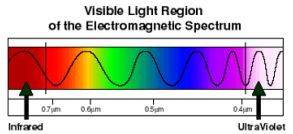
All objects that are not at absolute zero emit infrared radiation. Absolute zero defines the temperature where all molecular motion ceases, and is the coldest possible temperature. It corresponds to about minus 273 degrees Celsius, or minus 460 degrees Fahrenheit. Physicists define this point to be zero degrees Kelvin, with each increment on the Kelvin scale identical to that of the Celsius scale.



Visible Light = 400-700 namometers

violet	380–450 nm
blue	450–495 nm
green	495–570 nm
yellow	570–590 nm
orange	590–620 nm
red	620–750 nm





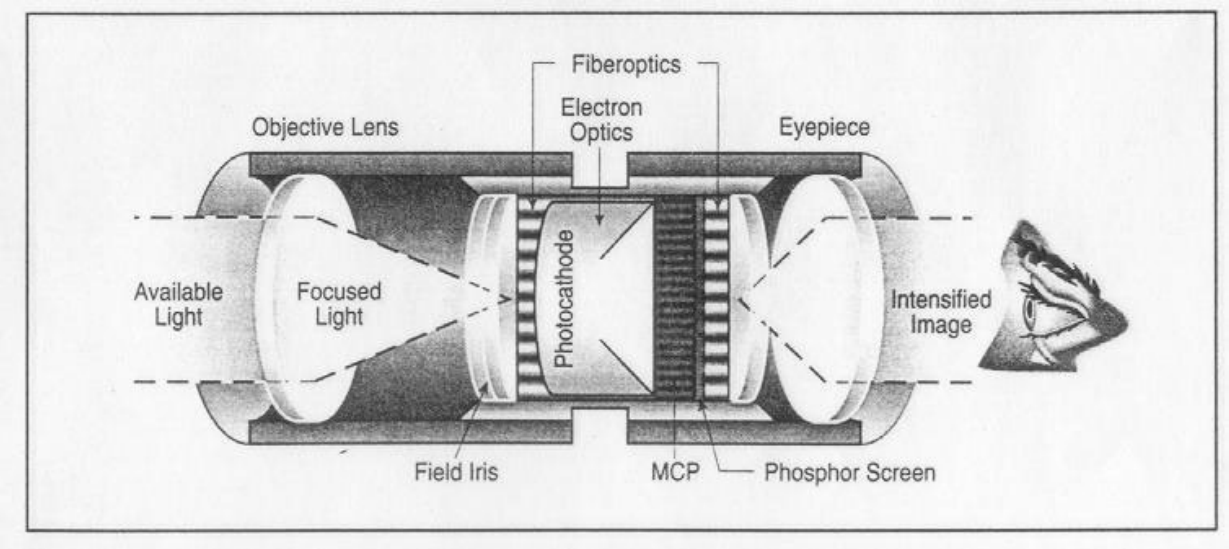
Infrared Waves are completely safe unlike Microwave and Ultraviolet! Thermal Imagers do not emit Infrared Radiation, they read the radiant energy!

Near Infrared = 0.75-1.4 µm

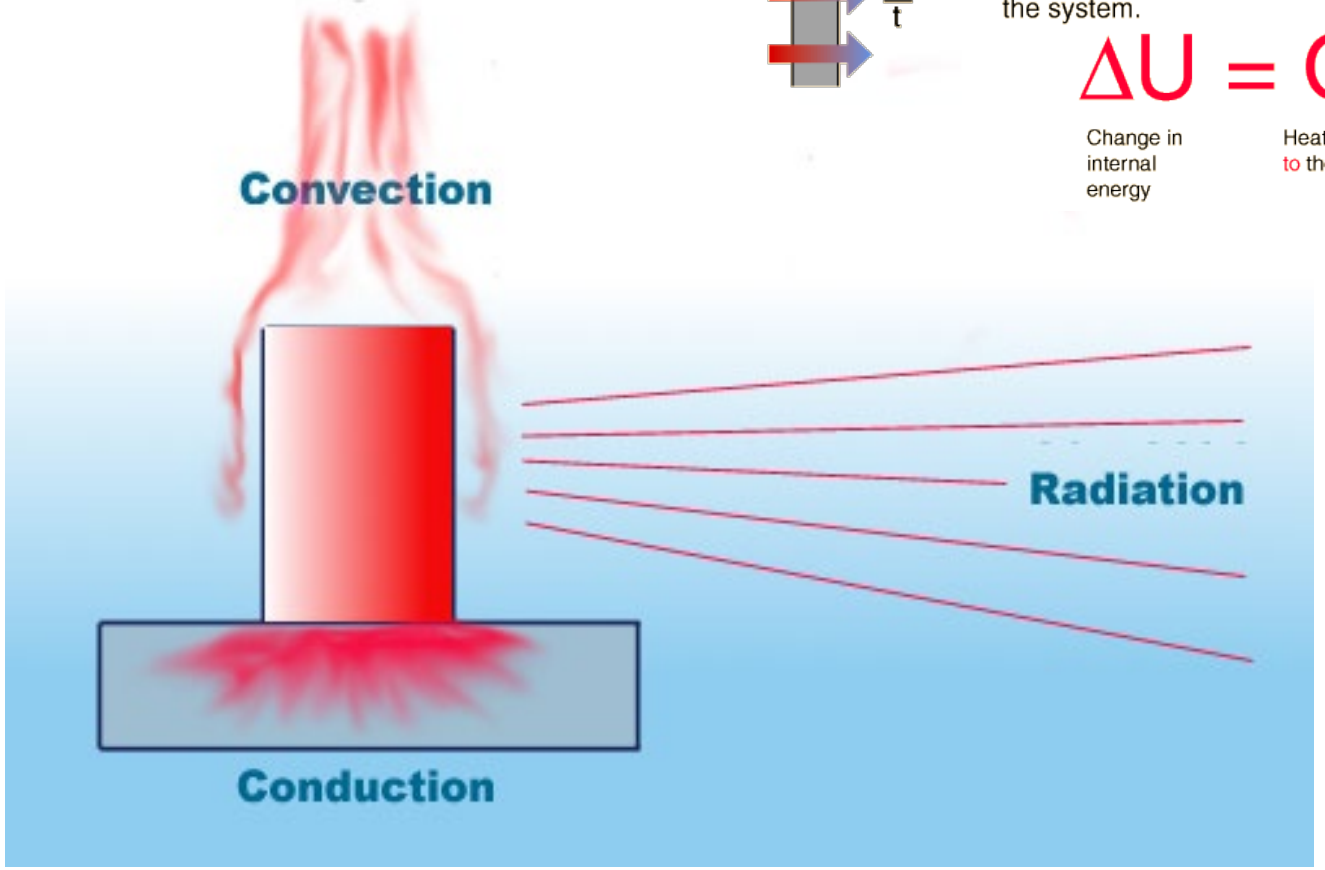
- Night Vision

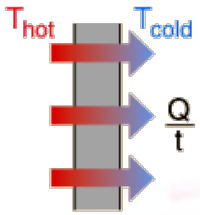
“Night Vision" are devices that utilize image intensification technology

They operate in visible and near IR wavelengths



Heat Transfer





First Law of Thermodynamics

The change in internal energy of a system is equal to the heat added to the system minus the work done by the system.

$$\Delta U = Q - W$$

Change in internal energy

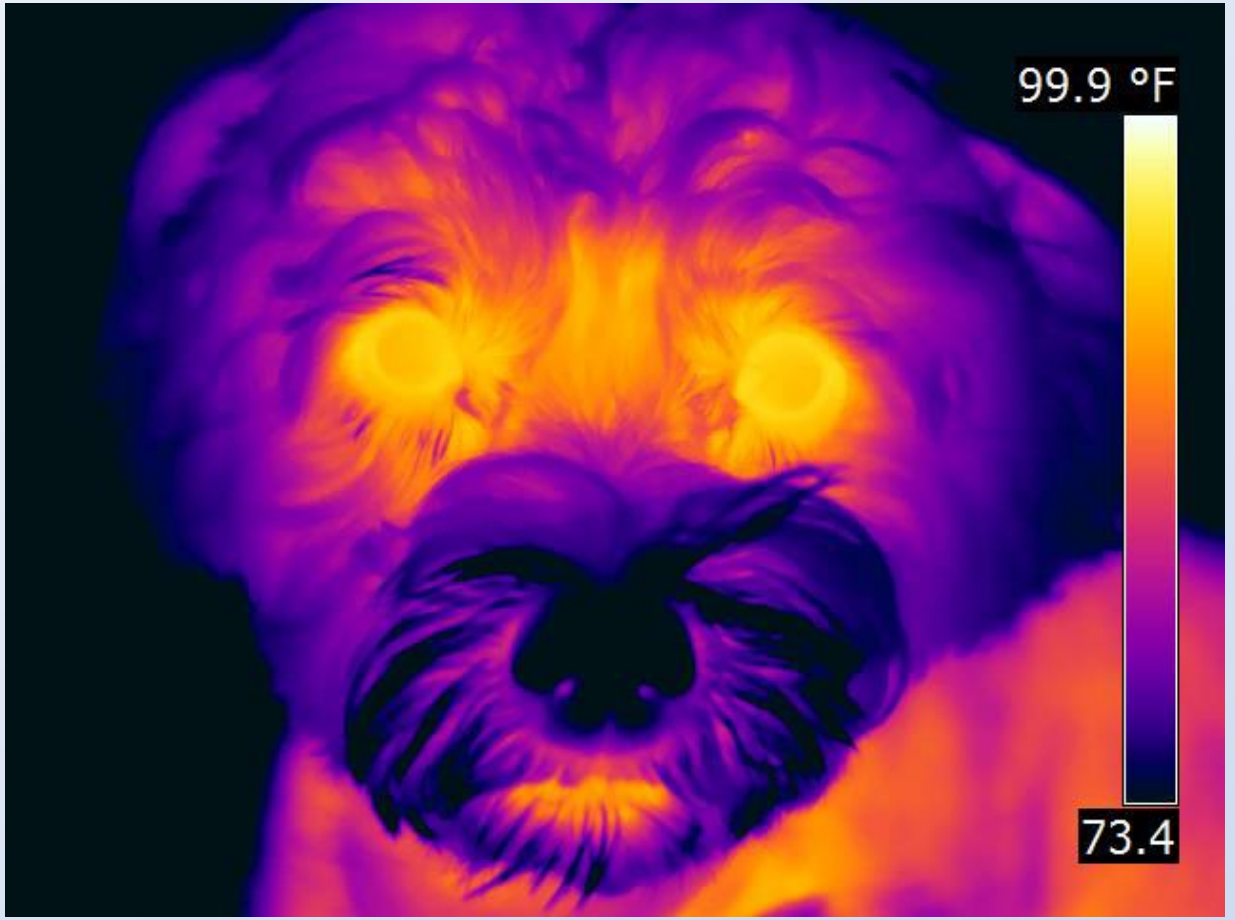
Heat added to the system

Work done by the system

Ludwig Boltzmann

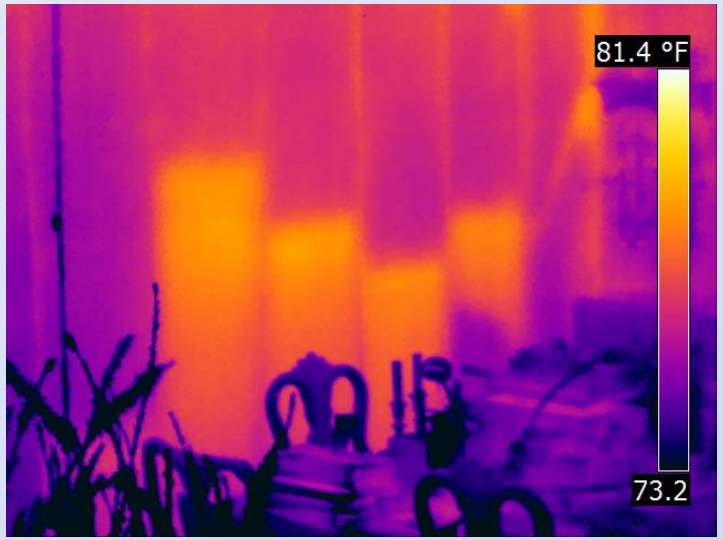
LOOK INTO MY EYES

YOU WILL BE MEZMORIZED by INFRARED

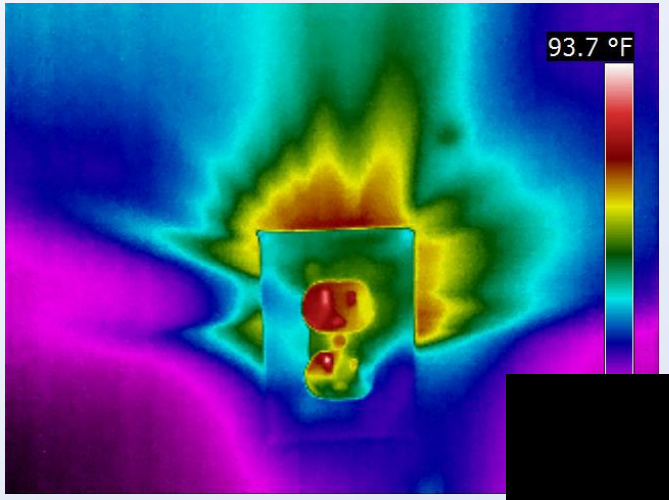


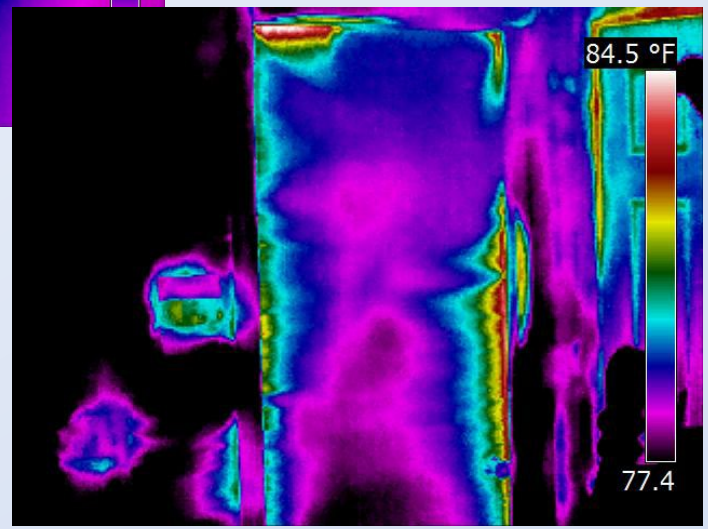
ENERGY

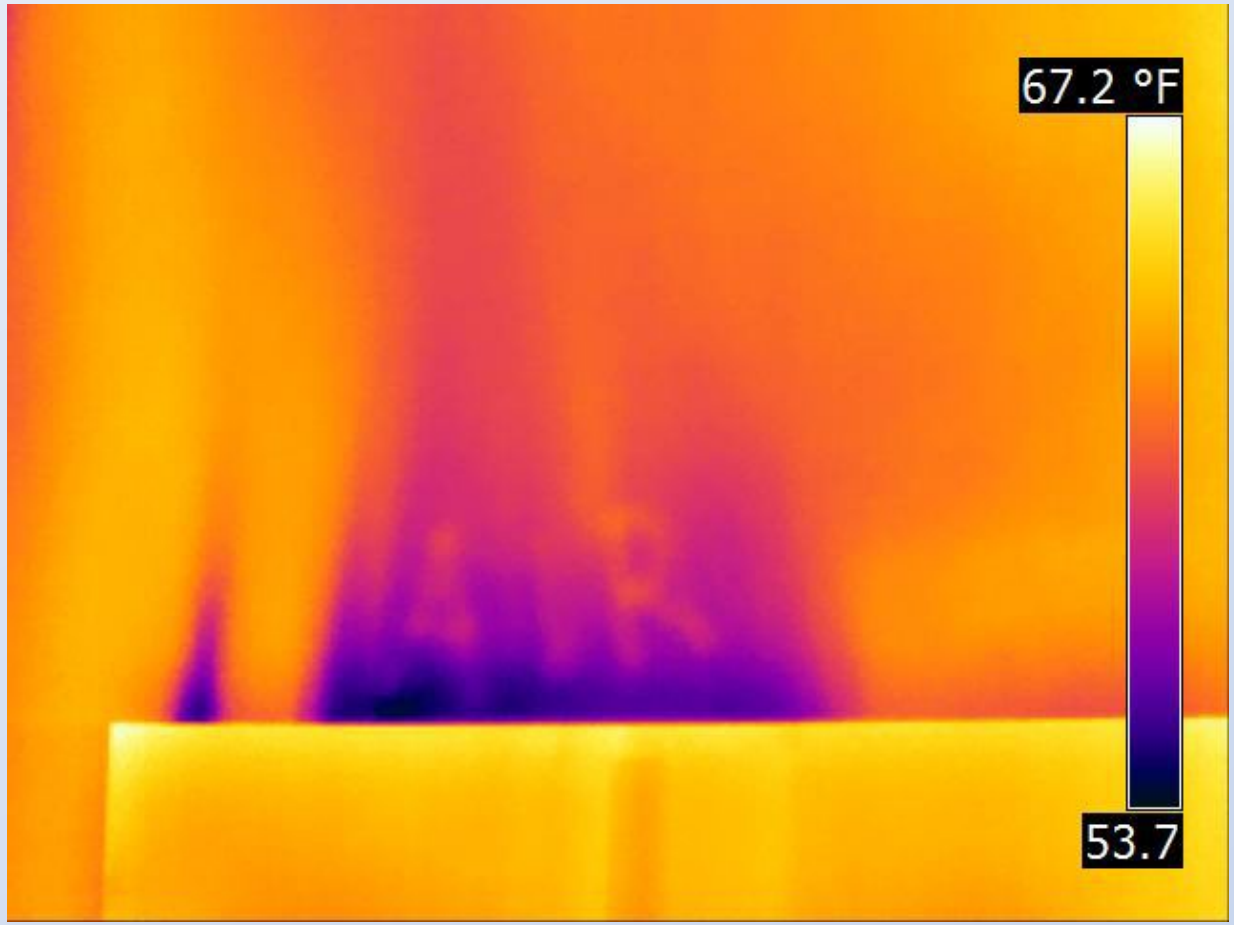
- Simple Principal: Hot goes to cold
  - In the winter, heat from the building is always trying to get out
  - In the Summer, heat is always trying to get in
  - Infrared is not seeing through the walls, it is reading the energy! Missing insulation allows the energy to pass at different rates!



IF we have a temperature differential from outside to inside (18°F recommended) and change the pressure in the building, we can visualize points of convective entry.







Quantifying Air Leakage

Zone Dimensions

Net Floor Area:	1900	(ft²) Square feet
Average Interior Height:	8	(ft) Feet
Internal Building Volume:	15200	(ft³) Cubic Feet
Surface Area (Envelope):	5528	(ft²) Square feet

Environmental Conditions

(20° delta T requires a +/- 2% temperature correction to ACH50 below)

	Before	After
Inside Temperature: °F	72	74
Outside Temperature: °F	84	84
Ext. Wind Speed (approx.)	2-5mph	2-5mph

Test Guide

Direction: Depressurize
Standard: ASTM E779-03
(sq in EfLA /100 sq ft. @ 4 Pa)

RESULTS

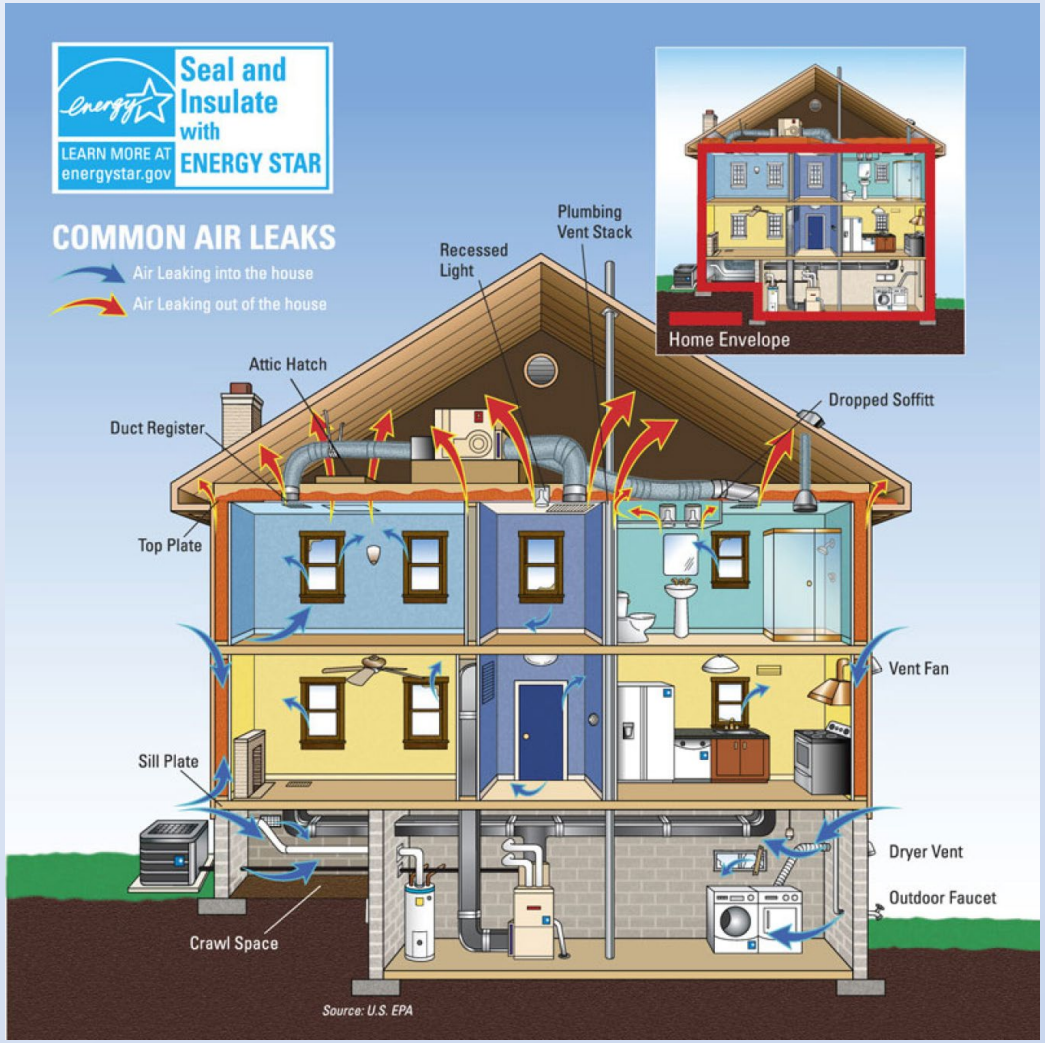
	UNIT	UNIT
(ACH50) Air Changes Per Hour at 50 Pascal	18.95	(ACH) Air Changes per Hour
(CFM50) Flow @ 50 Pascal	4815	(cfm) Cubic Feet per Minute
EfLA (Effective Leakage Area @ 4 Pa)	259	(in²) Square Inches

- Furthermore, with a blower door (the pressure changing machine), we can quantify air leakage rates and determine before/after mitigation if we are making progress.

Air Leakage Principals

- Air Leaks have many entry points.
  - Air Leaks at the top (warm air rises) can depressurize the home causing additional leakage from the bottom
  - DUCT Leakage in the home can depressurize the home causing more air to come in from openings! (HVAC = 30-50% of energy consumption in a home.

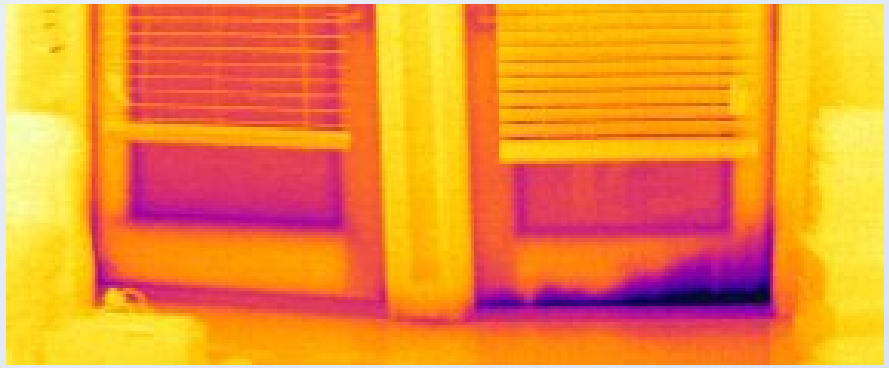
  - A **BLOWER DOOR** can measure ALL the leakage. Sealing methods can reduce the harmful entry of contaminated air (RADON)



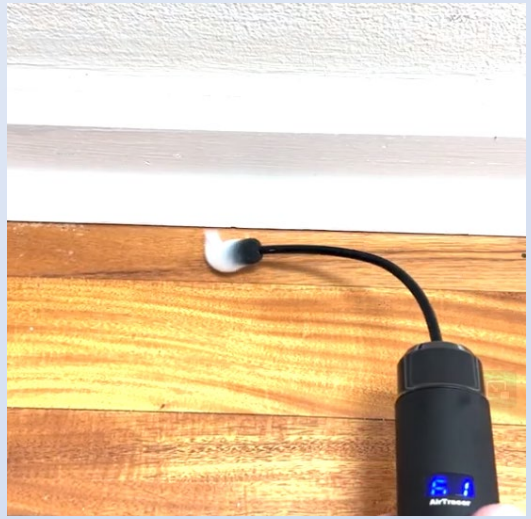
DOUBLE DOWN: Benefits are doubled!

- Effective air sealing in the home will reduce harmful air entry and the ADDED Benefit of saving energy by reducing utility consumption.
- How much RADON can get in a closed YETI!,
- Seal it Tight, Ventilate it RIGHT!

Finding the LEAKS

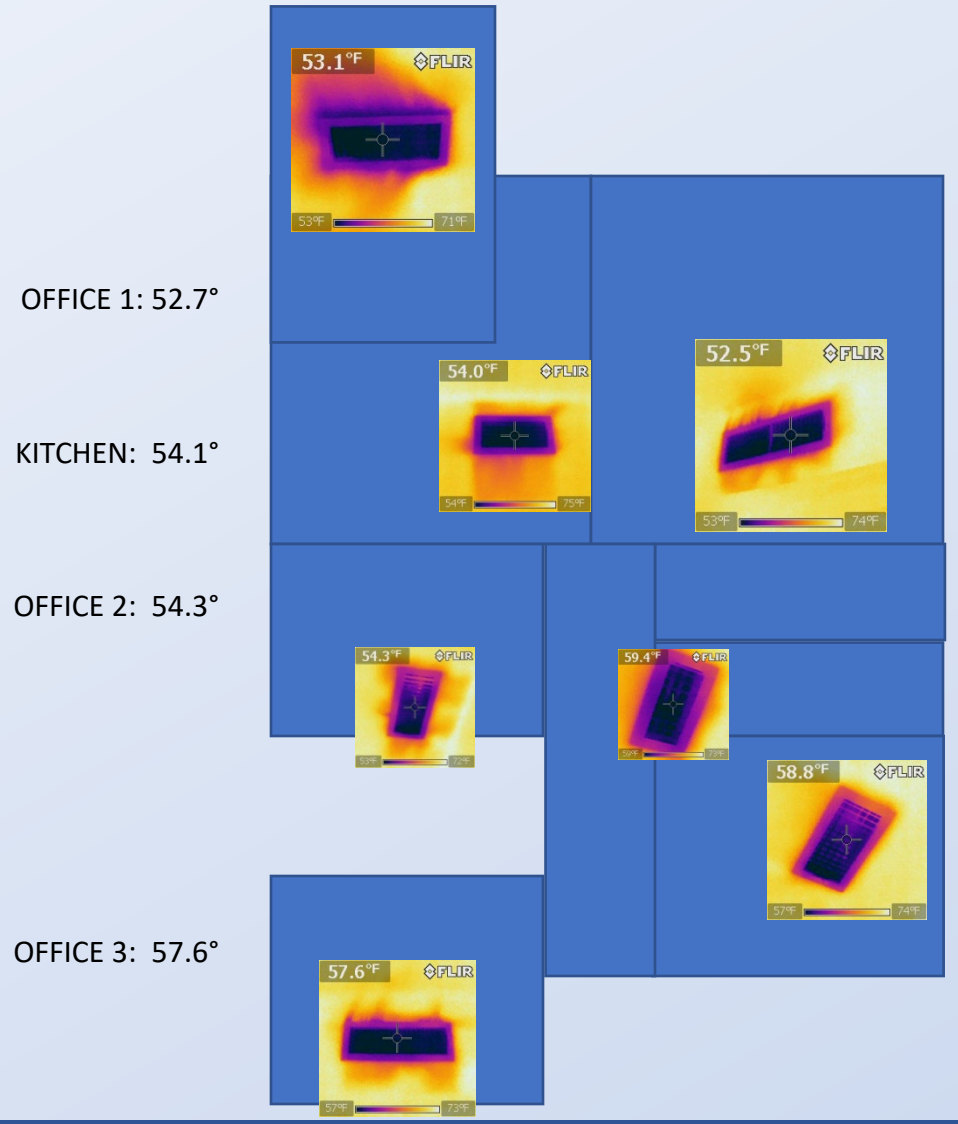


- INFRARED CAMERA
- MONOMETER: Pressure Changes
- SMOKE TESTER: Pressurize home view smoke where leakage is



TESTING

- MEASURE DUCT TEMPS by ROOM. Changes over 5° often indicate duct leakage
- PRESSURE CHANGES BY ROOM
- SINGLE CHANNEL MONOMETER
- SMOKE TESTING Suspected locations



OFFICE 1: 52.7°

MEETING 52.7°

KITCHEN: 54.1°

OFFICE 2: 54.3°

OFFICE 4&5 58.6°

BOARD ROOM 58.8°

OFFICE 3: 57.6°

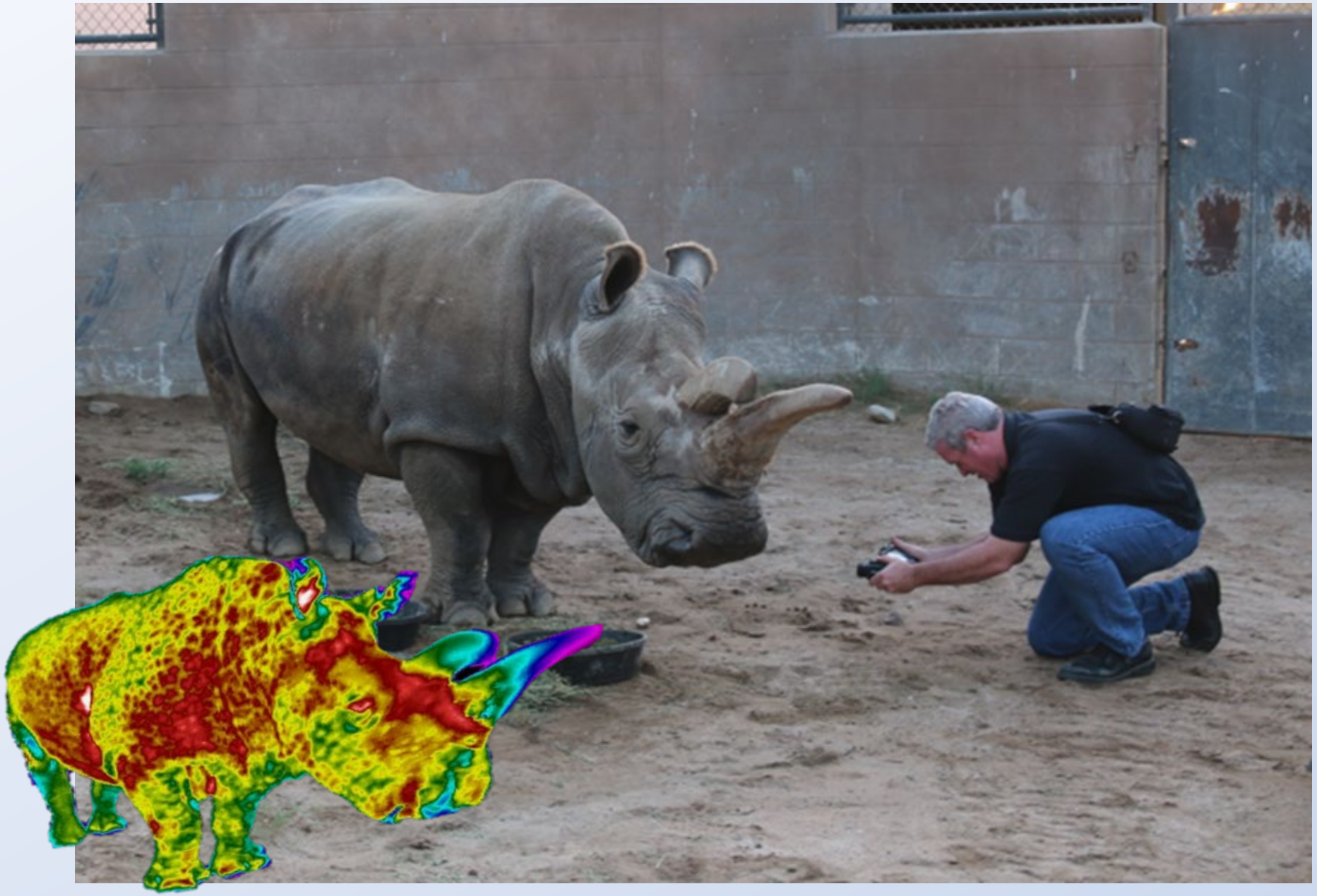
Thermal Imaging and Blower Doors?

- Thermal Imaging and Blower Doors
  - NO LICENSE REQUIRED and SAFE to OPERATE
    - Training won't hurt and is recommended so you don't GET "EGO" HURT!.
    - DOES NOT SEE THROUGH WALLS!

- Summary
  - *A blower door test is crucial for a successful radon mitigation approach because it helps a professional understand the specific air leakage pathways and the overall airtightness of a house. It can also confirm results once mitigation efforts are completed.*


Any
Questions?

RISKY BUSINESS ?



I hope this presentation was enlightening to your business and helps you understand some of the many ways you can utilize thermal imaging for your business.

- **www.unitedinfrared.com**
- ***Nationwide Service!***
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