EEBA
Energy & Environmental Building Alliance

Joe Medosch

How Can Low-Cost IAQ Monitors Benefit Builders and Contractors

HAYWARD™ SCORE
SO YOU CAN FEEL BETTER

Joe Medosch

Healthy Building Scientist

House Type

Occupant Behaviors

Occupant
Health Symptoms

Determine if your home is impacting your health!

Special Thanks

Linda Wigington
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HVAC School
www.hvacrschool.com/

Brett Singer and Woody Delp
Lawrence Berkley Laboratory

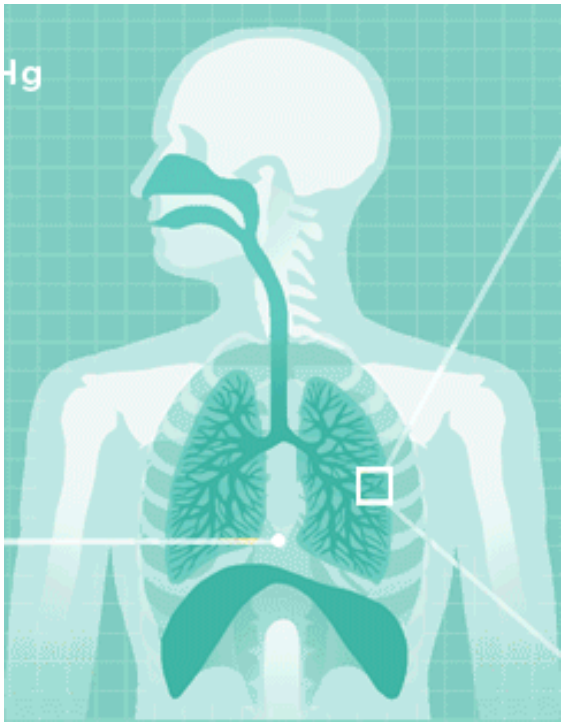
Low-Cost IAQ (Indoor Air Quality) Monitors

- Options for contractors
- Less optiuons for builders
- General overview of monitors and accuracy
- Criteria for monitoring IAQ
- Inherent challenges with low-cost devices
- Third Party evaluations and standard for monitors
- What is next for IAQ monitors and improving IAQ

Occupant is the IAQ Receptor

What are you breathing?

10’ x 10’ x 4’

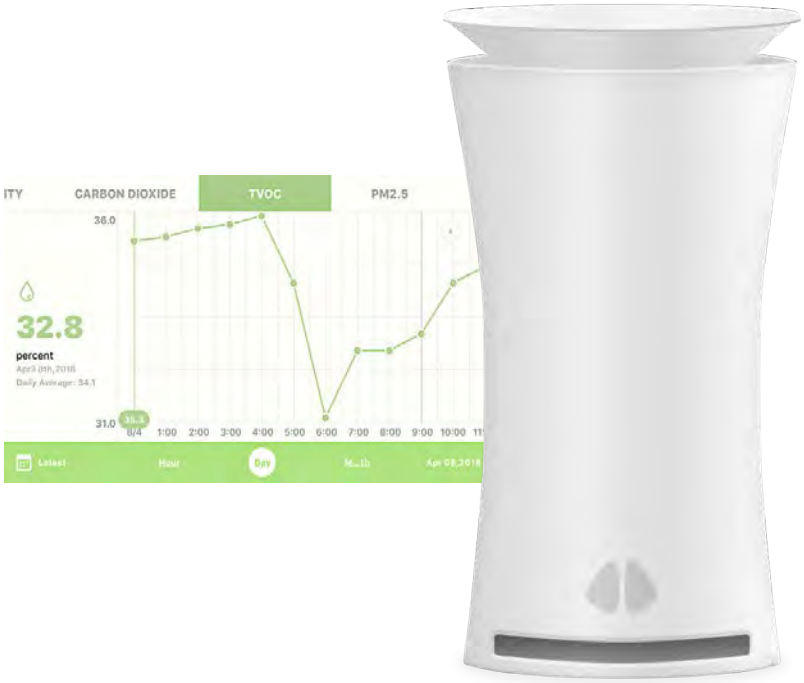


3000 gallons of air every day.

Animation source: http://noticing.co/how-insects-breathe/#

The Original IAQ Monitors

Foobot
PM 2.5, Temperature, Humidity, Total VOCs, Carbon Dioxide



uHoo
PM 2.5, Temperature, Humidity, Total VOCs, Carbon Dioxide, CO, Ozone, NO2, Barometric Pressure

Multiple devices

Consumer IAQ Monitors

Trend Indicators

What do want to use the IAQ monitor for?

- Measure what conditions / ?
- Where in the house?
- How long is it measuring? When?
- How will you get the data or share it?
- How will you know what occurred in the home?
    - cooking / showers

If you had a doctor visit that was 3 minutes – do you feel it would be a thorough evaluation?

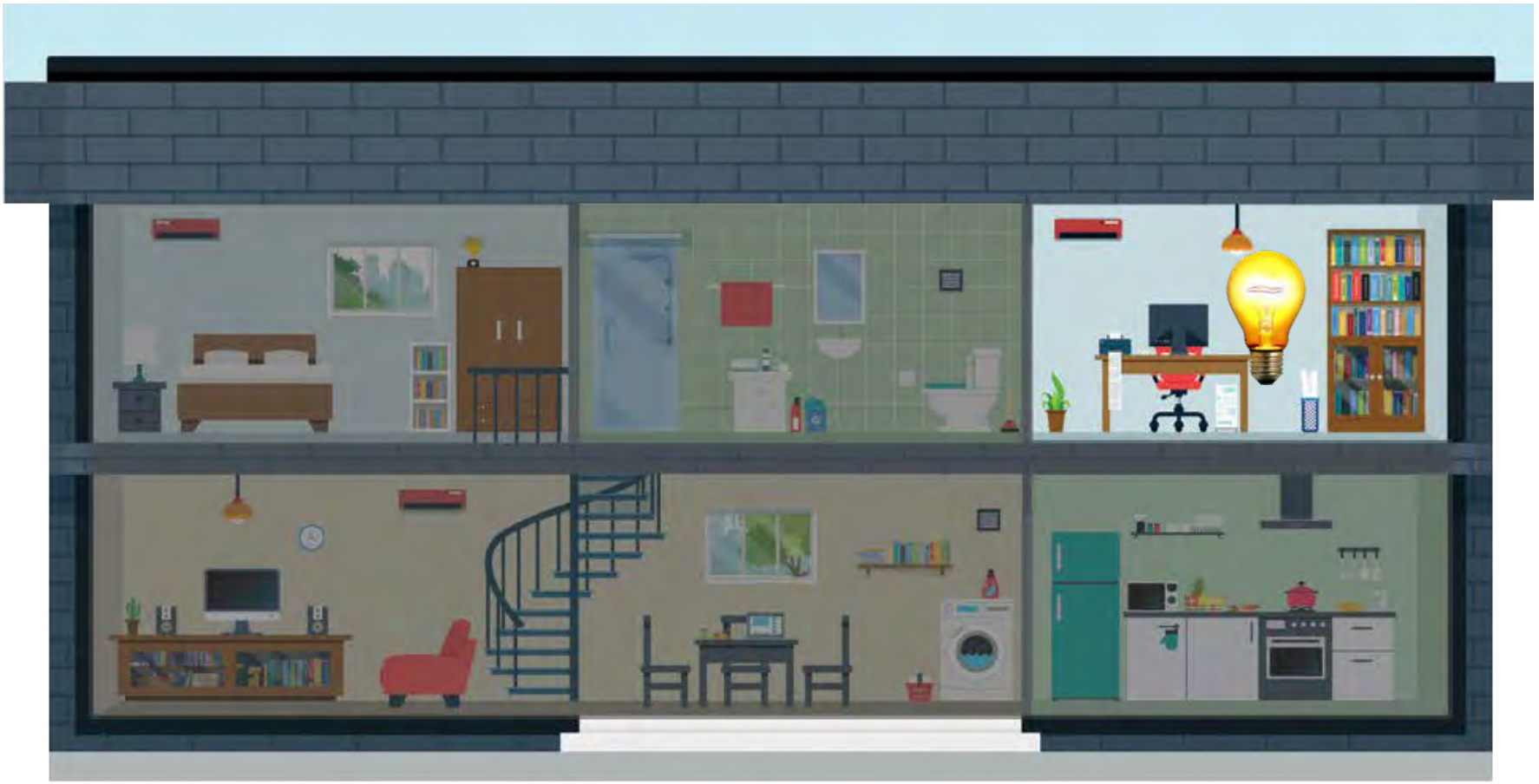
Consumer IAQ Monitors

at that time

Trend Indicators

in that location

IAQ Monitor =

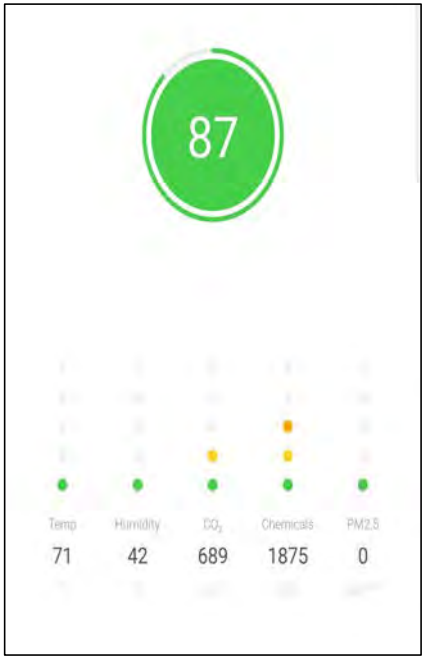


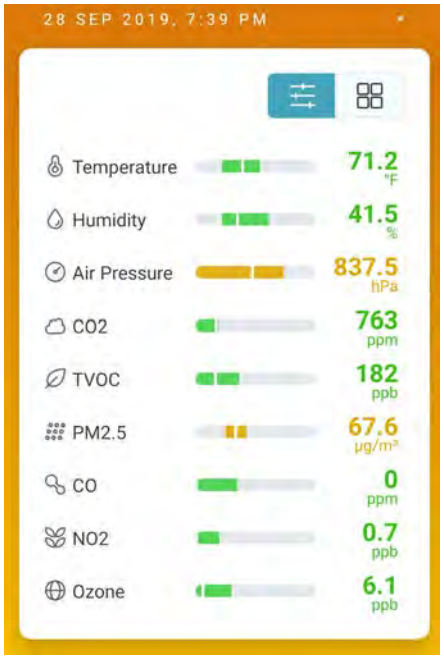
Consumer IAQ Monitors

Blood Test Results

Blood Test	Result	Normal Value
WBCs (billion/L)	8.00	3.5 to 10.5
Neutrophils (%)	62	40 to 70
Lymphocytes (%)	28	25 to 45
Monocytes (%)	10	2 to 8
Eosinophils (%)	1	1 to 5
Basophils (%)	0	0 to 1
RBCs (trillion/L)	3.84	4.3 to 5.7
Hb (g/dL)	11.7	13 to 17
Hematocrit (%)	37	37 to 52
Platelets (billion/L)	262	150 to 450

IAQ Monitor Results





Multiple devices that measure multiple conditions

- Temperature & Humidity - some Dew Point
- CO – carbon monoxide - ppm
- Radon - pCi/L
- PM Particle count/mass – PM 1, 2.5, 10
- tVOC – total volatile organic compounds
- - Formaldehyde
- CO2 - carbon monoxide – **have a direct CO2 sensor**
- Ozone
- Air Pressure / Barometer
- Ambient light – lux and or Sound - dBA

Trend Indicators

Multiple devices that measure multiple conditions

- **Temperature & Humidity** - some Dew Point
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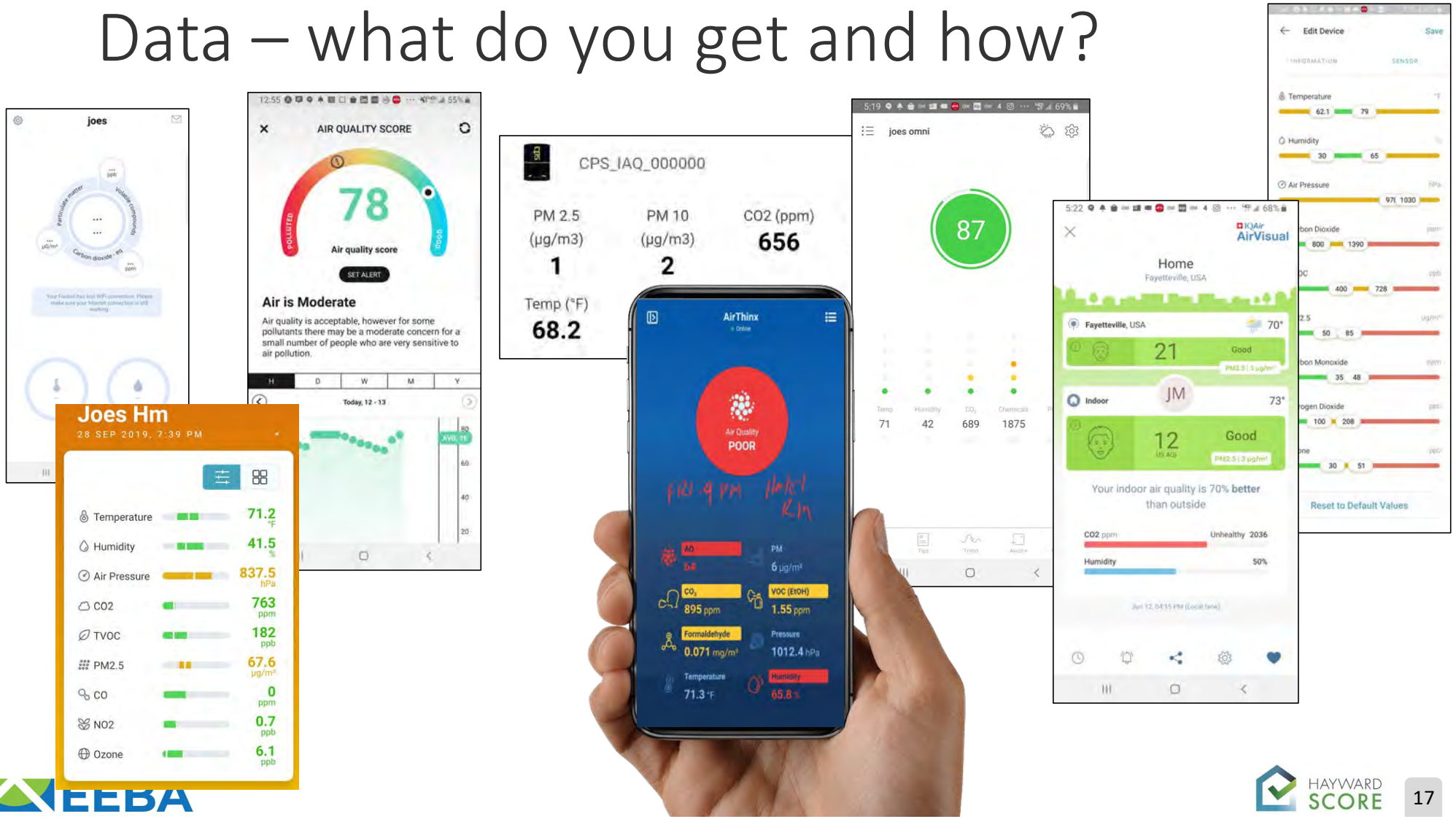
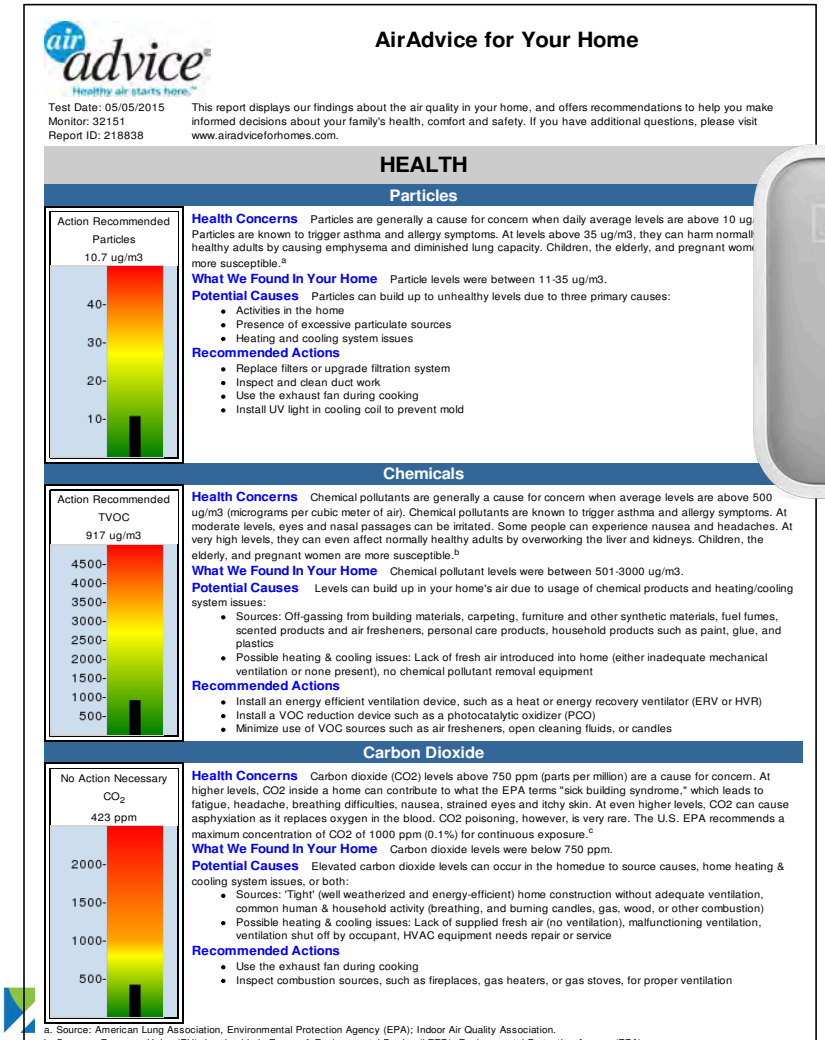
- tVOC – total volatile organic compounds
- - Formaldehyde
- **CO2 - carbon dioxide** – **have a direct CO2 sensor**
- Ozone
- Air Pressure / Barometer
- Ambient light – lux and or Sound - dBA

These Are Most Consistent & Stable Readings

Data – what do you get and how?



Data – what do you get and how?



air advice
Healthy air starts here.

AirAdvice for Your Home

Test Date: 05/05/2015
Monitor: 32151
Report ID: 218838

This report displays our findings about the air quality in your home, and offers recommendations to help you make informed decisions about your family's health, comfort and safety. If you have additional questions, please visit www.airadviceforhomes.com.

HEALTH

Particles

Action Recommended
Particles
10.7 ug/m3

40
30
20
10

Health Concerns Particles are generally a cause for concern when daily average levels are above 10 ug
Particles are known to trigger asthma and allergy symptoms. At levels above 35 ug/m3, they can harm normall
healthy adults by causing emphysema and diminished lung capacity. Children, the elderly, and pregnant wom
more susceptible.[a]

What We Found In Your Home Particle levels were between 11-35 ug/m3.

Potential Causes Particles can build up to unhealthy levels due to three primary causes:

- Activities in the home
- Presence of excessive particulate sources
- Heating and cooling system issues

Recommended Actions

- Replace filters or upgrade filtration system
- Inspect and clean duct work
- Use the exhaust fan during cooking
- Install UV light in cooling coil to prevent mold

Chemicals

Action Recommended
TVOC
917 ug/m3

4500
4000
3500
3000
2500
2000
1500
1000
500

Health Concerns Chemical pollutants are generally a cause for concern when average levels are above 500 ug/m3 (micrograms per cubic meter of air). Chemical pollutants are known to trigger asthma and allergy symptoms. At moderate levels, eyes and nasal passages can be irritated. Some people can experience nausea and headaches. At very high levels, they can even affect normally healthy adults by overworking the liver and kidneys. Children, the elderly, and pregnant women are more susceptible.[b]

What We Found In Your Home Chemical pollutant levels were between 501-3000 ug/m3.

Potential Causes Levels can build up in your home's air due to usage of chemical products and heating/cooling system issues:

- Sources: Off-gassing from building materials, carpeting, furniture and other synthetic materials, fuel fumes, scented products and air fresheners, personal care products, household products such as paint, glue, and plastics
- Possible heating & cooling issues: Lack of fresh air introduced into home (either inadequate mechanical ventilation or none present), no chemical pollutant removal equipment

Recommended Actions

- Install an energy efficient ventilation device, such as a heat or energy recovery ventilator (ERV or HVR)
- Install a VOC reduction device such as a photocatalytic oxidizer (PCO)
- Minimize use of VOC sources such as air fresheners, open cleaning fluids, or candles

Carbon Dioxide

No Action Necessary
CO_2
423 ppm

2000
1500
1000
500

Health Concerns Carbon dioxide (CO2) levels above 750 ppm (parts per million) are a cause for concern. At higher levels, CO2 inside a home can contribute to what the EPA terms "sick building syndrome," which leads to fatigue, headache, breathing difficulties, nausea, strained eyes and itchy skin. At even higher levels, CO2 can cause asphyxiation as it replaces oxygen in the blood. CO2 poisoning, however, is very rare. The U.S. EPA recommends a maximum concentration of CO2 of 1000 ppm (0.1%) for continuous exposure.[c]

What We Found In Your Home Carbon dioxide levels were below 750 ppm.

Potential Causes Elevated carbon dioxide levels can occur in the homedue to source causes, home heating & cooling system issues, or both:

- Sources: 'Tight' (well weatherized and energy-efficient) home construction without adequate ventilation, common human & household activity (breathing, and burning candles, gas, wood, or other combustion)
- Possible heating & cooling issues: Lack of supplied fresh air (no ventilation), malfunctioning ventilation, ventilation shut off by occupant, HVAC equipment needs repair or service

Recommended Actions

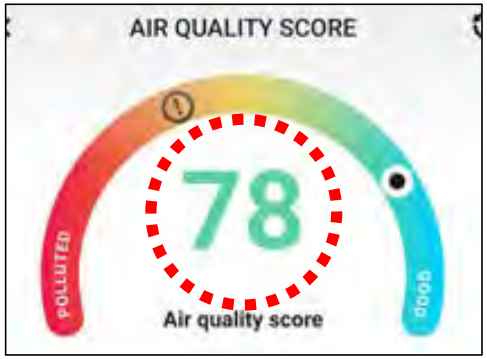
- Use the exhaust fan during cooking
- Inspect combustion sources, such as fireplaces, gas heaters, or gas stoves, for proper ventilation

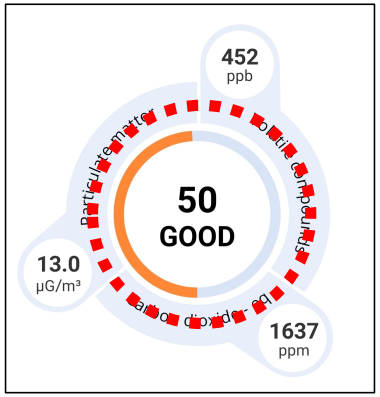
a. Source: American Lung Association, Environmental Protection Agency (EPA); Indoor Air Quality Association.

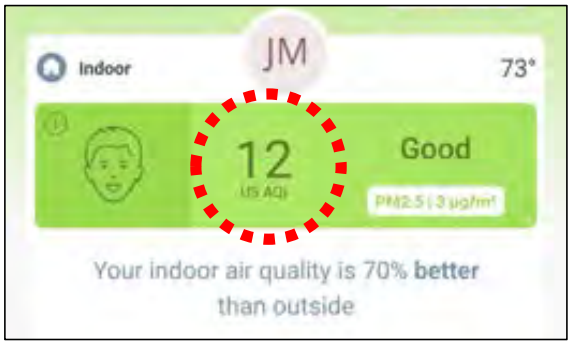
IAQ Monitors – **Data** 1, 2, 3...

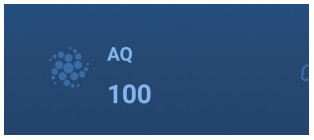
- The device measures the data...
- Where is it stored?
  - On the device?
  - In the cloud?
  - Do you own the data if you terminate the contract?
- Who has access to the data – Manufacturer?
  - GEO location!

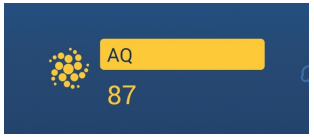
What is an AQ – Manufacturer's Air Quality Index Score Number

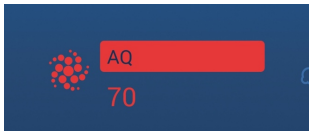


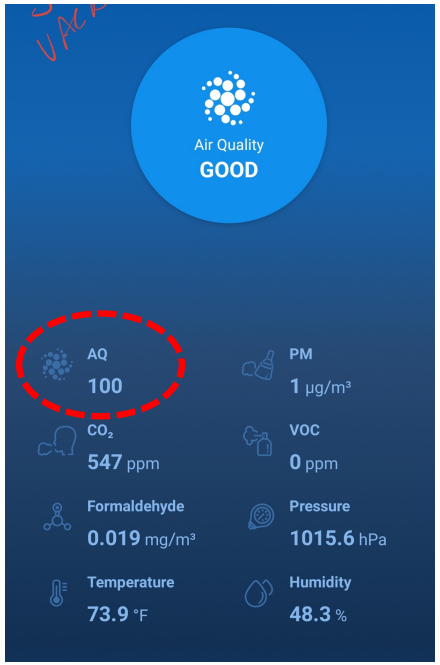


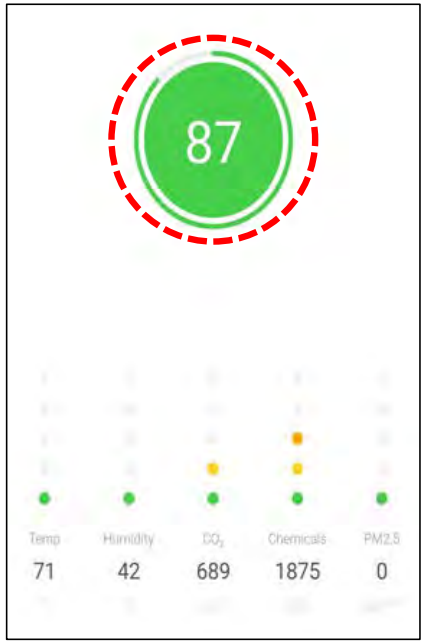










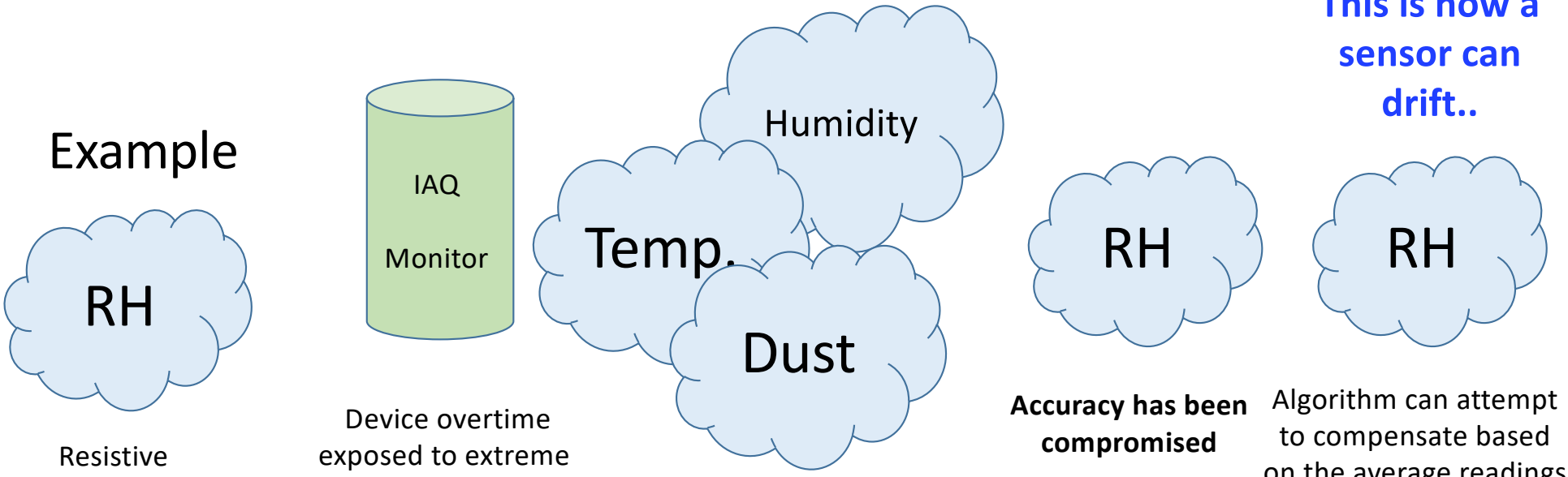


Same Sensor – different readings

- Most use same sensors – Plantower or Honeywell
- - May be customized for each manufacturer
- Sensor is integrated with the device
- - Soldering and additional electronics
- Typically only one sensor – accuracy can be questionable
- Sensors can get clogged with what your measuring

Same Sensor – different readings

- Some devices try to self correct
- This could cause the sensor to drift over time

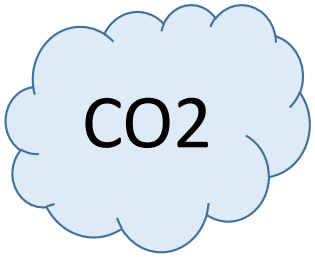


Same Sensor – different readings

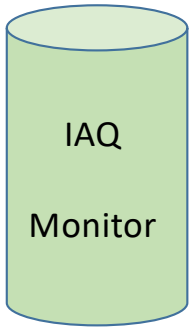
- Some devices try to self correct
- This could cause the sensor to drift over time

This is how a sensor can drift..

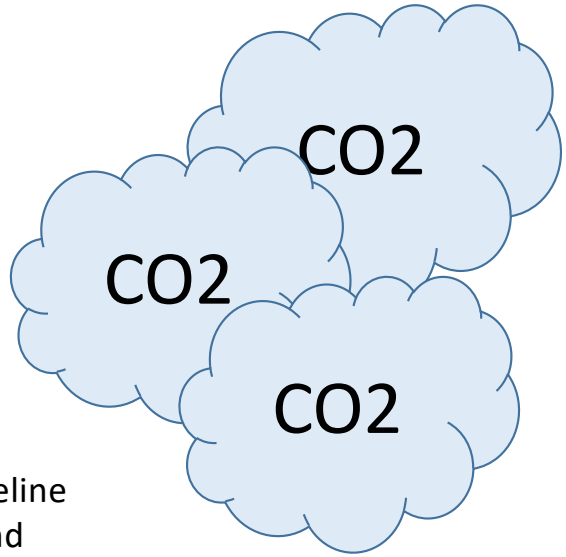
Example



Relative humidity is based on an outdoor baseline

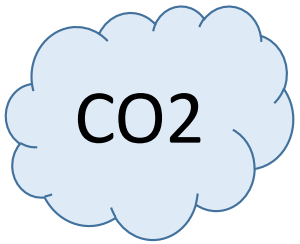


Device has a baseline of 400 ppm and measures the increase and decrees of CO2

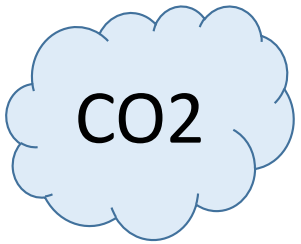


Algorithm after 7 days
It will assume the lowest value is Outdoors

7 day average is 450 ppm



Now it shifts the baseline and all the reading
Shift Down



7 days later the process is readjusted
Always comparing the last 7 days to the baseline.

This average may not be your conditions

EEBA

Prefer non-dispersive NDIR sensor

HAYWARD SCORE

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

www.aqmd.gov/aq-spec

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EEBA


FabLab - Smart Citizen Kit V2.1


Foobot


PurpleAir PA-II


PurpleAir PA-I-Indoor


Dylos - DC1700-PM

2B Technologies - POM


Acrobotic - Smart Citizen Kit


HabitatMap - AirBeam


HabitatMap - AirBeam2


RTI - MicroPEM


SainSmart - Pure Morning P3


Edimax - EdiGreen Home


Aeroqual - S500 (OZU 0-0.15)


Aeroqual - S500-PM


Hanvon-N1


IQAir - AirVisual Pro


Samyoung S&C - SY-DS-DK3


Sensirion - Nubo

Kaiterra - Laser Egg 2+

Kunak - Air A10

Sensirion - SPS30 Eval Kit


Shinyei - PM Evaluation Kit

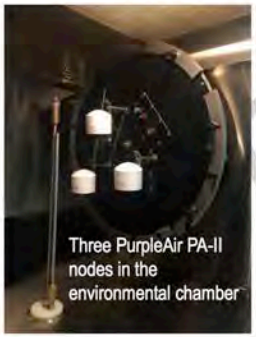
AQ-SPEC

Air Quality Sensor Performance Evaluation Center

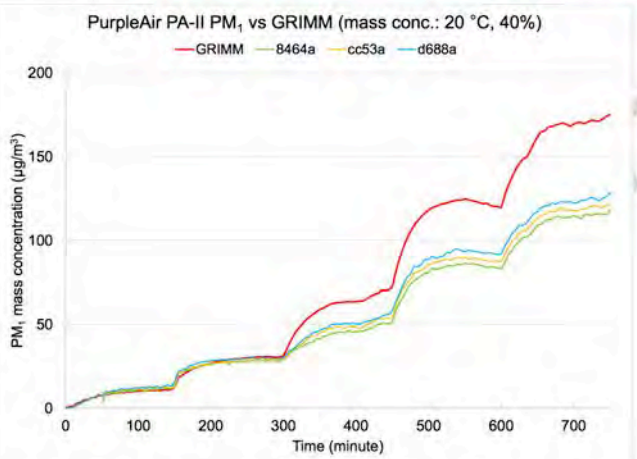
www.aqmd.gov/aq-spec

Evaluation results guideline

- PurpleAir PA-II *vs* GRIMM PM_1 mass concentration
- PurpleAir PA-II *vs* GRIMM $PM_{2.5}$ mass concentration
- PurpleAir PA-II *vs* APS *vs* GRIMM PM_{10} mass concentration

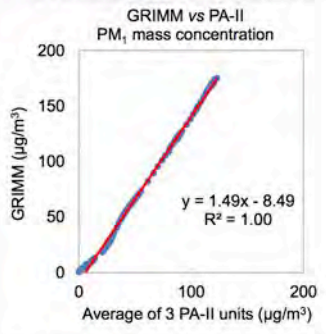

Three PurpleAir PA-II nodes in the environmental chamber

PA-II vs GRIMM (PM_1 mass; 5-min mean)



- Over the full PM_1 concentration range tested (0-175 µg/m³), the three PA-II sensors tracked well with the concentration variation recorded by GRIMM.

Coefficient of Determination



- PA-II sensors showed very strong correlations with GRIMM PM_1 mass conc. ($R^2 > 0.99$) between 0-175 µg/m³.
- PA-II sensors underestimated the GRIMM PM_1 mass conc.

RESET™

The intent of the RESET™ Air Test Procedure for Accredited Monitors is to:

- Evaluate monitor quality via a singular, standardized test protocol
- Standardization of the test methodologies and protocols as outlined, ensuring consistent replicability in laboratories, irrespective of geographic location.

Accredited monitors

- A Grade = Reference
- B Grade = Commercial
- C Grade = Consumer

- Particulate Matter 2.5 (PM2.5)
- Total Volatiles Organic Compounds (TVOC)
- Carbon Dioxide (CO2)
- Temperature
- Humidity

RESET™

RESET™ Air Accredited Monitors are defined and categorized by both Grade and Type. Monitor Grade defines the performance, accuracy and data reporting proficiency of a monitoring device. Monitor Type defines the “fit for purpose” scenarios applicable to each Grade and serves to define appropriate deployment of monitoring devices.

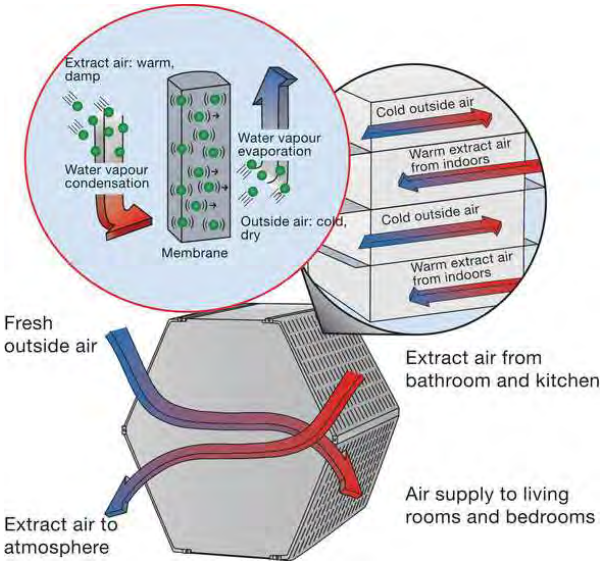
The RESET™ Air Accredited Monitor Grades include:

Grade A: Calibration Grade monitors. Monitors that are used for the calibration of Grade B and C monitors. Grade A monitors are typically (but not exclusively) handheld and are primarily utilized for project commissioning, site audits, and pollutant source detection.

Grade B: Commercial Grade monitors. Grade B monitors provide actionable, indoor air quality data at scale within buildings, balancing performance and cost while reliably enabling building automation and providing occupants with high-quality data.

Grade C: Consumer Grade monitors. Grade C monitors are affordable to the average user or “citizen scientist”. Primarily utilized for personal data gathering or non-scientific purposes.

Contractors



What do want to use the IAQ monitor for?

- Measure what conditions ? General conditions or ???
- Where in the house? Set a schedule for clients to relocate
  - more than 1 monitor? the monitor and document location & time
- How long is it measuring? When? 3 work days + weekend min.
  2 weeks +
- How will you get the data or share it? Send report / share data
- How will you know what occurred in the home?
  - windows open? / cooking / showers Clients keep a journal?

Role of the contractor and role of the device

- Do you let the client see the measurements?
  - does a device have a display?
  - is it better to hide this information or let them see it?
- What is the data really mean as actionable items
  - are there thresholds for these readings
- What are these devices telling you?
  - conditions and materials in the home,
  - their habits

Role of the contractor and role of the device

This is the ultimate engagement tool.

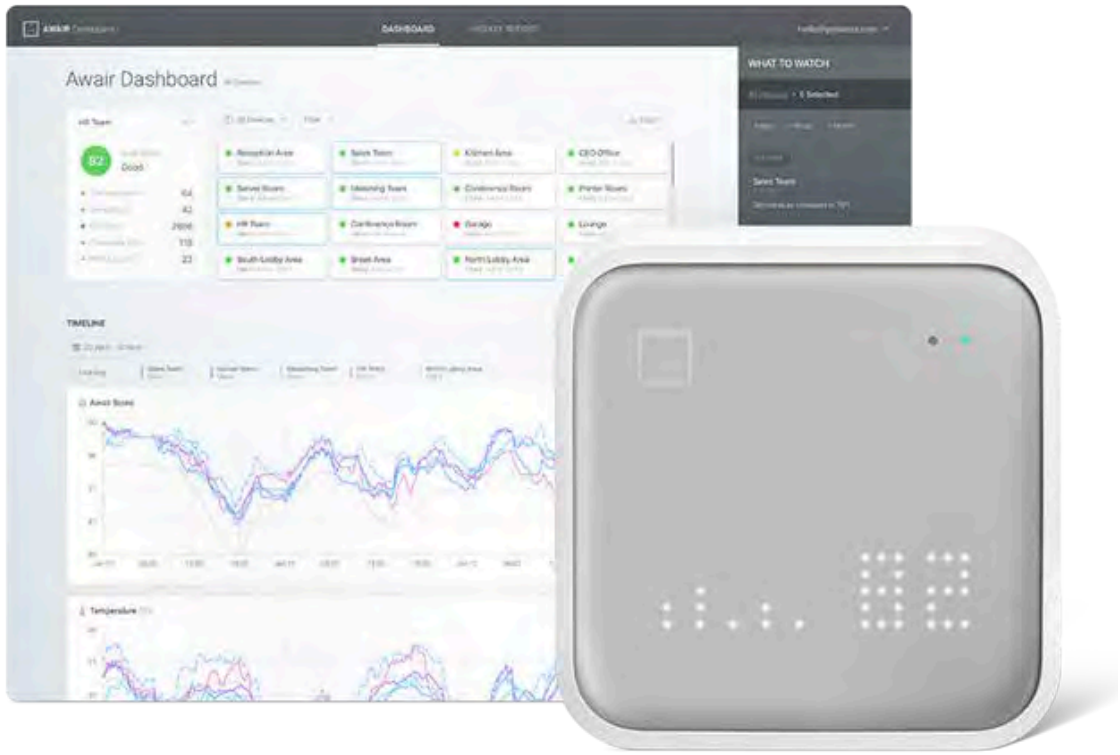
It is useless unless you the contractor

fully engage the client.

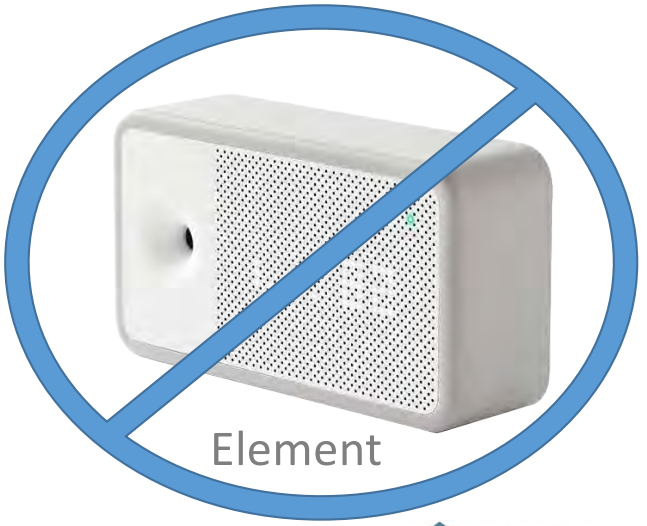
The success of the IAQ monitor is dependent on the contractor – more than the device, or the client.

Recommended - share one with technicians and staff.

AWAIR Omni

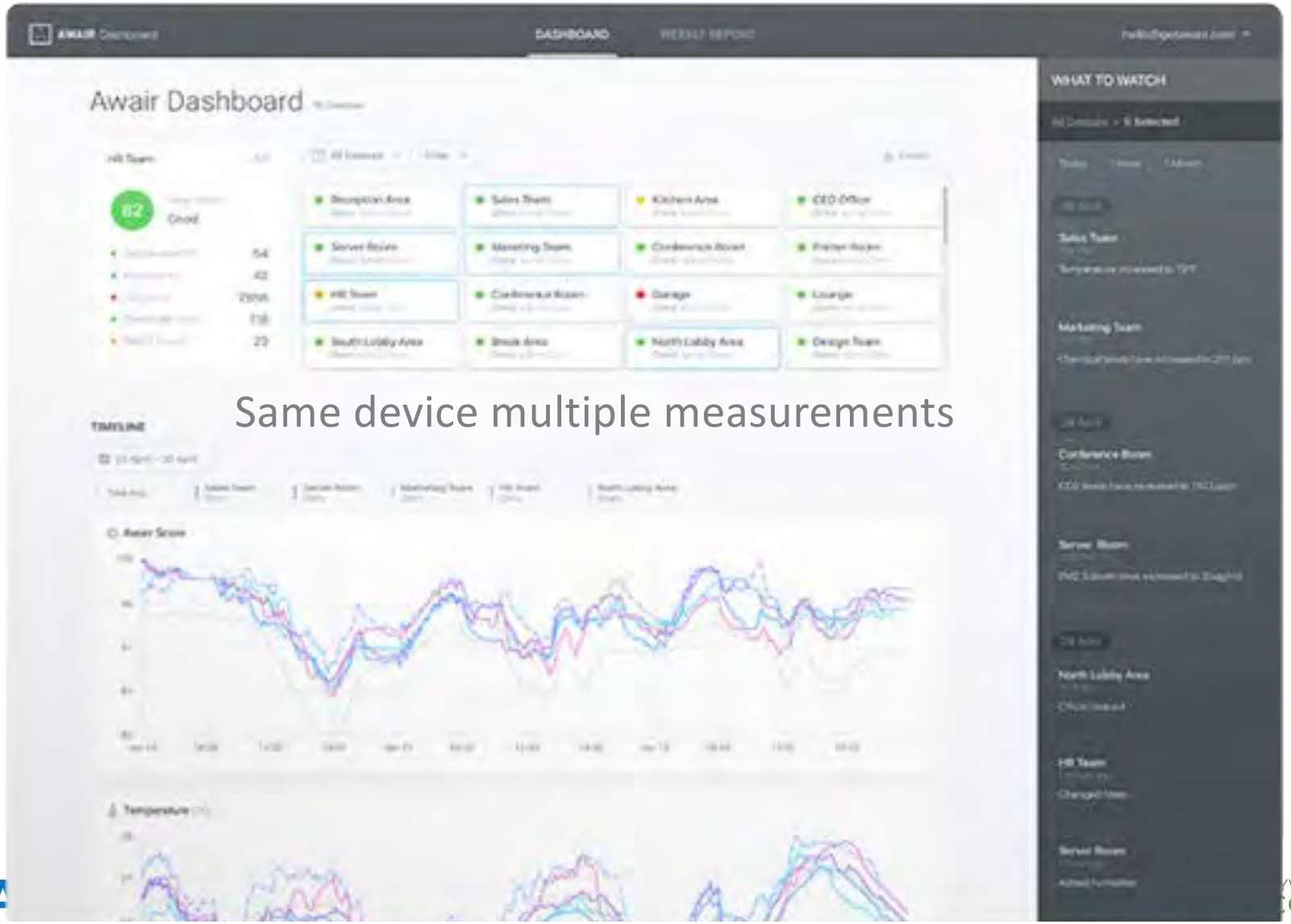


Includes internal battery



Front indicator lights display conditions.
Fully customizable

AWAIR
Omni


DASHBOARD
Awair Dashboard
WHAT TO WATCH
Same device multiple measurements

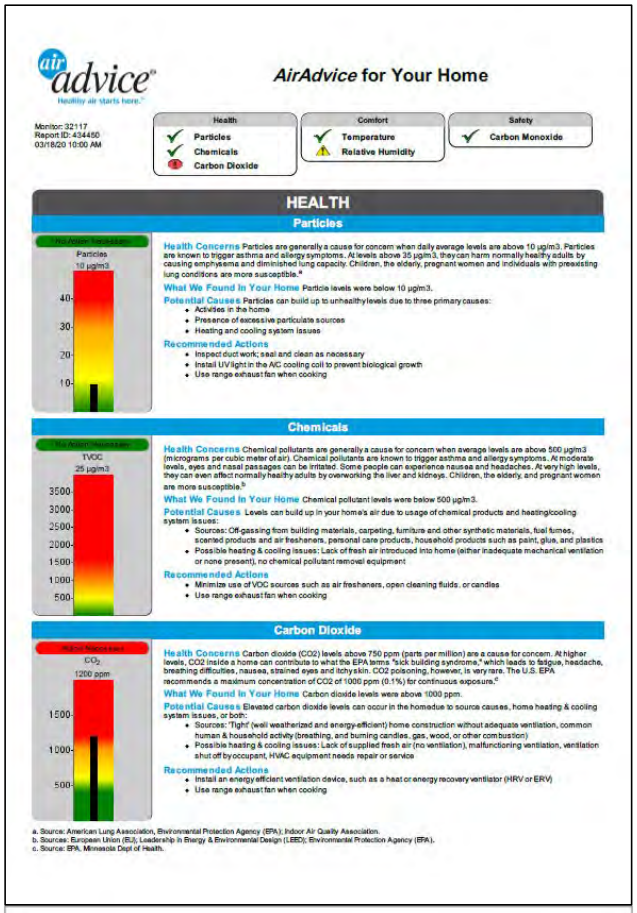
The M5200 IAQ Monitor from AirAdvice
A Complete Report in 30 Minutes

Plug in the power cord.

An email is sent to the Technician in 30 minutes.

Test for Opportunities on Every Call!

The AirAdvice 30- min. *FlashReport*



AirAdvice for Your Home

Monitor: 32117
Report ID: 434450
03/18/20 10:00 AM

Health	Comfort	Safety
✓ Particles	✓ Temperature	✓ Carbon Monoxide
✓ Chemicals	⚠ Relative Humidity	
! Carbon Dioxide		

HEALTH

Particles

Particles
10 µg/m3

Health Concerns Particles are generally a cause for concern when daily average levels are above 10 µg/m3. Particles are known to trigger asthma and allergy symptoms. At levels above 35 µg/m3, they can harm normally healthy adults by causing emphysema and diminished lung capacity. Children, the elderly, pregnant women and individuals with preexisting lung conditions are more susceptible.[a]

What We Found In Your Home Particle levels were below 10 µg/m3.

Potential Causes Particles can build up to unhealthy levels due to three primary causes:
- Activities in the home
- Presence of excessive particulate sources
- Heating and cooling system issues

Recommended Actions
- Inspect duct work; seal and clean as necessary
- Install UV light in the A/C cooling coil to prevent biological growth
- Use range exhaust fan when cooking

Chemicals

TVOC
25 µg/m3

Health Concerns Chemical pollutants are generally a cause for concern when average levels are above 500 µg/m3 (micrograms per cubic meter of air). Chemical pollutants are known to trigger asthma and allergy symptoms. At moderate levels, eyes and nasal passages can be irritated. Some people can experience nausea and headaches. At very high levels, they can even affect normally healthy adults by overworking the liver and kidneys. Children, the elderly, and pregnant women are more susceptible.[b]

What We Found In Your Home Chemical pollutant levels were below 500 µg/m3.

Potential Causes Levels can build up in your home's air due to usage of chemical products and heating/cooling system issues:
- Sources: Off-gassing from building materials, carpeting, furniture and other synthetic materials, fuel fumes, scented products and air fresheners, personal care products, household products such as paint, glue, and plastics
- Possible heating & cooling issues: Lack of fresh air introduced into home (either inadequate mechanical ventilation or none present), no chemical pollutant removal equipment

Recommended Actions
- Minimize use of VOC sources such as air fresheners, open cleaning fluids, or candles
- Use range exhaust fan when cooking

Carbon Dioxide

CO_2
1200 ppm

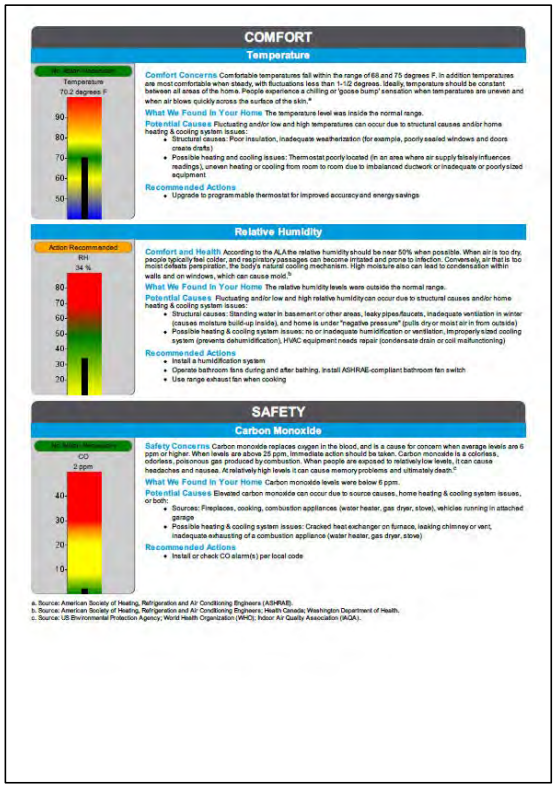
Health Concerns Carbon dioxide (CO_2) levels above 750 ppm (parts per million) are a cause for concern. At higher levels, CO_2 inside a home can contribute to what the EPA terms "sick building syndrome," which leads to fatigue, headache, breathing difficulties, nausea, strained eyes and itchy skin. CO_2 poisoning, however, is very rare. The U.S. EPA recommends a maximum concentration of CO_2 of 1000 ppm (0.1%) for continuous exposure.[c]

What We Found In Your Home Carbon dioxide levels were above 1000 ppm.

Potential Causes Elevated carbon dioxide levels can occur in the homedue to source causes, home heating & cooling system issues, or both:
- Sources: 'Tight' (well weatherized and energy-efficient) home construction without adequate ventilation, common human & household activity (breathing, and burning candles, gas, wood, or other combustion)
- Possible heating & cooling issues: Lack of supplied fresh air (no ventilation), malfunctioning ventilation, ventilation shut off by occupant, HVAC equipment needs repair or service

Recommended Actions
- Install an energy efficient ventilation device, such as a heat or energy recovery ventilator (HRV or ERV)
- Use range exhaust fan when cooking

a. Source: American Lung Association, Environmental Protection Agency (EPA); Indoor Air Quality Association.
b. Source: European Union (EU); Leadership in Energy & Environmental Design (LEED); Environmental Protection Agency (EPA).
c. Source: EPA, Minnesota Dept of Health.



COMFORT

Temperature

Temperature
70.2 degrees F

Comfort Concerns Comfortable temperatures fall within the range of 68 and 75 degrees F. In addition temperatures are most comfortable when steady, with fluctuations less than 1-1/2 degrees. Ideally, temperature should be constant between all areas of the home. People experience a chilling or "goose bump" sensation when temperatures are uneven and when air blows quickly across the surface of the skin.[a]

What We Found In Your Home The temperature level was inside the normal range.

Potential Causes Fluctuating and/or low and high temperatures can occur due to structural causes and/or home heating & cooling system issues:
- Structural causes: Poor insulation, inadequate weatherization (for example, poorly sealed windows and doors create drafts)
- Possible heating and cooling issues: Thermostat poorly located (in an area where air supply falsely influences readings), uneven heating or cooling from room to room due to imbalanced ductwork or inadequate or poorly sized equipment

Recommended Actions
- Upgrade to programmable thermostat for improved accuracy and energy savings

Relative Humidity

RH
34 %

Comfort and Health According to the ALA the relative humidity should be near 50% when possible. When air is too dry, people typically feel colder, and respiratory passages can become irritated and prone to infection. Conversely, air that is too moist defeats perspiration, the body's natural cooling mechanism. High moisture also can lead to condensation within walls and on windows, which can cause mold.[b]

What We Found In Your Home The relative humidity levels were outside the normal range.

Potential Causes Fluctuating and/or low and high relative humidity can occur due to structural causes and/or home heating & cooling system issues:
- Structural causes: Standing water in basement or other areas, leaky pipes/faucets, inadequate ventilation in winter (causes moisture build-up inside), and home is under "negative pressure" (pulls dry or moist air in from outside)
- Possible heating & cooling system issues: no or inadequate humidification or ventilation, improperly sized cooling system (prevents dehumidification), HVAC equipment needs repair (condensate drain or coil malfunctioning)

Recommended Actions
- Install a humidification system
- Operate bathroom fans during and after bathing. Install ASHRAE-compliant bathroom fan switch
- Use range exhaust fan when cooking

SAFETY

Carbon Monoxide

CO
2 ppm

Safety Concerns Carbon monoxide replaces oxygen in the blood, and is a cause for concern when average levels are 6 ppm or higher. When levels are above 25 ppm, immediate action should be taken. Carbon monoxide is a colorless, odorless, poisonous gas produced by combustion. When people are exposed to relatively low levels, it can cause headaches and nausea. At relatively high levels it can cause memory problems and ultimately death.[c]

What We Found In Your Home Carbon monoxide levels were below 6 ppm.

Potential Causes Elevated carbon monoxide can occur due to source causes, home heating & cooling system issues, or both:
- Sources: Fireplaces, cooking, combustion appliances (water heater, gas dryer, stove), vehicles running in attached garage
- Possible heating & cooling system issues: Cracked heat exchanger on furnace, leaking chimney or vent, inadequate exhausting of a combustion appliance (water heater, gas dryer, stove)

Recommended Actions
- Install or check CO alarm(s) per local code

a. Source: American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
b. Source: American Society of Heating, Refrigeration and Air Conditioning Engineers; Health Canada; Washington Department of Health.
c. Source: US Environmental Protection Agency; World Health Organization (WHO); Indoor Air Quality Association (IAQA).

- Particles
- VOCs
- CO2
- Temperature
- Relative Humidity
- CO

30 min airadvice
A healthy home starts here™

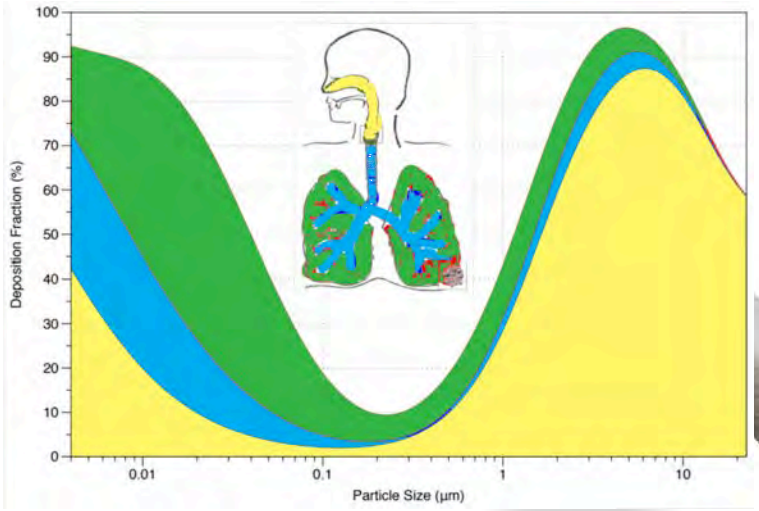
EEBA

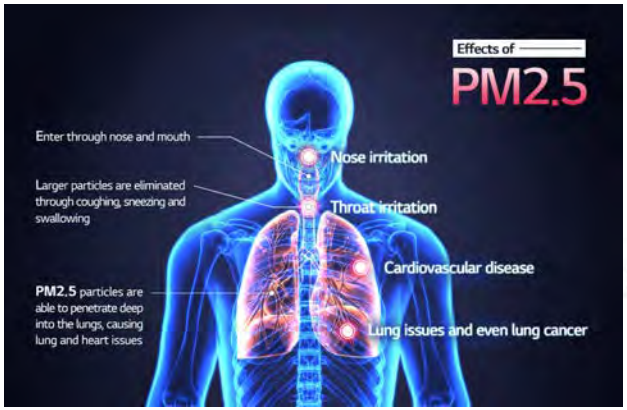
HAYWARD SCORE

What are you breathing?

*Lawrence Berkley Labs (LBL) MERV 8-13

Air Leakage / Infiltration = Exposure pathway





HUMAN HAIR
50-70 µm
(microns) in diameter

PM2.5
Combustion particles, organic compounds, metals, etc.
< 2.5 µm *(microns)* in diameter

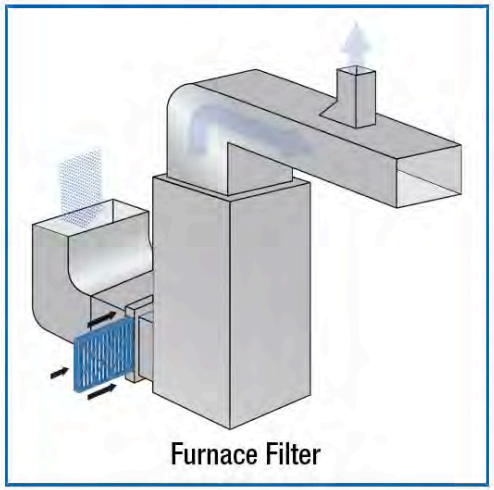
← SARS-CoV-2 0.06-0.14 µm
← Bacteria 0.5-2 µm
← Blood cell 7.5 µm

PM10
Dust, pollen, mold, etc.
<10 µm *(microns)* in diameter

90 µm *(microns)* in diameter
FINE BEACH SAND

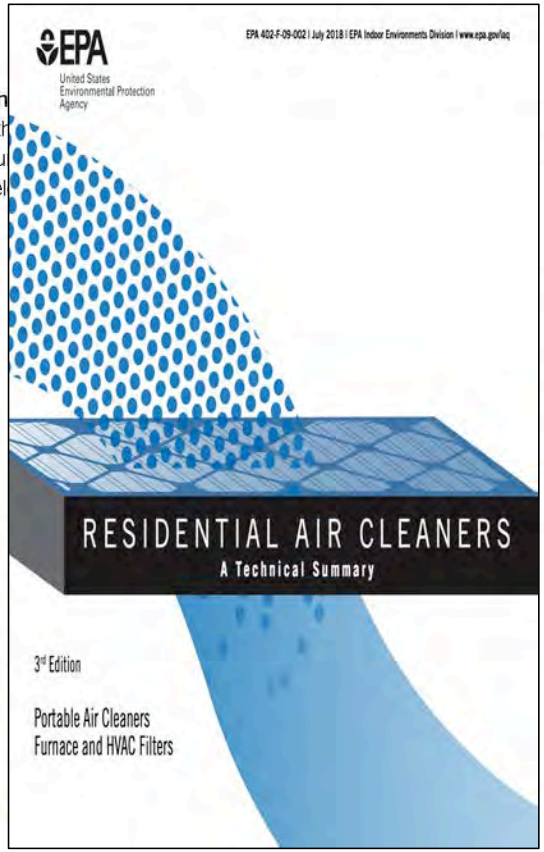
FURNACE AND HVAC SYSTEM FILTERS

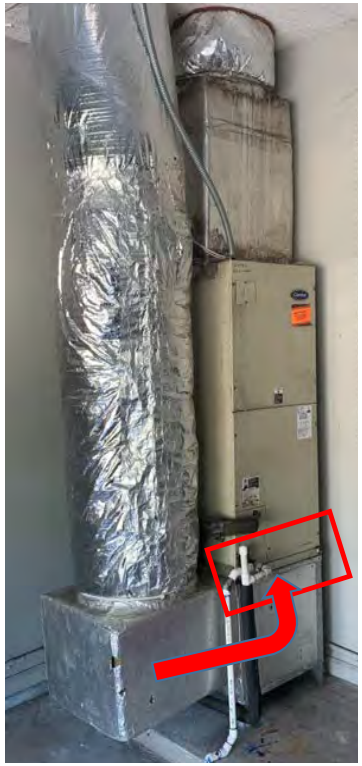
Furnace and HVAC filters work to filter the air only when
run only when heating or cooling is needed (usually less th
In order to get more filtration, the system would have to ru
practical in many cases since longer run times increase el
control during the cooling season.



Furnace Filter

Furnace or HVAC filter—Select a filter rated at least MERV 13 or as high as your system will accommodate.





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Air Handler Intervention

16x25x1 MERV 12

20x25x4 MERV 13

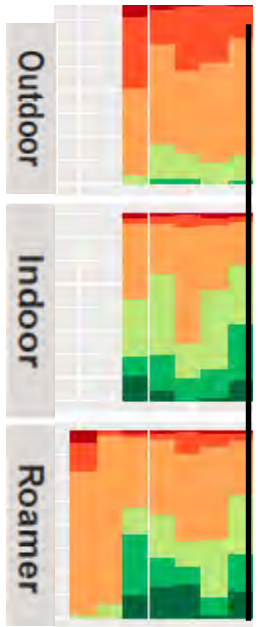
CASE STUDY: Indoor Air Quality Interventions
Chris Guignon, evolveEA

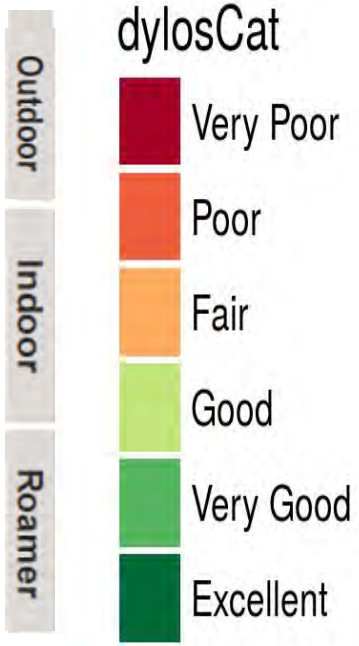
Source: Linda Wigington

24/7 Air Handler w High MERV Filter

1) Using existing 1” pleated filter

2) Return drop modification
w/ turning vanes
4”, 20”x 25” MERV 13 filter





Before

After

1

2

Date
(by periods of 3 weeks)

Dylos particles ≥0.5 µm

Source: Linda Wigington

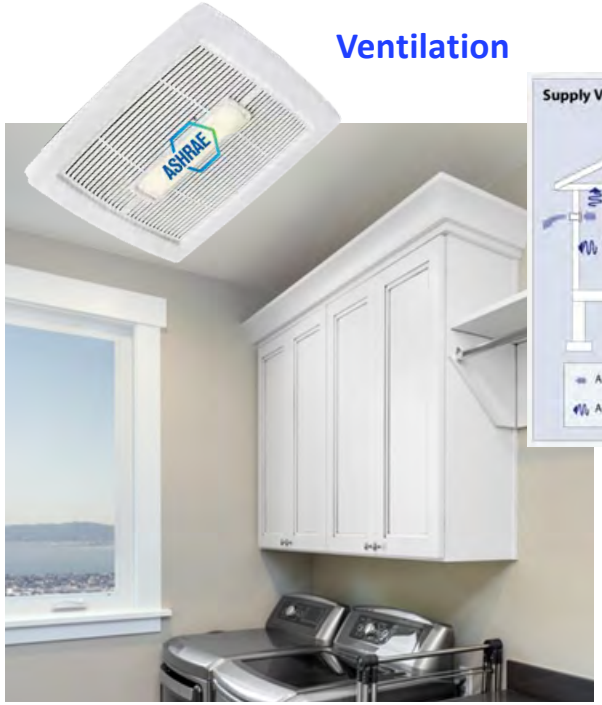
CASE STUDY: Indoor Air Quality Interventions
Chris Guignon, evolveEA

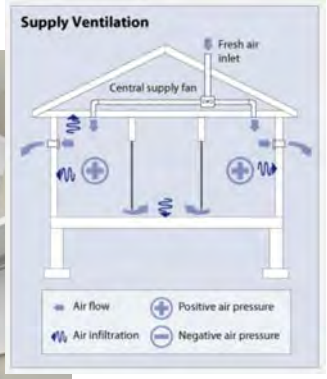
Energy Audit

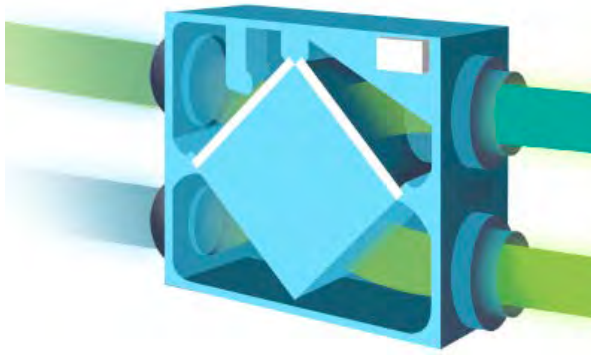
- Actually an energy penalty
- Typically Exhaust only
- Follow ASHRAE 62.2 X

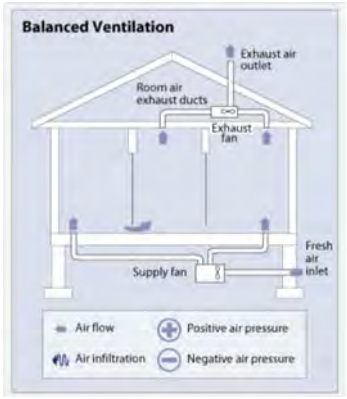
ASHRAE®

Ventilation









Healthy Home Assessment

- Balanced Ventilation has significant improvements including a reduction in respiratory triggers such as formaldehyde and other VOCs, airborne mold and phthalates, carbon dioxide as well as radon and fewer asthma/respiratory symptoms.
- And associated with lower dust mite levels.

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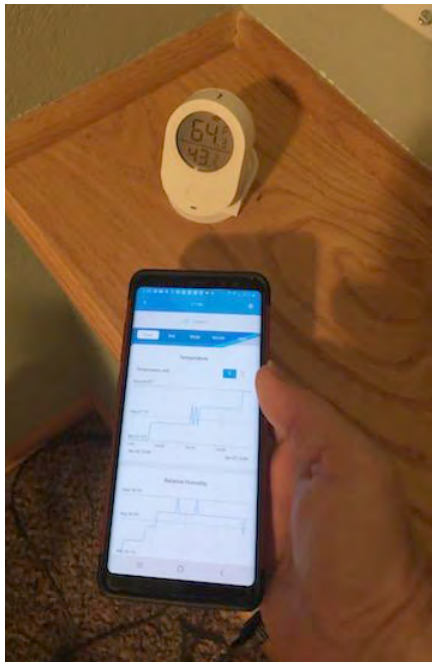
Handheld IAQ Monitors

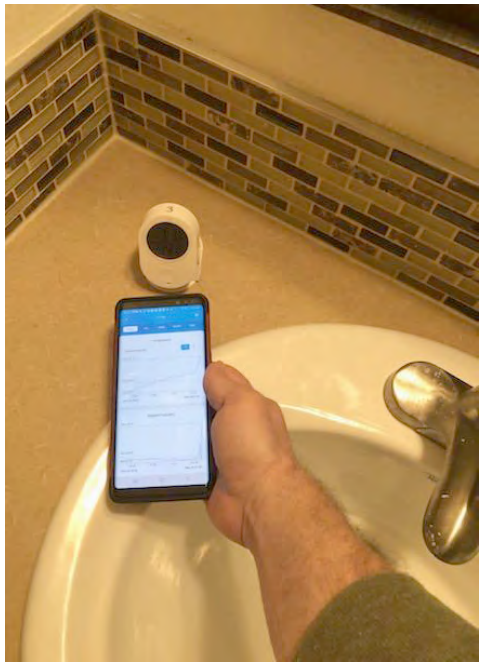
www.aeroqual.com

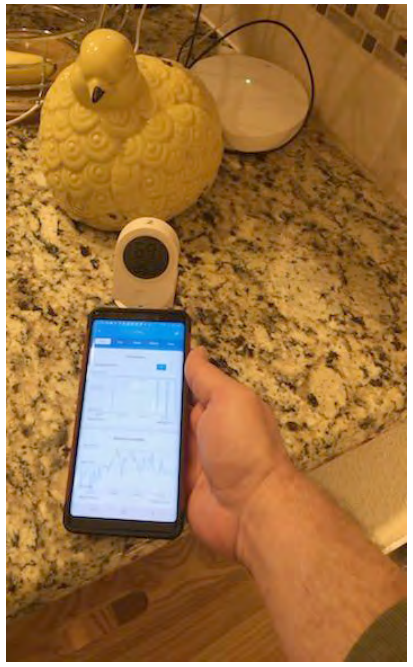
graywolfsensing.com

Virtual or Remote Diagnostics

Govee Temperature and Rh monitor and datalogger







Send to occupant. Place in different rooms, maybe move them every few days.
You arrive and read the data via Bluetooth (set it up before you sent it)

Digital Radon Detector

AirThings Corentium Home Model

Accuracy (±5%) (plus or minus 0.14 pCi/L)

Precision (2.7 pCi/L): Short term (7 days): 80+% after 1 week, Long term: 90+% after 1 month

LCD display short term 1 day and 7 days, and long term 1 year average

Radon Gas Sampling Method: Passive radon diffusion chamber

Radon Gas Detection Method: Alpha spectrometry using digital detector technology

Readout in pCi/L

Designed in Europe, and tested in Japan

Unaffected by humidity, electromagnetic interference and dust

Not universally accepted in Real Estate Transactions

Low Level CO Alarm – Perfict Gift

Low-Level Carbon Monoxide Monitor - These are Carbon Monoxide detectors that can detect and alarm at levels at 5 ppm. Other units detect when above 70ppm for 4+ hours.

Ultra Low Level Display Time:	5 ppm within 1 minute
Low Level Visual Alert Time:	9 ppm within 10 minutes, 25 ppm within 2 minutes
Low Level Audible Alert Time:	15 ppm within 60 minutes
Low Level Alarm Time:	25 ppm within 30 minutes
Mid Level Alarm Time:	50 ppm within 15 minutes
High Level Alarm Times:	100 ppm within 5 minutes; 150 ppm within 3 minutes
Visual Alert and Alarm Signals:	Current CO level detected and flashing Red Alarm LED
Display Resolution:	1 PPM
Display Accuracy:	±15%, plus ±2% each succeeding year, or 5 PPM, whichever is greater, from 20 to 500 PPM @ 50% RH, 72F ±5F

Particulate and VOC / Formaldehyde Meters

Particulate Counter

Measures Volatile Organic Compounds and CH_2O/HCHO Concentrations in Real Time

FM200: Formaldehyde Meter

VFM200: VOC/Formaldehyde Meter

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Carbon Dioxide (CO_2) Meters

Building DOCTORS.com

buildingdoctors.com

GET THE BEST INDOOR AIR QUALITY

MAKE YOUR HOUSE MORE COMFORTABLE

HELP THE ENVIRONMENT

REDUCE COSTS

HAZARDS THAT AFFECT YOUR HOME'S HEALTH & INDOOR AIR QUALITY

Did you know that according to the EPA, your indoor air might be two to five times more polluted than the air outside? This is because many homes have structural issues which allow airborne contaminants to accumulate inside the home.

Even if you give your house a deep clean on a regular basis, there could be problem areas in your house which harm your IAQ and waste valuable energy. For example:

- Air leaks let outside pollutants seep into the home
- Poor ventilation keeps stale air indoors
- Ductwork leaks let dust into your HVAC system
- Excess indoor humidity causes mold growth
- Crawl space issues send musty air throughout the home

For a truly healthy home, it's important to uncover these types of issues at the source and make targeted improvements which improve indoor air quality, comfort, and energy efficiency.

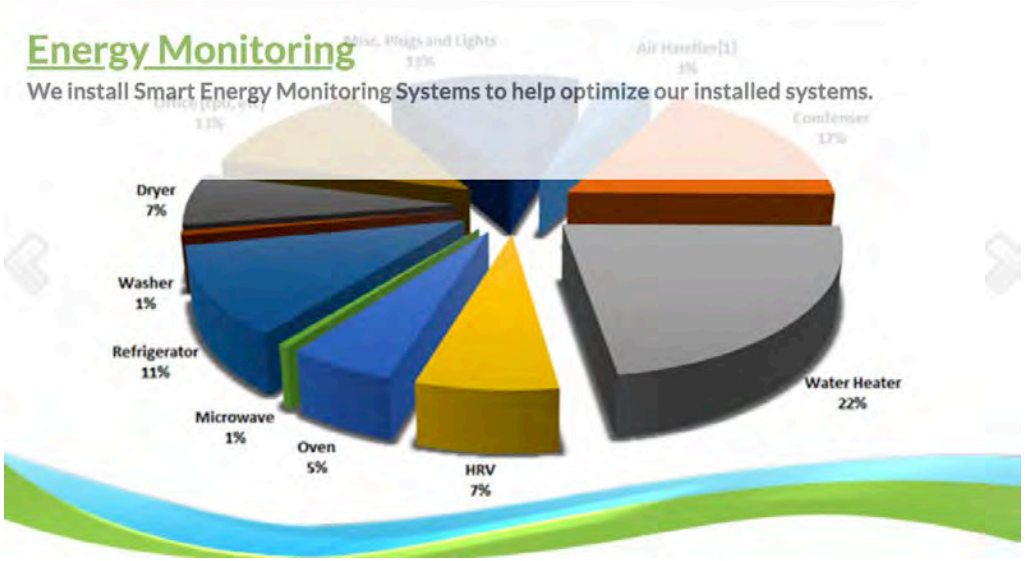
TOTAL home PERFORMANCE
The Energy Audit, Weatherization & Crawl Space Specialists

totalhomeperformance.com

HOW TO MAKE YOUR HOME A HEALTHY HOME

With Total Home Performance, creating a healthy home is simple. We offer a wide range of services that work together to make your home healthier inside and out.

Here are some key home improvements we recommend if you're looking to boost overall home health.



ecoperformancebuilders.com

ECO PERFORMANCE BUILDERS

HAYWARD SCORE MINNICK'S

Is your house at risk to make you sick?
Start here to find out!

Does your house have:

Active and/or recent leaks?
○ Yes ○ No ○ I don't know

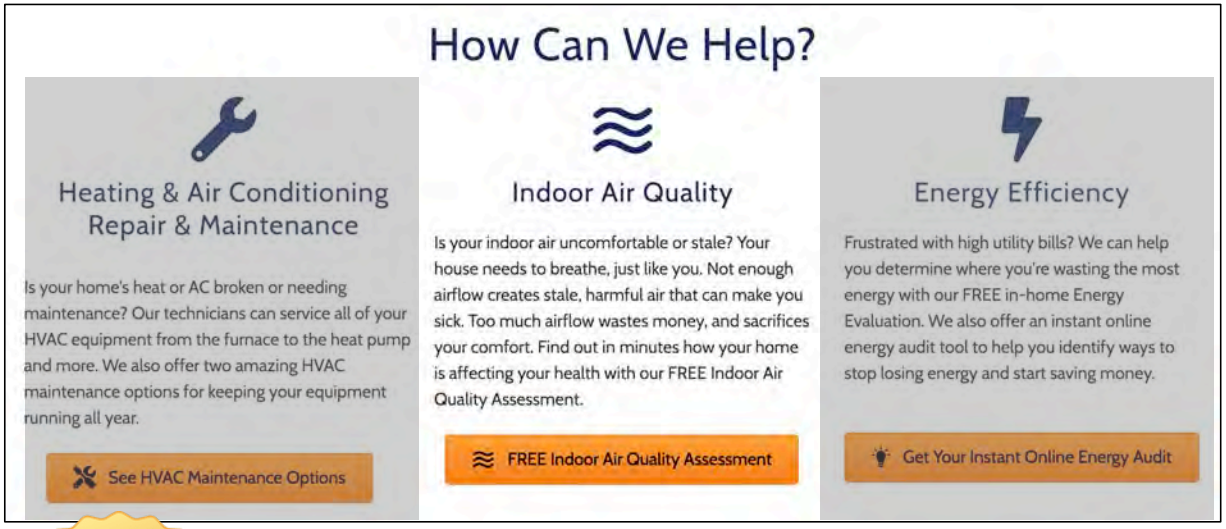
Visible or suspected mold?
○ Yes ○ No ○ I don't know

Wall-to-wall carpet?
○ Yes ○ No ○ I don't know

A crawlspace?
○ Yes ○ No ○ I don't know

Forced air heating/cooling?
○ Yes ○ No ○ I don't know

Frequent indoor or outdoor pest treatment?



100% RIGHT MINNICK'S 100% GUARANTEE OR 100% FREE

virtual assessments

minnicks.com

Healthy Homes, Healthy Living.
MINNICK'S
Heating • Cooling • Plumbing • Insulation

Builders

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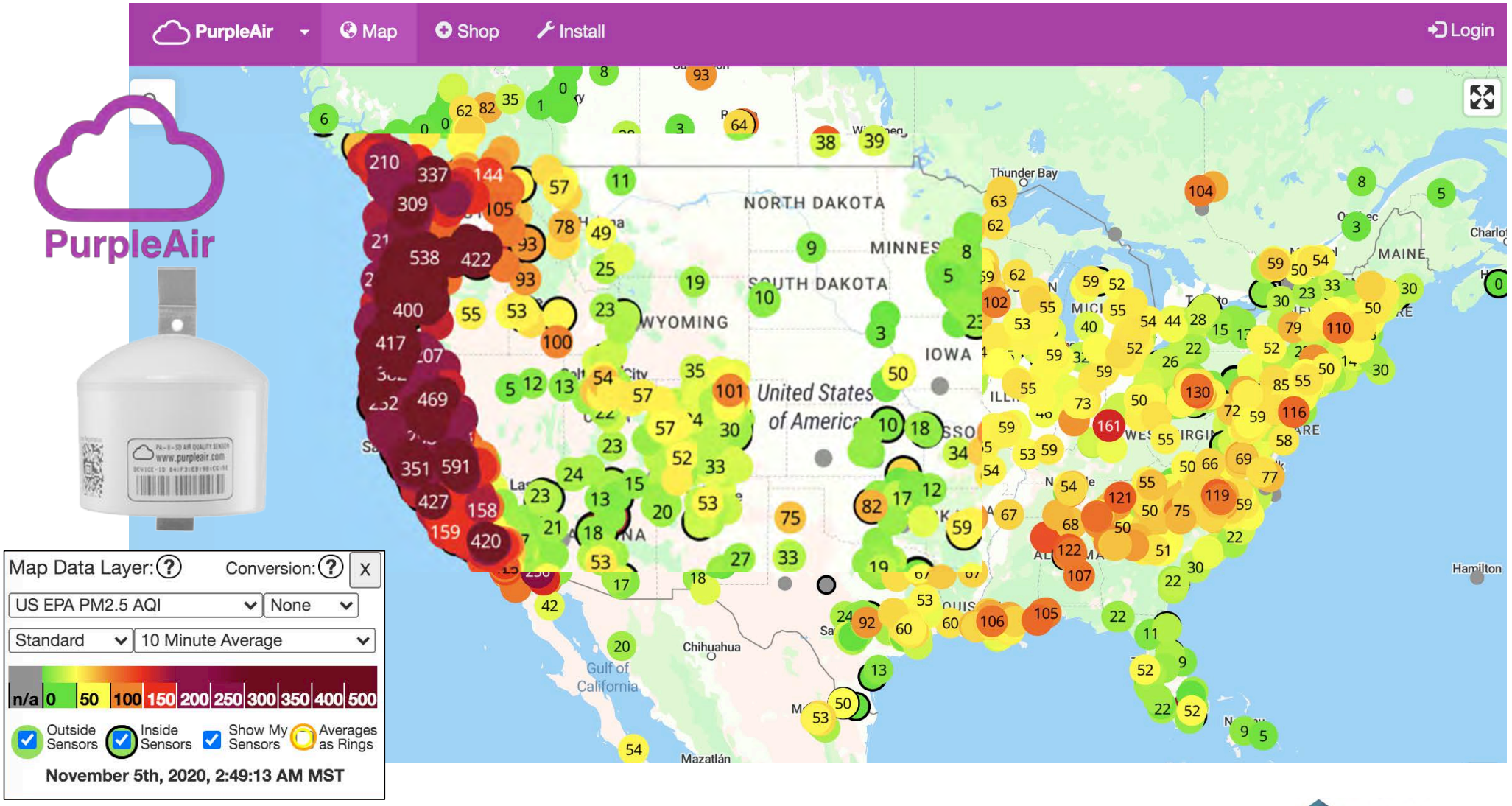
HIGH PERFORMANCE
HOME SUMMIT 2019
EEBA
OCTOBER 1-3 \ DENVER, CO

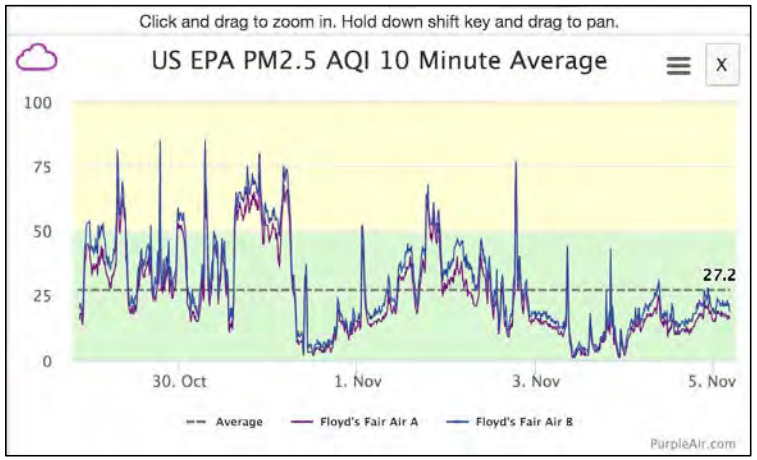
EEBA 2019

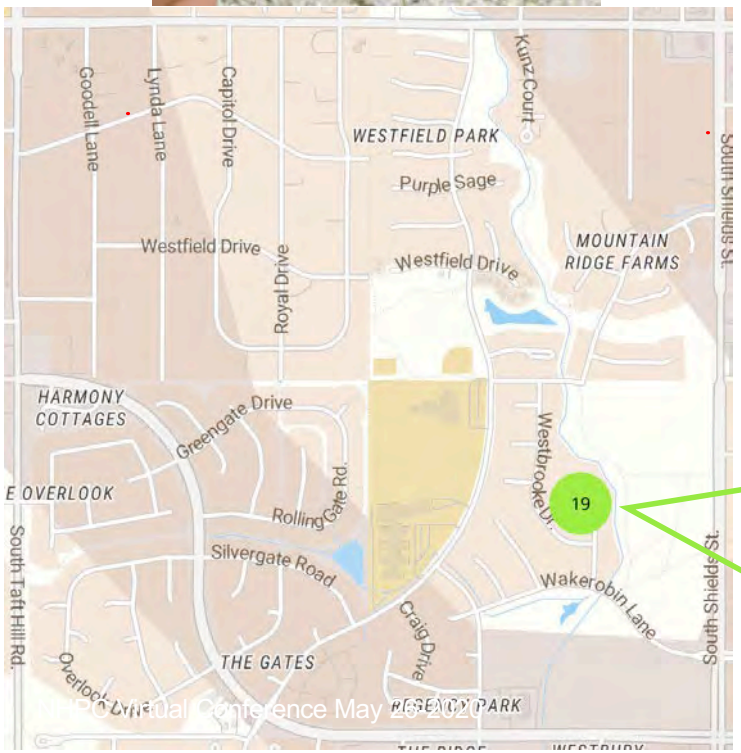


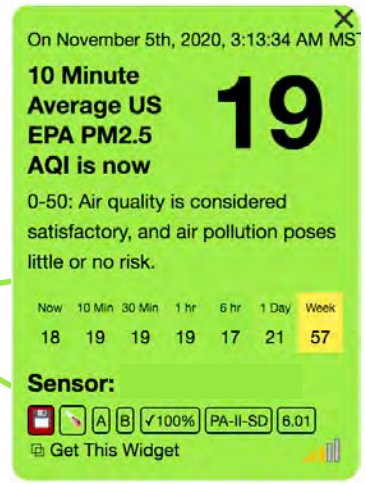
https://www.purpleair.com/map?opt=1/mAQI/a10/cC0#3.37/34.08/-100.5

PurpleAir


www.purpleair.com


Click and drag to zoom in. Hold down shift key and drag to pan.
US EPA PM2.5 AQI 10 Minute Average
100
75
50
25
0
27.2
30. Oct
1. Nov
3. Nov
5. Nov
Average
Floyd's Fair Air A
Floyd's Fair Air B
PurpleAir.com


Goodell Lane
Lynda Lane
Capitol Drive
WESTFIELD PARK
Kunz Court
Purple Sage
Westfield Drive
Royal Drive
Westfield Drive
MOUNTAIN RIDGE FARMS
HARMONY COTTAGES
Greengate Drive
E OVERLOOK
Rolling Gate Rd.
Silvergate Road
19
Westbrooke Ln.
Wakerobin Lane
South Taft Hill Rd.
Overlook Lane
THE GATES
Craig Drive
South Shields St.


On November 5th, 2020, 3:13:34 AM MST
10 Minute Average US EPA PM2.5 AQI is now
19
0-50: Air quality is considered satisfactory, and air pollution poses little or no risk.
Now 10 Min 30 Min 1 hr 6 hr 1 Day Week
18 19 19 19 17 21 57
Sensor:
A B ✓100% PA-II-SD 6.01
Get This Widget

Sensor Integration

iRobot

NETATMO

Works with Apple HomeKit

wemo

SmartThings

hue PHILIPS

Works with IFTTT

alexa

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HAYWARD SCORE

You Can Only Control
If You Measure the Conditions.

If you Measure the Conditions...
Can You Control the Conditions

Sensor Integration

Air Purifiers

New & Unique

CENTRAL AIR CONTROLLER

To control HVAC system fan during air quality events and ensure regular circulation

OTHER EQUIPMENT

Automatically triggers ventilation or filtration during AQ events

AH Control

Indoor Stand Alone Device

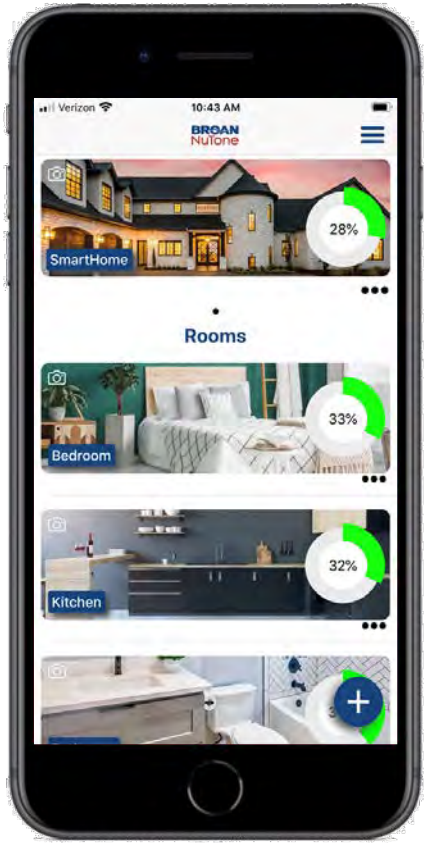
Haven Central IAQ Monitor

Sensor Integration

CONNECTED IAQ SYSTEM

BROAN

NuTone



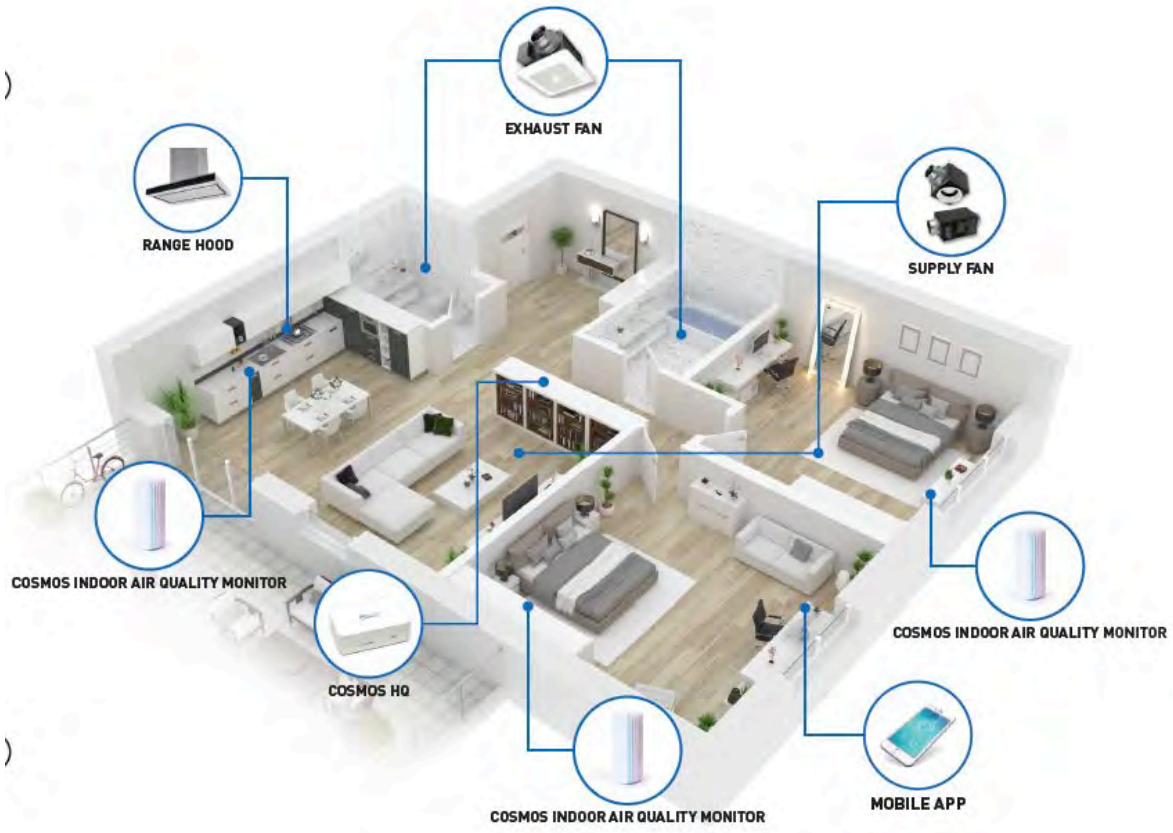
Temp
RH
tVOC

Temp
RH
tVOC
PM 2.5

Sensor Integration

Panasonic

cosmos™
HEALTHY HOME SYSTEM



Cosmos Command Center

Cosmos HQ

Monitors system operations in real-time, receives alerts and recommendations, and automates processes efficiently

Cosmos Indoor Air Quality Monitor

Constantly monitors indoor air quality levels to determine when outside the normal range. Color coded LED lights provide instant air quality reading

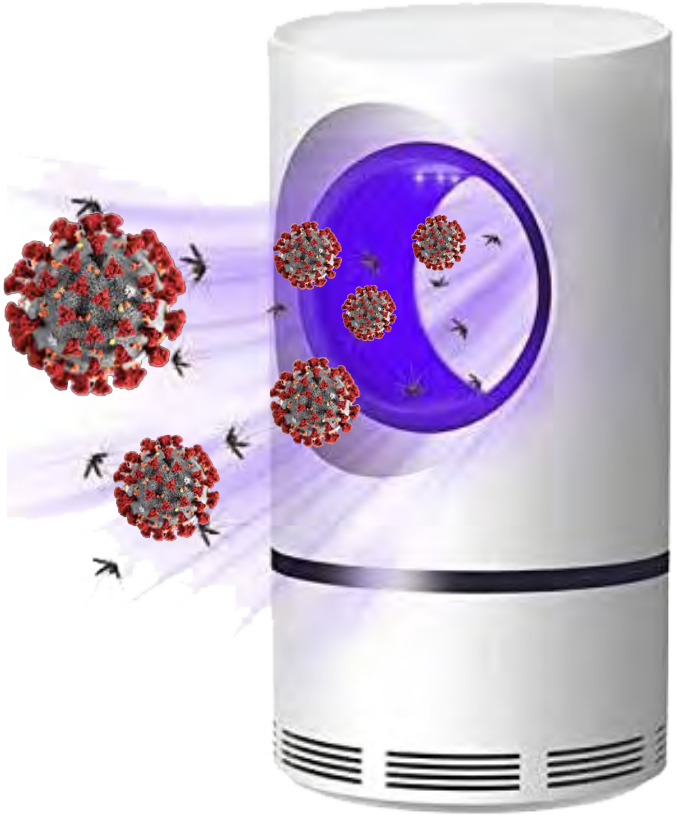
Cosmos Communication Modules

Provides communication for signal reliability among Cosmos components

Mobile App

Provides data on your home's indoor air quality in an easy to read dashboard, you'll know when something is wrong, and how Cosmos resolves it, automatically.

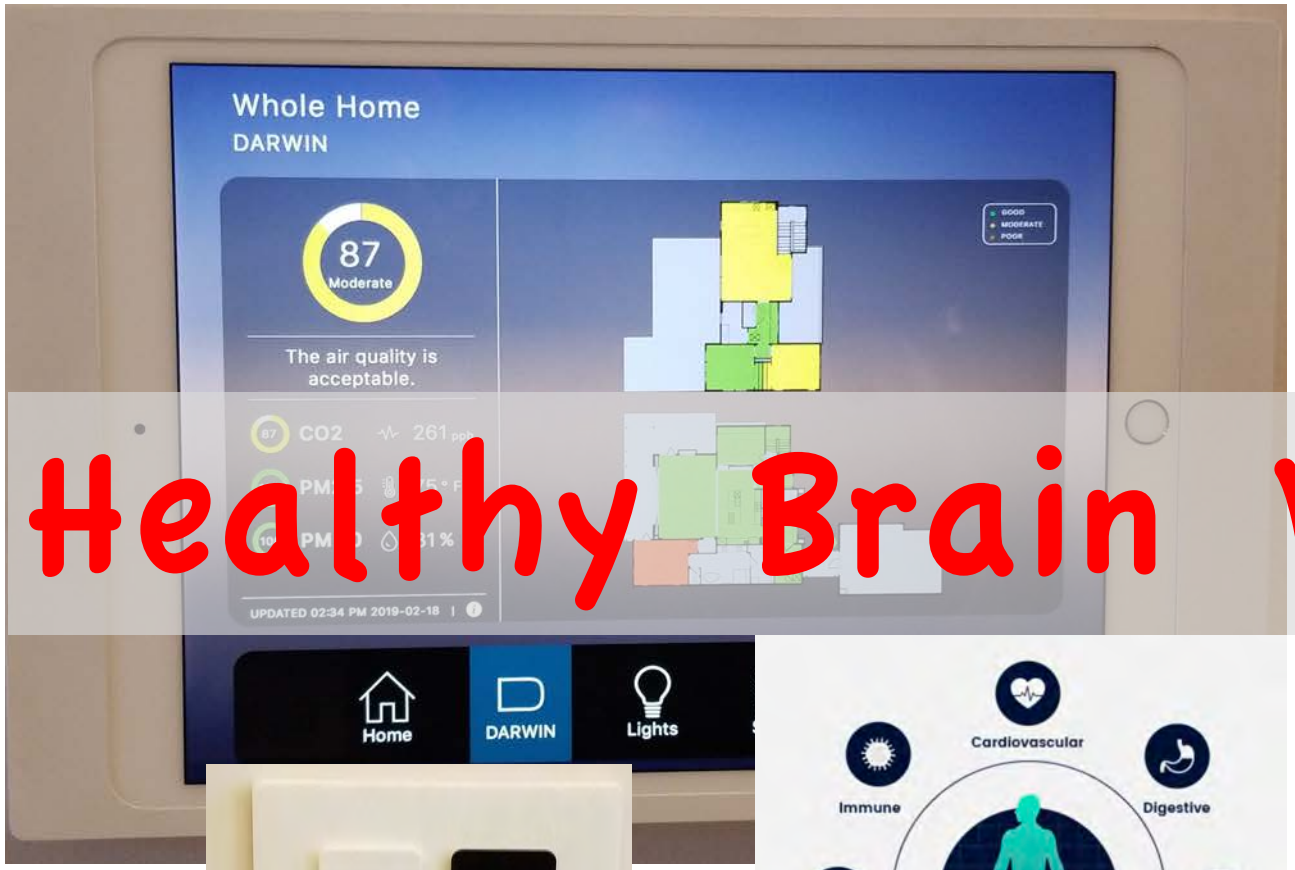
COVID-19 Zappers



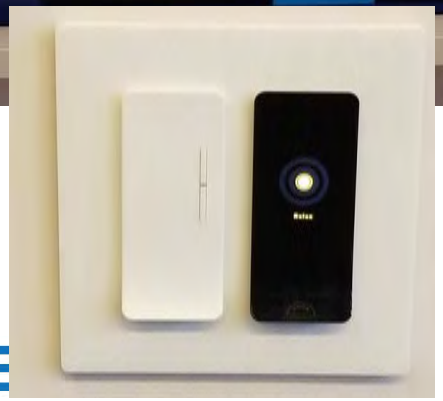
CAUTION

uHoo Virus Index

The ‘uHoo Virus Index’ is a patent pending technology that uses the power of air quality data to help you know **how to deactivate viruses** in your home/workplace and how your air quality affects your health and immune system. Optimize your air quality so you can **deactivate viruses**, if they’re present.



Healthy Brain Washing



Responsive Purification

Designed to help optimize indoor environmental conditions, DARWIN Home Wellness Intelligence uses advanced algorithms and machine learning methods to monitor and improve indoor air quality.

Air monitoring sensors passively test air quality in real-time and automatically turns on the heating and cooling system to provide you with fresh air exactly when you need it

Active Spread Sheet

Readings
- Temperature
- Humidity
- Dew Point
- TVOCs
- Formaldehyde
- CO2 Carbon dioxide
- CO Carbon monoxide
- NO2 Nitrogen dioxide
- PM 1.0, 2.5, 10
- Ozone
- Air Pressure / Barometer
- Ambient light - lux
- Sound - dBA
- Local Whether

Sensor
- Self Calibration
- Factory Calibration
- Passive or fan assist

Connectivity
- 3G / 4G/ 5G
- WiFi
- Bluetooth / range
- Collects data if not connected to cloud
- Phone app
- Web access
-Cloud storage
- Integrates w/ other devices
- API

Power
- 120v

Portable - internal battery

Portable - works off a battery pack

USB power

A	B	C	D	E	F	G	H
	ALPHABETICAL Updated 2020-05-26	**Air Advice**	**AirThinx - standard**	**(IAQ) AirVisual Pro**	**Atmotube PRO**	**Awair 2 Element**	**Awair Omni**
	Type	**Contractor**	**Commercial / Residential**	**Residendial / Maybe small commercial applications**	**Personal Portable monitor**	**Residential**	**Consummer**
	Esta Price for unit (as of June 2020)	$1,200	$699	$269	$149	$149	$300
	Monthly / anual service fee	Yes	$299	No	No	-	$60
	Visual Display	Minimal -	Connectivity and Alert single color	Full color display	No	Yes - minimal - can be changed	Yes - minimal - can be changed
	Display can be turned OFF	Yes	Yes	Yes	NA	Yes	Yes
Readings							
	Temperature	Yes	Range - 0-99°C Resolution - 0.1 °C Maximum Error - ±0.5 °C	14 - 104°F	Yes	-40 to +125°C (-40 to +257°F),+/- 0.3°C	Range: -40 to 125°C (-40 to 257°F) Accuracy: +0.2°C (=/- ~3° F)
	Humidity	Yes	Range - 0-99 %RH Resolution - 0.1 %RH Maximum Error - ±2 %RH	0 - 95%	Yes	0 to 95%, +/- 3%	Range: 0-100% RH Accuracy: +2% RH
	Dew Point	No	Yes	No	No	No	No
	TVOCs	Yes	PPM Effective Range - 1~30ppm of EtOH Sensitivity - 0.15 ~ 0.5 Rs (10ppm of EtOH)/ Rs (air)	No	Yes	0 to 2014 ppb	TVOC Range: 0-60,000 ppb Accuracy: +10%
	Formaldahyde	No	CH2O Sensor Effective Range - 0~1 mg/m3 Resolution - 0.001 mg/m3 Maximum Error - < 5% FS		No		
	CO2 Carbon dioxide	Yes	Effective Range - 0~3000 PPM Resolution - 1 PPM Maximum Consistancy Error - ±50ppm+5%FS Single Response Time - < 3 sec. Total Response Time - ≤ 25 sec	CO2: 400 - 10,000 PPM	Yes	0 to 4000 ppm,+/- 75ppm	Range: 400-5,000 ppm Accuracy:+ 75 ppm or +10%

link - https://bit.ly/36t1jPZ

Velux https://youtu.be/ygHU0mQGuJU

Conclusions

- All chemicals matter
  - All particulates matter
    - All homes matter
      - All occupants matter


Dynamic


Static

Thank You

joemedosch@gmail.com

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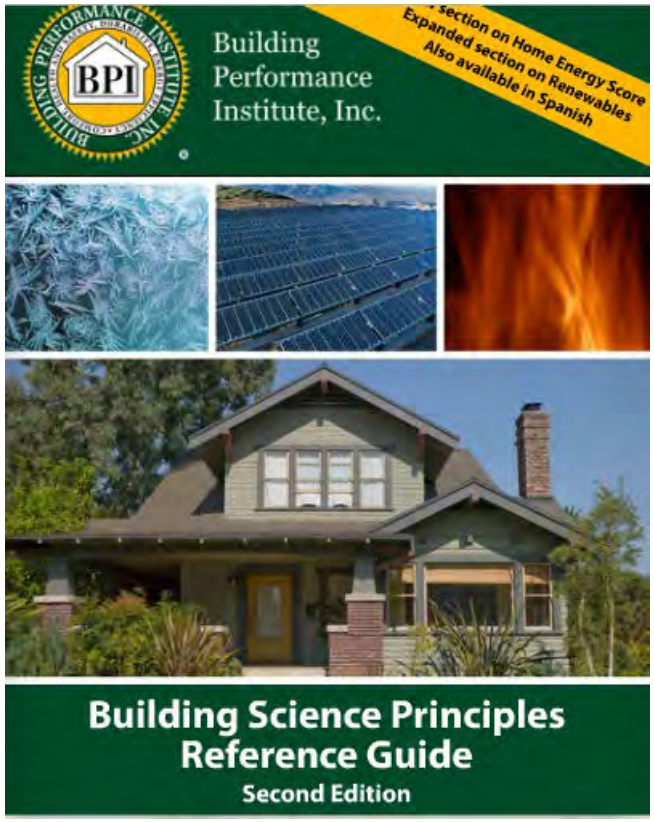
Building Science Principles Reference Guide and Certificate of Knowledge Exam



Healthy Housing Principles Reference Guide and Certificate of Knowledge Exam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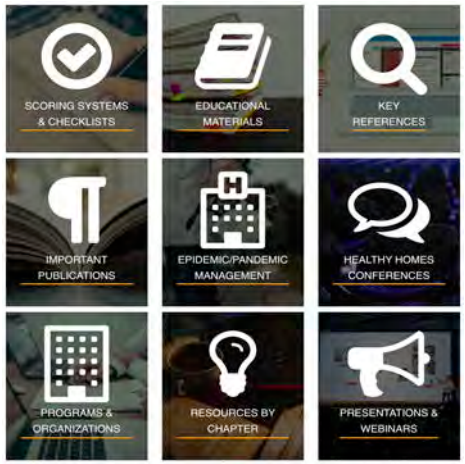

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Video Recording is on EEBAs YouTube site

https://www.youtube.com/playlist?list=PL18eaEJUabuVXShxYBZw5Ym1bt9AlMv2p

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