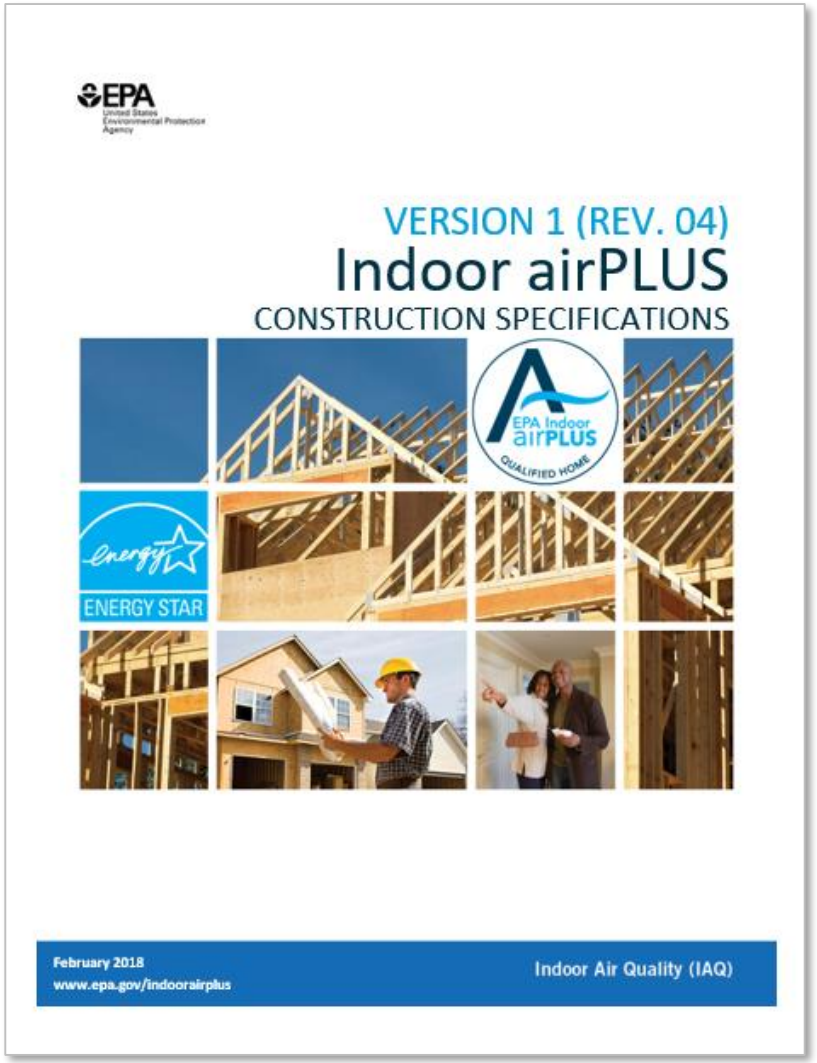
Measured Humidity Loads & Surface Water Activity in 12 Occupied Florida Homes

RESNET Building Performance Conference
February 2018

Agenda

- IAP update – Revision 4
- Dehumidification in IAP Specs
- Case studies and challenges in Florida homes – Lew Harriman
  - Ventilation and DH loads
  - RH in air vs. RH on surfaces
  - Surface water activity vs. mold
  - Attic dew point vs. outdoor dew point
- Tools and resources

Indoor airPLUS Program Overview



- Non-regulatory home label; currently for new homes – will complete launch of existing homes this year.
- Assists home builders, trade contractors & renovators
- Concrete way for builders to sell health benefits to customers
- Independent, 3rd-party verification
- Constructions Specs, technical support, marketing resources

ENERGY STAR + Indoor airPLUS

- Envelope
- HVAC
- Moisture
- CO

+

look for EPA Indoor airPLUS QUALIFIED HOME

- Radon
- Pests
- Materials
- HVAC +
- Moisture +
- CO +

=

1. **Better durability**
2. **Less long-term maintenance**
3. **Comprehensive indoor air quality protection**
4. **A safer, healthier home**

Indoor airPLUS as a Health Benchmark for High-Performance Homes

- IAP is respected as a benchmark for IAQ to protect occupant health in new homes.
- IAP is <u>required</u> by other labeling programs (Zero Energy Ready, PHIUS) as a pre-requisite.
- IAP is also referenced by LEED for Homes and the National Green Building Standard.

LEED™ FOR HOMES

NATIONAL GREEN BUILDING STANDARD™

Indoor Air Protections, Long-term Value

Indoor airPLUS Qualified Home

This home built at

123 Main Street
Anywhere, DC 11111

was verified by

Home Energy Rater

to meet Indoor airPLUS construction specifications as established by the U.S. Environmental Protection Agency.

EPA Indoor airPLUS QUALIFIED HOME

Indoor airPLUS qualified homes are designed to contribute to improved indoor air quality.

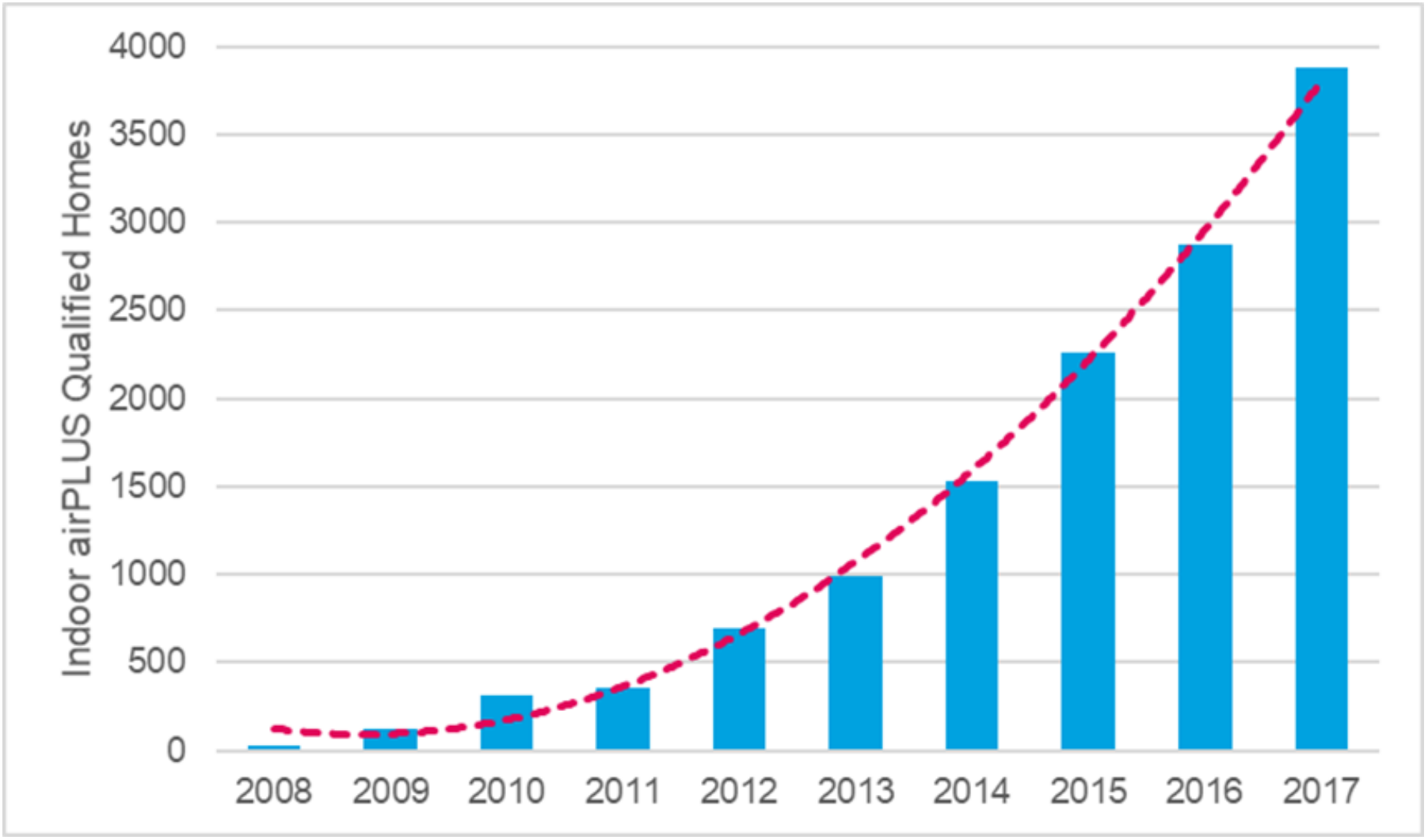
November 1, 2016

Indoor airPLUS Features

- Moisture and Mold Control
- Radon Resistant Construction
- Pest Barriers
- Effective Heating, Ventilating, and Air-Conditioning Systems
- Safe Combustion
- Low Emission Building Materials

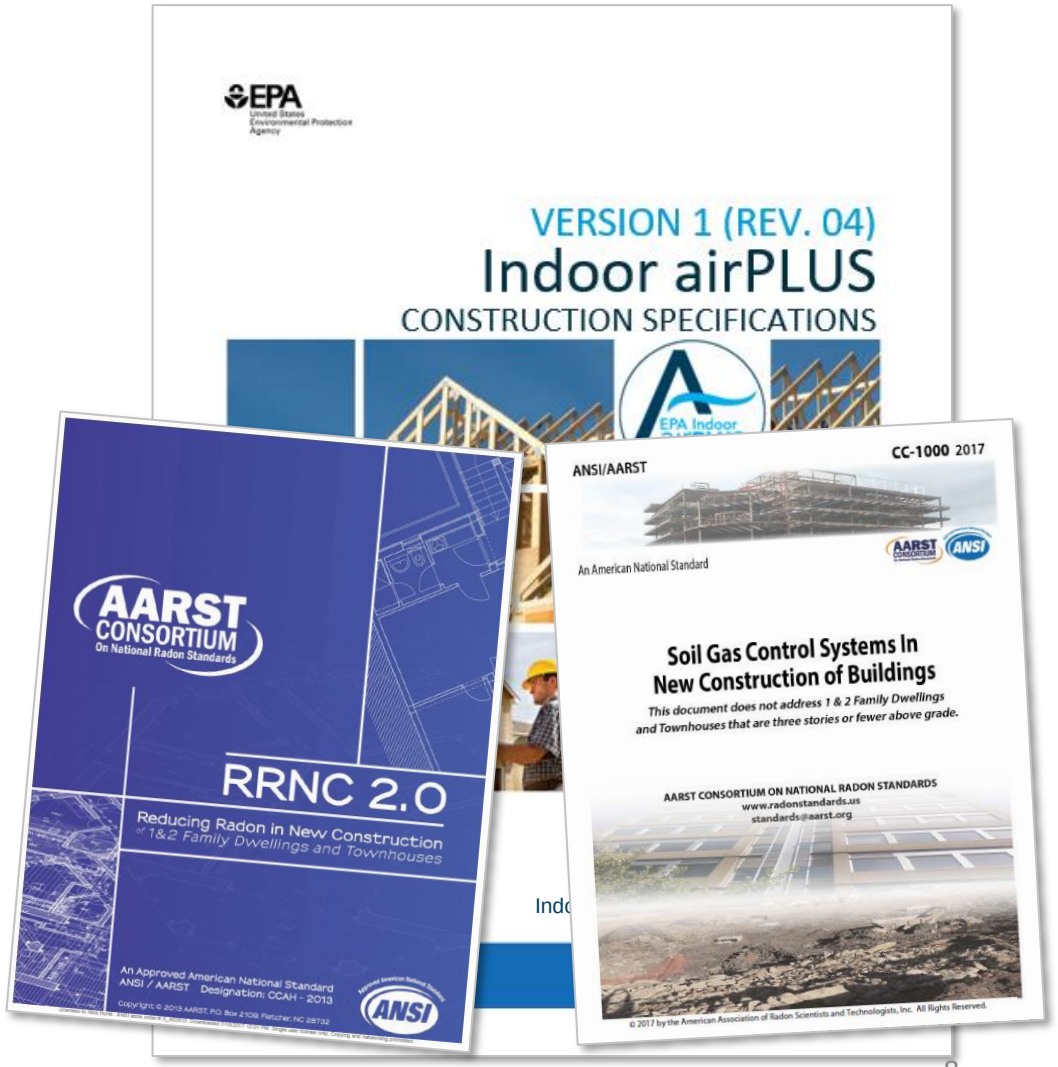
Not all features are required in all cases. To learn more about indoor air quality features in your home, ask your builder to review the Indoor airPLUS verification checklist with you, or visit www.epa.gov/indoorairplus.

Indoor airPLUS Labeled Homes Growth



Indoor airPLUS Update: *Revision 4*

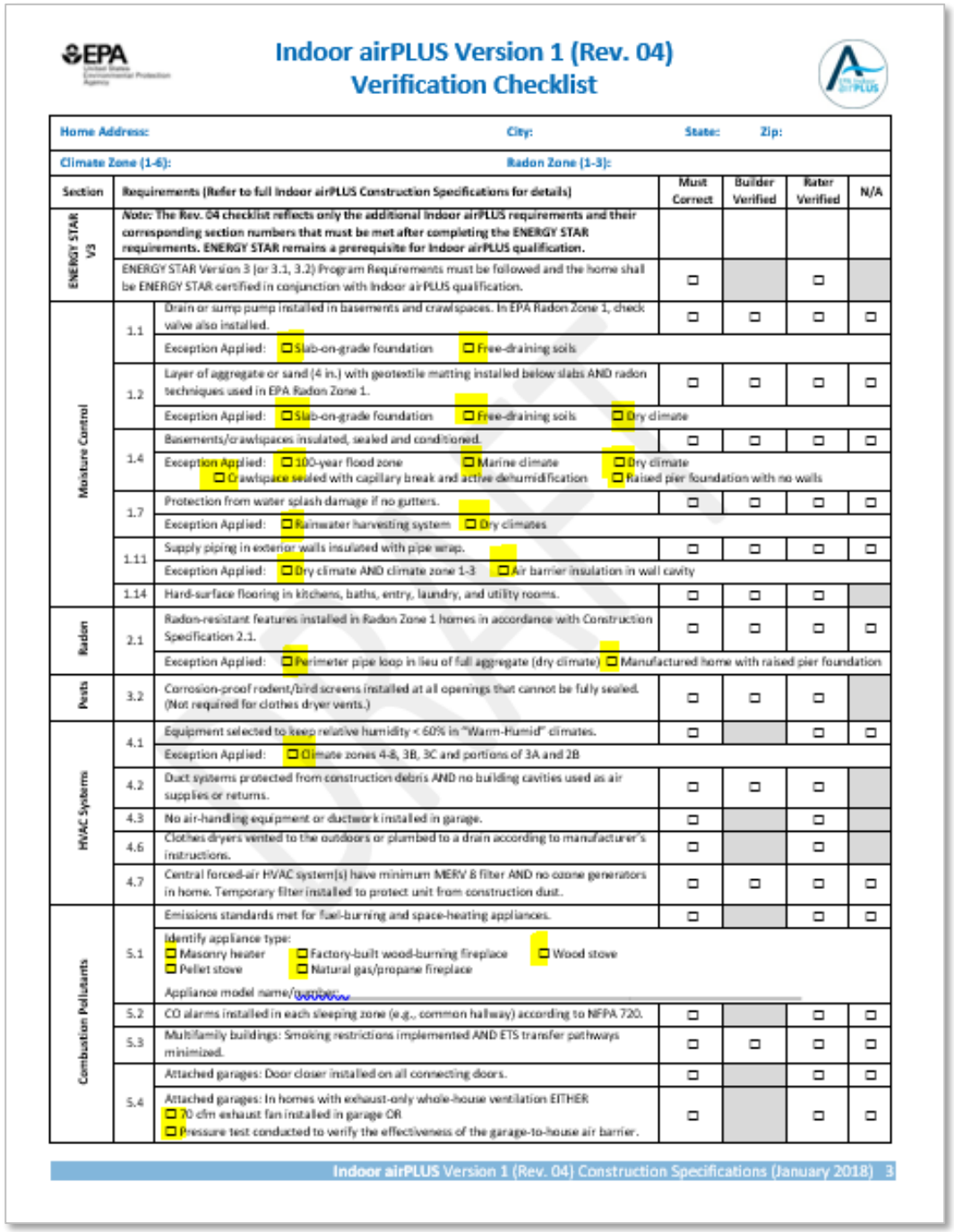
- Revision 4 released this week.
- New exceptions:
  - Dehumidification option in crawl spaces
  - Pipe insulation in exterior walls, per climate zone
- Updated radon section:
  - Referencing ANSI/AARST standards
    - CCAH – 2013 (single family)
    - CC – 1000 (multifamily)
  - Multifamily considerations
- Recommending MERV 13 for central forced air *and* ventilation air
- Low-emission materials
  - Hard surface flooring advisory.
  - Formaldehyde in composite wood (TSCA Title IV)



Indoor airPLUS Revision 4 Introduction & Checklist

- **Introduction:**
  - Clarified document retention policy for Raters (2 years from verification).
  - Streamlined documentation requirement for similar, high-volume units.

- **Checklist:**
  - Additional fields and checkboxes.
  - Reminds verifier to confirm specific exceptions.
  - Enhances both short-term and long-term programmatic QA.



EPA

Indoor airPLUS Version 1 (Rev. 04) Verification Checklist

Home Address: City: State: Zip:

Climate Zone (1-6): Radon Zone (1-3):

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
ENERGY STAR V3		Note: The Rev. 04 checklist reflects only the additional Indoor airPLUS requirements and their corresponding section numbers that must be met after completing the ENERGY STAR requirements. ENERGY STAR remains a prerequisite for Indoor airPLUS qualification.				
		ENERGY STAR Version 3 (or 3.1, 3.2) Program Requirements must be followed and the home shall be ENERGY STAR certified in conjunction with Indoor airPLUS qualification.	☐		☐	
Moisture Control	1.1	Drain or sump pump installed in basements and crawlspaces. In EPA Radon Zone 1, check valve also installed.	☐	☐	☐	☐
		Exception Applied: ☐ Slab-on-grade foundation ☐ Free-draining soils				
	1.2	Layer of aggregate or sand (4 in.) with geotextile matting installed below slabs AND radon techniques used in EPA Radon Zone 1.	☐	☐	☐	☐
		Exception Applied: ☐ Slab-on-grade foundation ☐ Free-draining soils ☐ Dry climate				
	1.4	Basements/crawlspaces insulated, sealed and conditioned.	☐	☐	☐	☐
		Exception Applied: ☐ 100-year flood zone ☐ Marine climate ☐ Dry climate ☐ Crawlspace sealed with capillary break and active dehumidification ☐ Raised pier foundation with no walls				
	1.7	Protection from water splash damage if no gutters.	☐	☐	☐	☐
		Exception Applied: ☐ Rainwater harvesting system ☐ Dry climates				
	1.11	Supply piping in exterior walls insulated with pipe wrap.	☐	☐	☐	☐
		Exception Applied: ☐ Dry climate AND climate zone 1-3 ☐ Air barrier insulation in wall cavity				
	1.14	Hard-surface flooring in kitchens, baths, entry, laundry, and utility rooms.	☐	☐	☐	
Radon	2.1	Radon-resistant features installed in Radon Zone 1 homes in accordance with Construction Specification 2.1.	☐	☐	☐	☐
		Exception Applied: ☐ Perimeter pipe loop in lieu of full aggregate (dry climate) ☐ Manufactured home with raised pier foundation				
Pests	3.2	Corrosion-proof rodent/bird screens installed at all openings that cannot be fully sealed. (Not required for clothes dryer vents.)	☐	☐	☐	
HVAC Systems	4.1	Equipment selected to keep relative humidity < 60% in "Warm-Humid" climates.	☐		☐	☐
		Exception Applied: ☐ Climate zones 4-8, 3B, 3C and portions of 3A and 2B				
	4.2	Duct systems protected from construction debris AND no building cavities used as air supplies or returns.	☐	☐	☐	
	4.3	No air-handling equipment or ductwork installed in garage.	☐		☐	
	4.6	Clothes dryers vented to the outdoors or plumbed to a drain according to manufacturer's instructions.	☐		☐	
	4.7	Central forced-air HVAC system(s) have minimum MERV 8 filter AND no ozone generators in home. Temporary filter installed to protect unit from construction dust.	☐	☐	☐	☐
Combustion Pollutants	5.1	Emissions standards met for fuel-burning and space-heating appliances.	☐		☐	☐
		Identify appliance type: ☐ Masonry heater ☐ Factory-built wood-burning fireplace ☐ Wood stove ☐ Pellet stove ☐ Natural gas/propane fireplace Appliance model name/number:				
	5.2	CO alarms installed in each sleeping zone (e.g., common hallway) according to NFPA 720.	☐		☐	☐
	5.3	Multifamily buildings: Smoking restrictions implemented AND ETS transfer pathways minimized.	☐	☐	☐	☐
	5.4	Attached garages: Door closer installed on all connecting doors.	☐		☐	☐
		Attached garages: In homes with exhaust-only whole-house ventilation EITHER ☐ 70 cfm exhaust fan installed in garage OR ☐ Pressure test conducted to verify the effectiveness of the garage-to-house air barrier.	☐		☐	☐

1. Moisture Control

- Moisture is a leading cause of health, comfort and durability concerns in homes.
- 19% of U.S. households have at least one person with asthma.
- There is a 20-50% increased risk of asthma in damp houses.
- The economic cost of asthma amounts to more than $56 billion annually.
- Mold grows where there is moisture.
- Molds produce allergens, irritants, and in some cases, potentially toxic substances.

Items 1.3 and 1.4
Foundation Walls, Basements, Crawlspaces

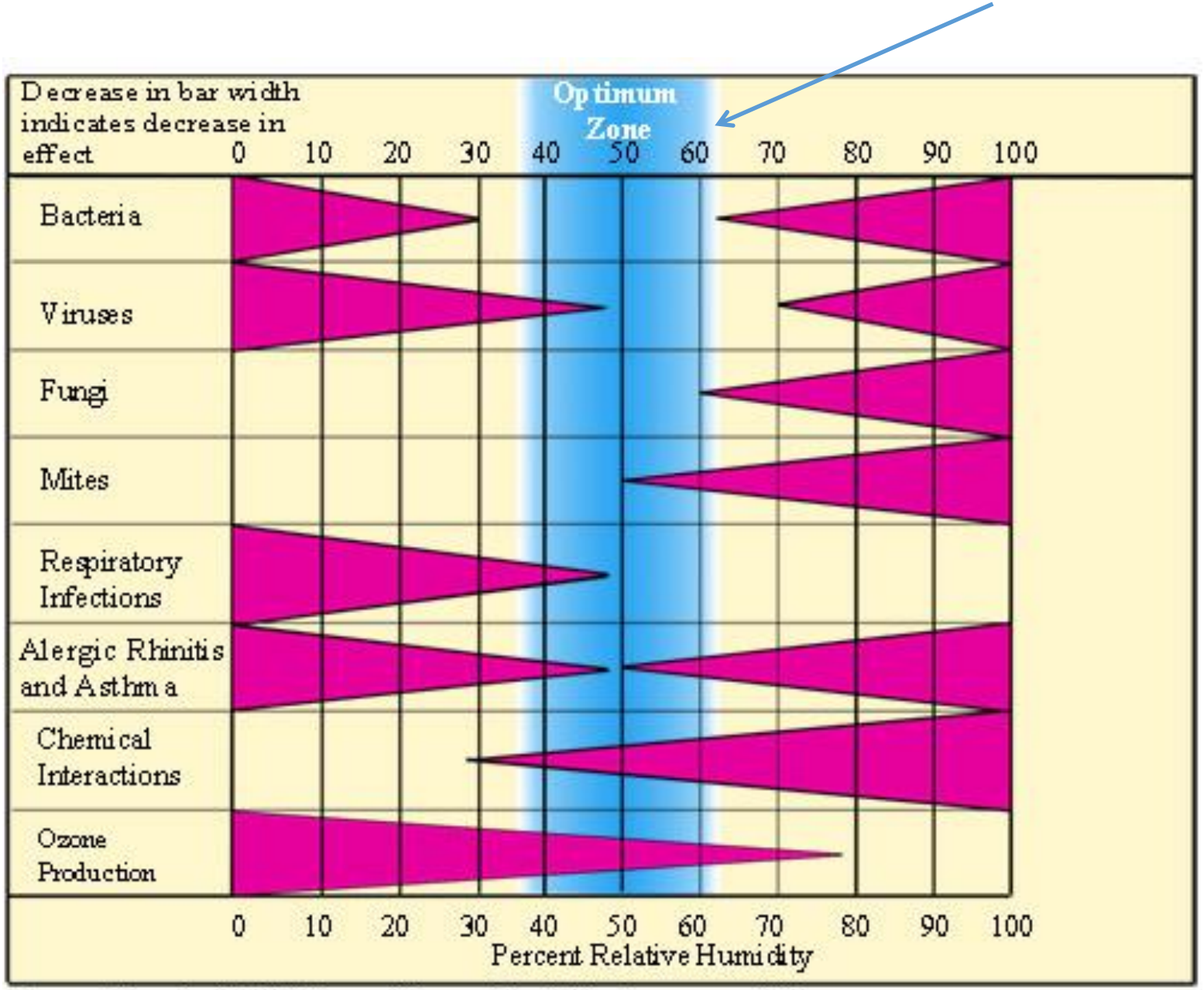
- Finish all masonry and concrete walls with damp-proofing.
- Seal crawlspace and basement perimeter walls to prevent outside air infiltration.
- Insulate crawlspace and basement perimeter walls according to the prescriptive values determined by local code at minimum or R-5, whichever is greater.
- Provide conditioned air at a rate not less than 1 cfm per 50 sq. ft. of horizontal floor area. This can be achieved by a dedicated supply (2015 IRC section R408.3.2.2) or through crawl-space exhaust (2015 IRC section R408.3.2.1).
    - Exceptions: Flood zones, dry climates, marine climates, etc. (See spec).

1.4 Basement & Crawlspace Insulation & Conditioned Air

- New exception:
  - In lieu of perimeter wall insulation and conditioned air, crawlspaces that utilize a capillary break on the floor and that are well-sealed to prevent outside air infiltration are permitted to utilize active dehumidification with sufficient latent capacity to maintain relative humidity (RH) at or below 60 percent. The dehumidifier shall be drained to the outside or to a sump pump.
    - With this exception, ENERGY STAR Certified Homes Water Management System Builder Requirements Item 1.4.3 staking method for poly sheeting may not be used in crawlspaces with no slab.

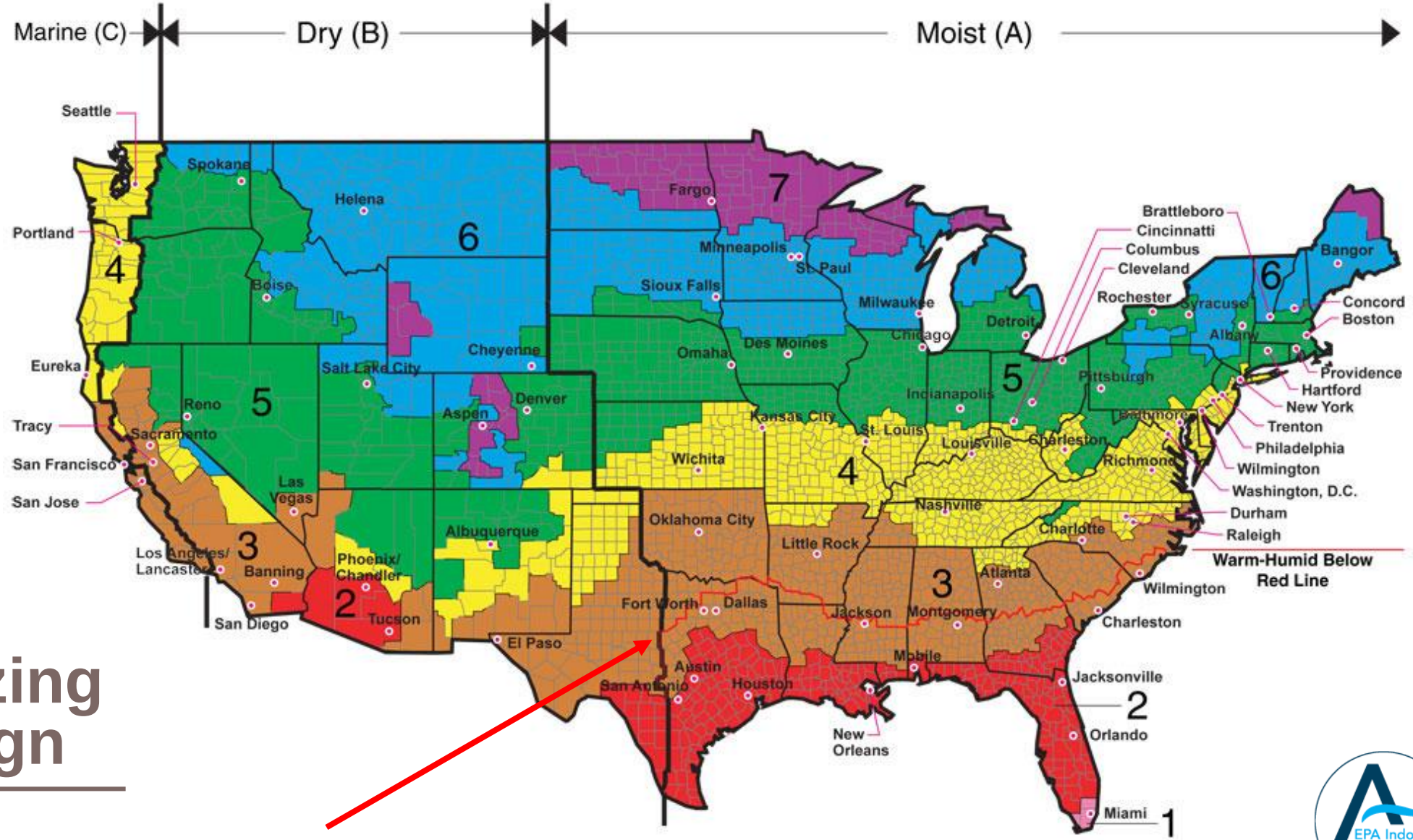
Moisture & Relative Humidity

- IAP < 60% in warm humid climates



Source: Theodor D. Sterling and Associates, Ltd, Vancouver, B.C.

Item 4.1: HVAC Sizing and Design



Homes in “Warm-Humid” climates use additional controls or dehumidification systems to maintain RH ≤ 60%

Indoor Air Quality (IAQ)

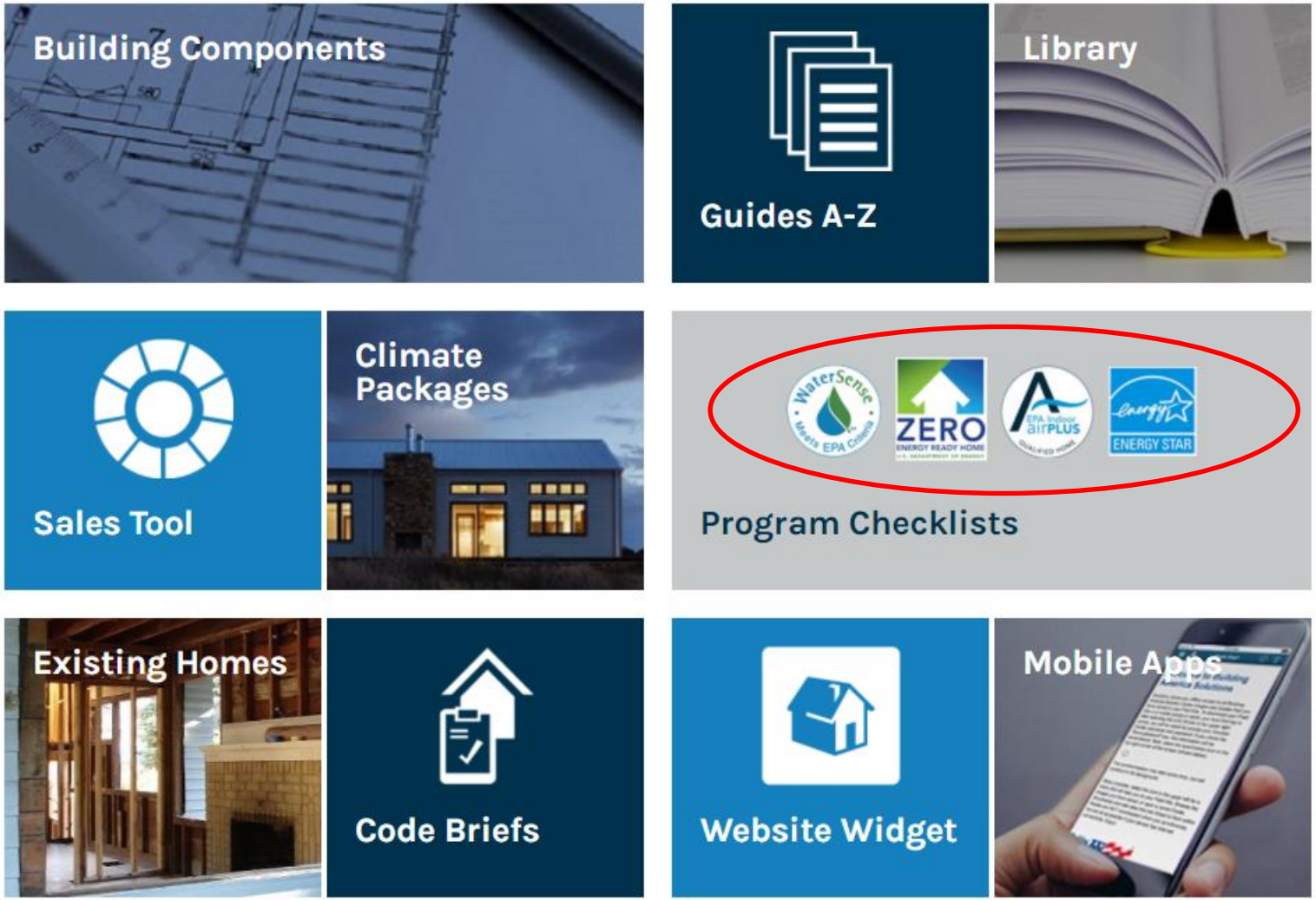
4.1 HVAC Sizing and Design - Verification

- Some of these items *must* be Rater verified.
- Rater should **verify documentation before the start of construction** showing the method and calculations for retaining an indoor relative humidity below 60 percent in “Warm-Humid” climates.

Section		Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
HVAC Systems	4.1	Equipment selected to keep relative humidity < 60% in “Warm-Humid” climates.	☐		☐	☐
		Exception Applied: ☐ Climate zones 4-8, 3B, 3C and portions of 3A and 2B				
	4.2	Duct systems protected from construction debris AND no building cavities used as air supplies or returns.	☐	☐	☐	
	4.3	No air-handling equipment or ductwork installed in garage.	☐		☐	
	4.6	Clothes dryers vented to the outdoors or plumbed to a drain according to manufacturer’s instructions.	☐		☐	
	4.7	Central forced-air HVAC system(s) have minimum MERV 8 filter AND no ozone generators in home. Temporary filter installed to protect unit from construction dust.	☐	☐	☐	☐

Technical Assistance

- Specifications
- Webinars
- Online Resources and Tools
- Integration with DOE Building America Solution Center



https://basc.pnnl.gov/

Theory v. Practice in Residential HVAC

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Mason-Grant Consulting
LewHarriman@MasonGrant.com
Mobile: **603-828-7138**

How Dry I'm Not

Measured Dehumidification And Water Activity (a_w) in Houses in Florida

2018 RESET Conference – Orlando

Acknowledgements

- Condensate sensor field calibration protocol designed and accomplished by **Andrew Äsk, PE** of Ft. Myers, FL

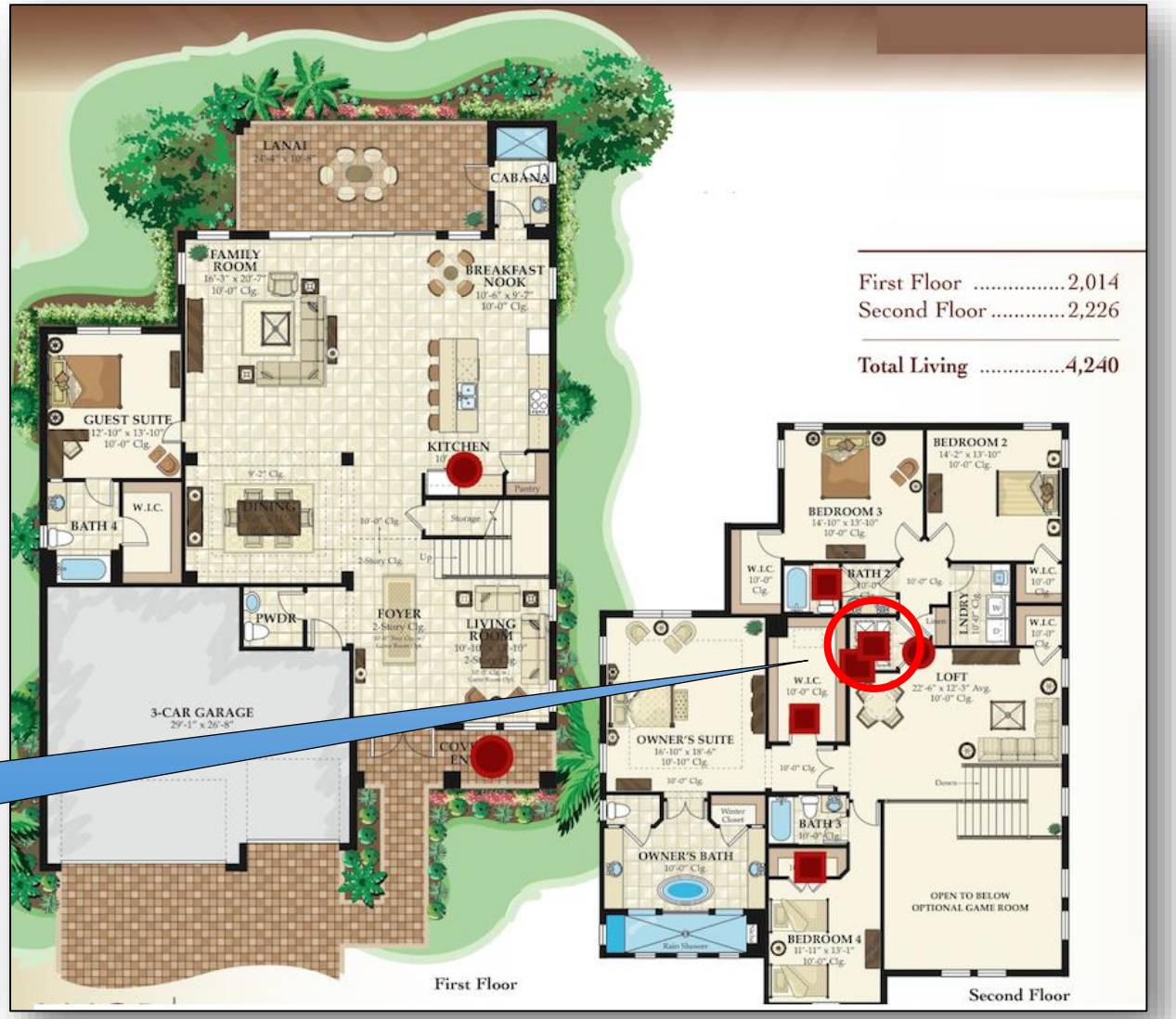
- Sensors, technical support and website database for remote monitoring provided by Chris Hoogenboom, CEO of **OmniSense.com**, Lady's Island, SC

Target Homes
Located in South Florida

- The Issues
- The Building & Systems
- Three (3) key results
  - DX AC systems ADD moisture to the air if fan is set to “ON.”
  - They still remove a great deal of moisture/day
  - Under ASHRAE Std 62.2 ventilation—we’re going to need MUCH MORE Dehumidification
- Surface water activity (a_W) measurements vs. mold growth

2-Story House

4,240 ft^2 5 Bedrooms + 5 Bathrooms



Mechanical closet located on the 2nd floor

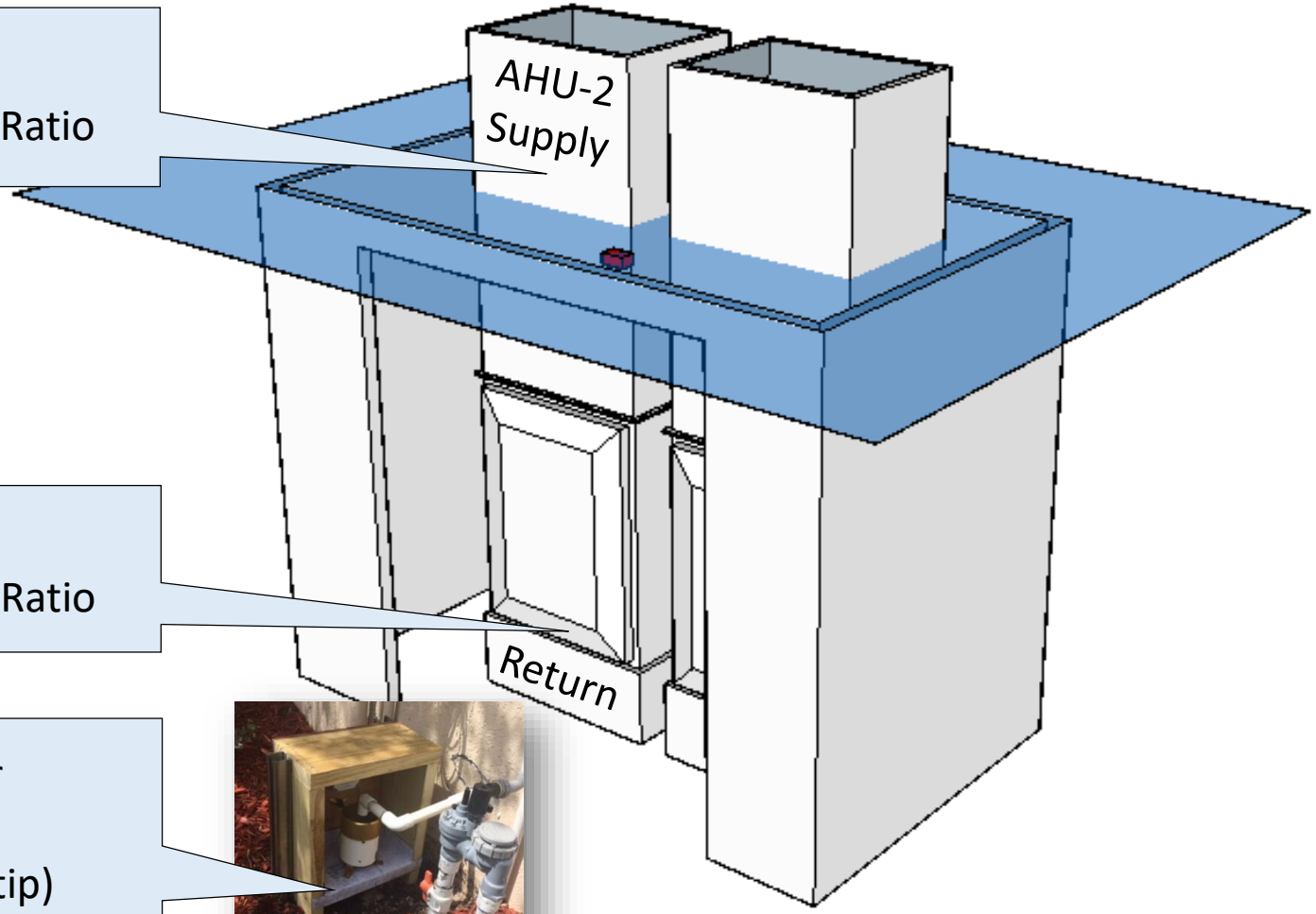
Mechanical closet

Sensors and sensor locations

Air in **supply outlet** plenum
Temp + RH + Dew Point + Humidity Ratio

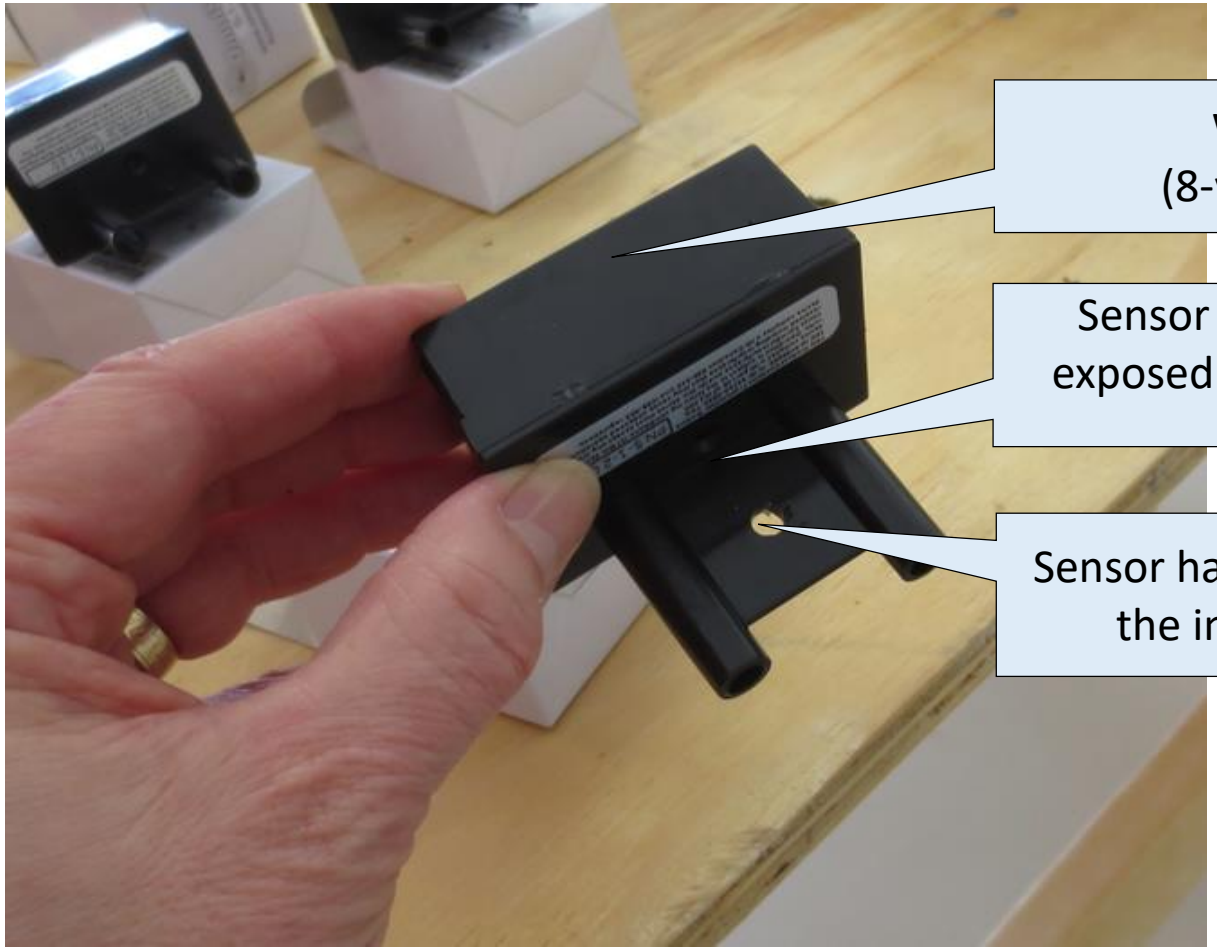
Air in **return inlet** plenum
Temp + RH + Dew Point + Humidity Ratio

Outdoors - **Condensate** sensor
Tipping-bucket-type
(0.00474 lb of water per bucket tip)



Air sensor configuration

Temperature and RH (calculated Dpt + HR)



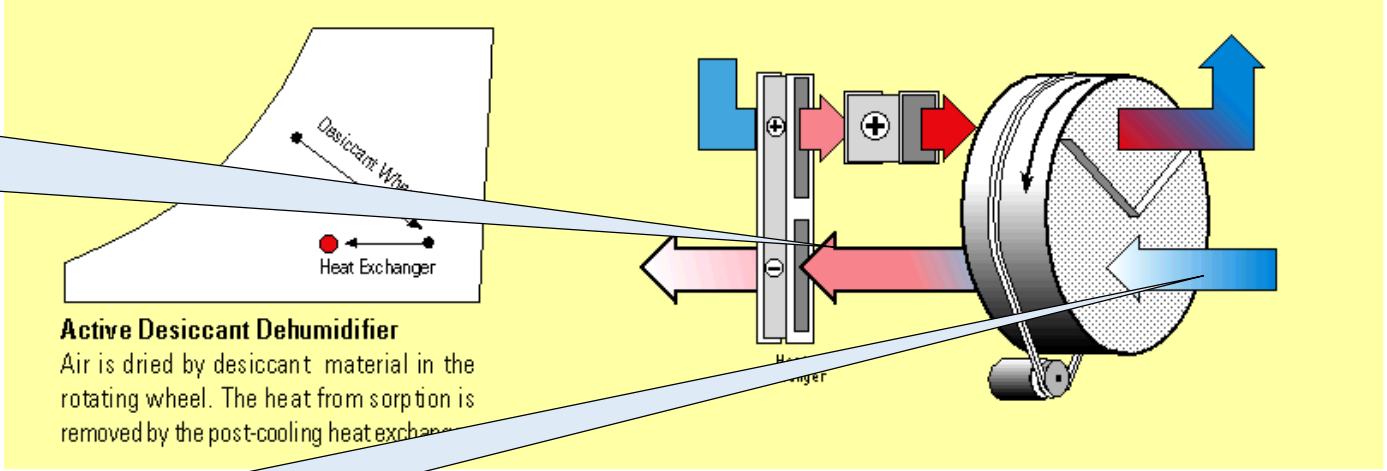
Measuring dehumidification in real time

Tipping bucket + wireless pulse-counter

Dehumidification

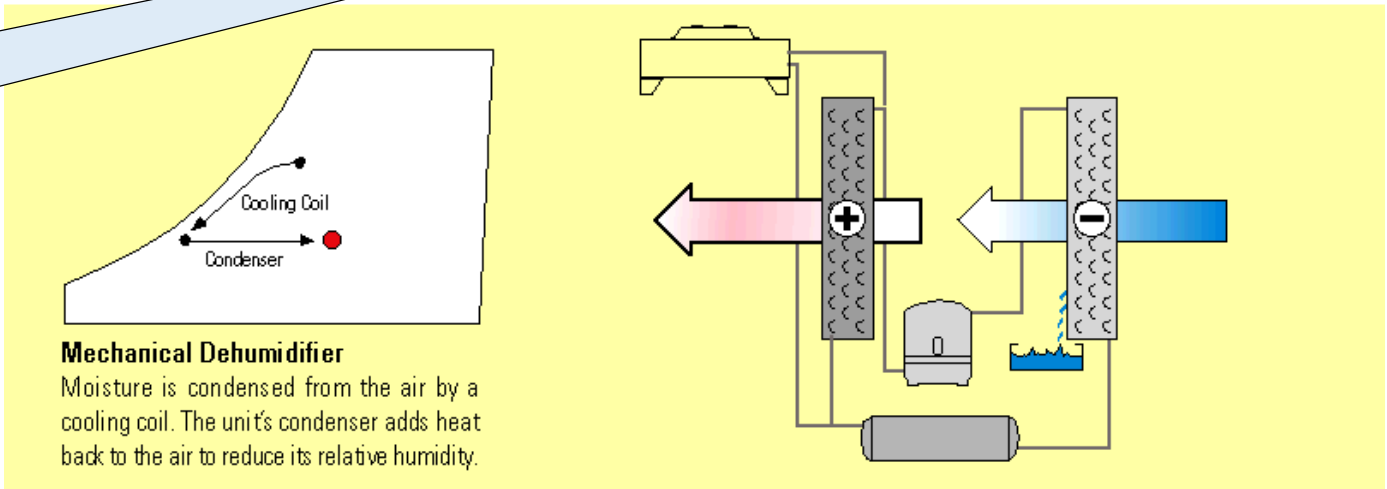
Supply air Dpt *must be lower* than return air Dpt

Dew point leaving the dehumidifier MUST BE LOWER...



Active Desiccant Dehumidifier
Air is dried by desiccant material in the rotating wheel. The heat from sorption is removed by the post-cooling heat exchan

...than the dew point ENTERING the dehumidifier!



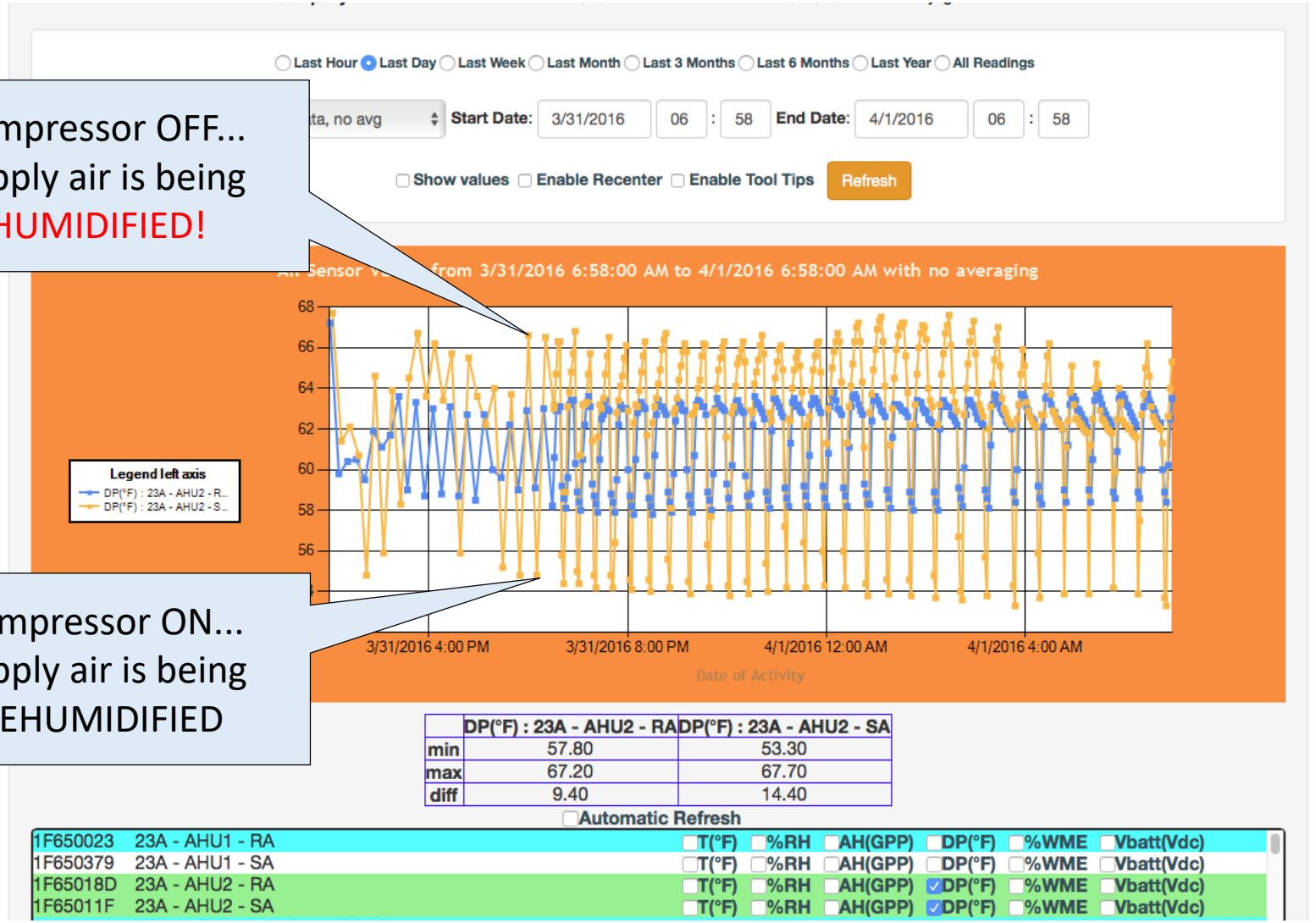
Mechanical Dehumidifier
Moisture is condensed from the air by a cooling coil. The unit's condenser adds heat back to the air to reduce its relative humidity.

DX DH performance ("Fan ON")

Supply air Dpt (Yellow) vs. return air Dpt (Blue)

Compressor OFF...
Supply air is being
HUMIDIFIED!

Compressor ON...
Supply air is being
DEHUMIDIFIED



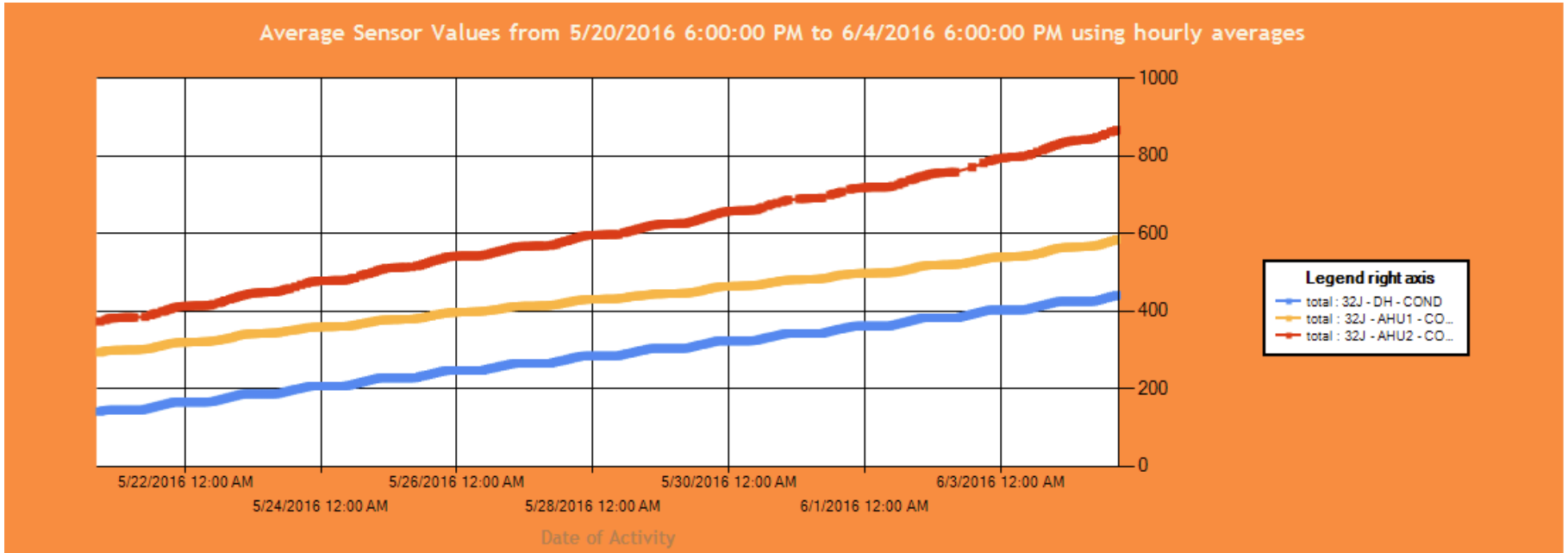
	DP(°F) : 23A - AHU2 - RA	DP(°F) : 23A - AHU2 - SA
min	57.80	53.30
max	67.20	67.70
diff	9.40	14.40

Automatic Refresh

1F650023	23A - AHU1 - RA	T(°F)	%RH	AH(GPP)	DP(°F)	%WME	Vbatt(Vdc)
1F650379	23A - AHU1 - SA	T(°F)	%RH	AH(GPP)	DP(°F)	%WME	Vbatt(Vdc)
1F65018D	23A - AHU2 - RA	T(°F)	%RH	AH(GPP)	☑DP(°F)	%WME	Vbatt(Vdc)
1F65011F	23A - AHU2 - SA	T(°F)	%RH	AH(GPP)	☑DP(°F)	%WME	Vbatt(Vdc)

Still.. the AC units DO dry the air

Condensate measurements over 13 days



	total : 32J - DH - COND	total : 32J - AHU1 - COND	total : 32J - AHU2 - COND
min	140.70	293.00	372.90
max	440.20	583.80	865.40
diff	299.50	290.80	492.50

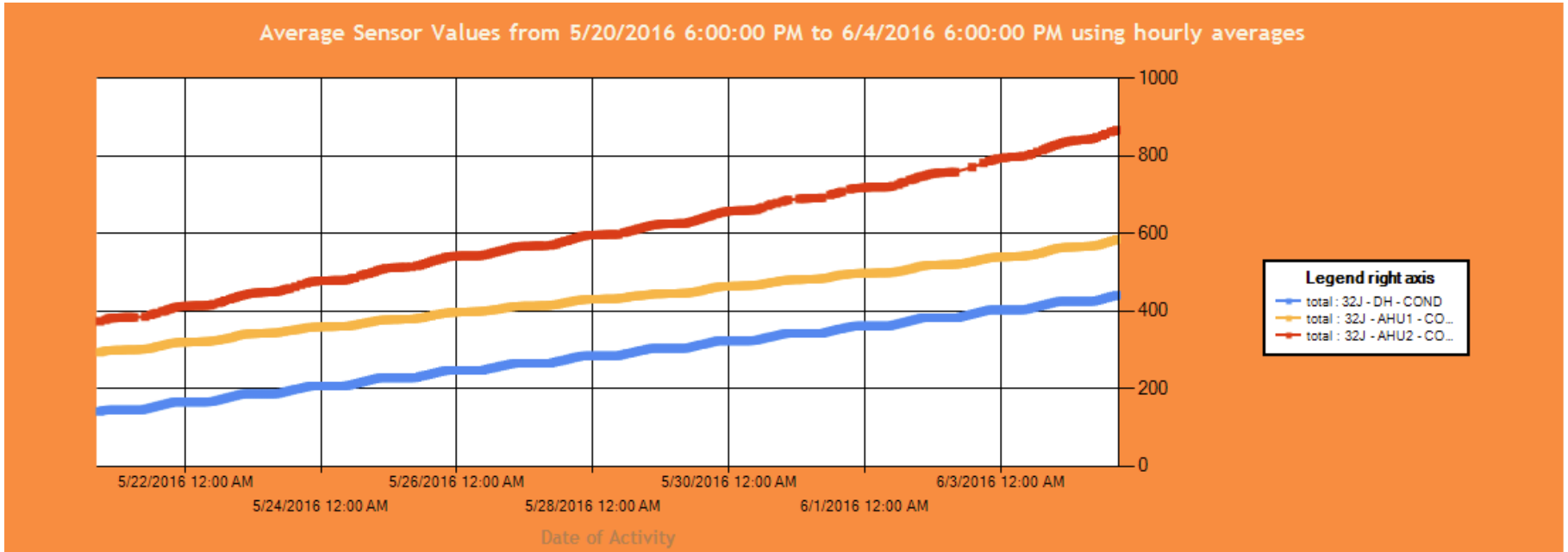
Supplemental DH Unit
300 lbs of water
removed

AHU-1
290 lbs of water
removed

AHU-2
492 lbs of water
removed

My Goodness.. What a big DH load!

4240 ft² house – 12.5 days, 1082 lb = 86 lb/day



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min	140.70	293.00	372.90
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diff	299.50	290.80	492.50

Supplemental DH Unit
300 lbs of water removed

AHU-1
290 lbs of water removed

AHU-2
492 lbs of water removed

Very High DH loads were observed in all of the monitored houses

Summer DH Loads During Three 3-day periods			
Lot and Model	**Whole-house Daily DH Load** lb H_2O / 24 hours	**Normalized Daily DH Load** Lb H_2O • ft^2 of living space	Hourly DH Load **lb/h**
Lot 21H - 2-Story	55.1	0.021	2.3
Lot 8J - 1-Story	54.9	0.020	2.3
Lot 1T - 2-Story	64.0	0.015	2.7
Lot 32J - 2-Story	78.9	0.019	3.3
Lot 35G - 2-Story	84.3	0.020	3.5
Lot 43G - 2-Story	94.7	0.022	3.9
Lot 3H - 1-Story	53.0	0.016	2.2

Values are based on average condensate during nine days, measured over three sets of three 24-hour periods. Dates of these three periods vary by house, because houses did not have condensate data available at all times.

2018 RESNET Load Assumptions vs. Measured Loads (South Florida)

Measured DH Loads vs. RESNET Assumptions

House Code	Measured DH Load (lb H_2O / 24 hours)	Measured DH Load Btu/h	Bedrooms	RESNET Assumed Load Btu/h	**RESNET Shortcoming vs. Reality** Btu/h
21H	55.1	2,434	3	800	**-1,634**
8J	54.9	2,425	3	800	**-1,625**
1T	64.0	2,827	5	1,200	**-1,627**
32J	78.9	3,485	5	1,200	**-2,285**
35G	84.3	3,723	5	1,200	**-2,523**
43G	94.7	4,183	5	1,200	**-2,983**
3H	53.0	2,341	4	1,000	**-1,341**

"Internal heat gains shall be 1,600 Btu/h sensible plus 230 Btu/h sensible and 200 Btu/h latent per occupant, with the number of occupants equal to the number of Bedrooms plus one." (RESNET Draft Std 2018)

ASHRAE 62.2-2016 ventilation for single-family residences

4.1.1 Total Ventilation Rate. The total required ventilation rate (Q_{tot}) shall be as specified in Table 4.1a or Table 4.1b or, alternatively, calculated using Equation 4.1a or Equation 4.1b.

$$Q_{tot} = 0.03A_{floor} + 7.5(N_{br} + 1) \qquad \text{(I-P)} \quad (4.1a)$$

CFM

0.03 cfm * ft2

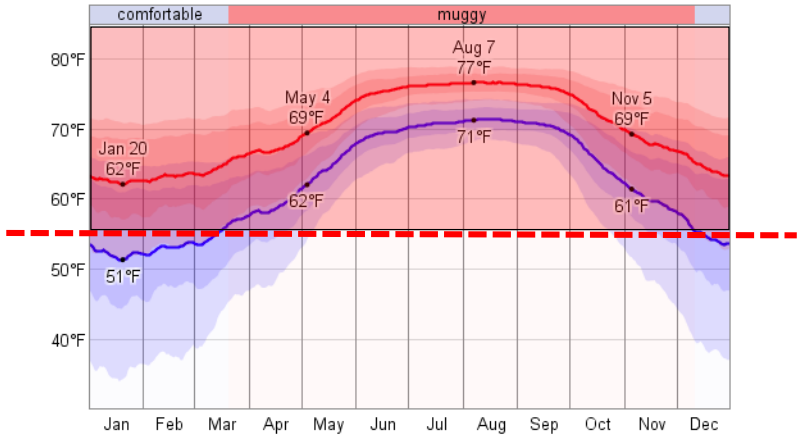
7.5 cfm *(Number of bedrooms +1)

DH loads after 62.2 ventilation (if located in Florida)

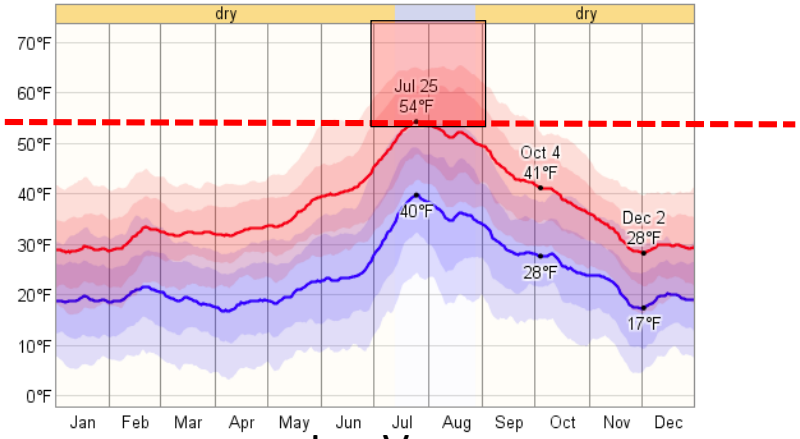
Measured DH Loads PLUS ASHRAE Std 62.2 Ventilation (Florida)			
Lot, living space and bedrooms	**Current Measured DH Load** lb H_2O / 24 hours	**New 62.2 Ventilation DH Load** Lb H_2O /24 hrs 75° dpt Outdoors vs. 55°F dpt Indoors	Total current + new ventilation DH Loads Lb H_2O /24 hrs
Lot 21H - 1-Story 2677 ft², 3 bedrooms	55.1	113.7	**168.8**
Lot 8J - 1-Story 2677 ft², 3 bedrooms	54.9	113.7	**168.6**
Lot 1T - 2-Story 4240 ft², 5 bedrooms	64.0	177.8	**241.8**
Lot 32J - 2-Story 4240 ft², 5 bedrooms	78.9	177.8	**256.7**
Lot 35G - 2-Story 4240 ft², 5 bedrooms	84.3	177.8	**262.1**
Lot 43G - 2-Story 4240 ft², 5 bedrooms	94.7	177.8	**272.5**
Lot 3H - 1-Story 3318 ft², 4 bedrooms	53.0	141.6	**194.6**

Ventilation air dew points

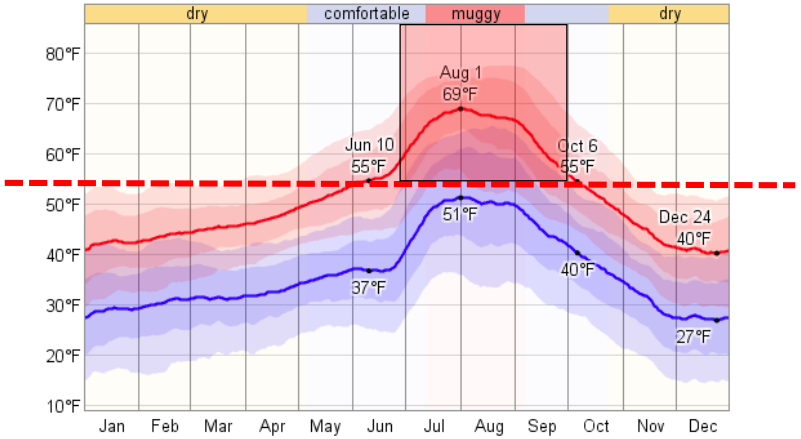
Typical annual patterns of dew points above 55°F



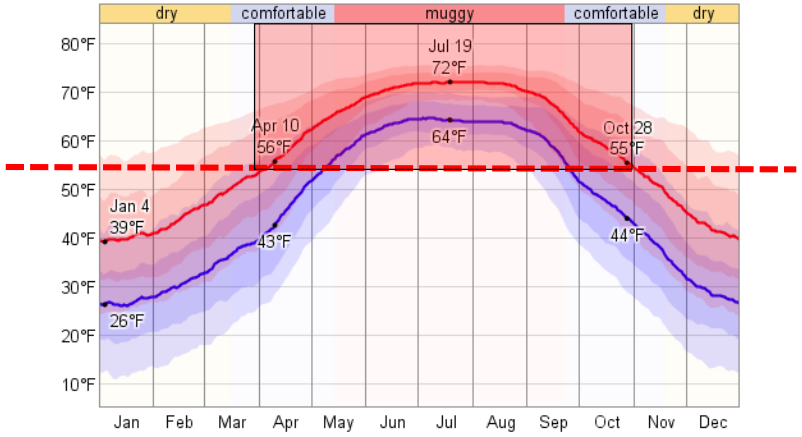
South Florida



Las Vegas



Imperial, CA



Dallas, TX

Data Source: WeatherSpark.com

Dehumidification Loads

Possible implications based on measured dehumidification

- Dehumidification loads are MUCH higher than either ASHRAE FUNDAMENTALS or ACCA Manual J calculations would suggest.
- "Reserve capacity" measured in Btu/h does NOT mean the unit will remove moisture—the compressor MUST be operating.
- Adding ASHRAE Standard 62.2-2016 ventilation will create a new demand for supplemental DH units in residential buildings in most of the US.
- **MEASUREMENTS** of dehumidification and cooling are more reliable indicators of real-world performance than are computer calculations or manufacturer's catalog ratings.
- Try it for yourself! Real world measurements will impress your clients and astonish your friends!

Water activity (aW)

Water Activity: Measuring Energy

The Energy State of Water

The water in the glass has higher energy. It's available. The water in the sponge has lower energy, and is less available. Both the sponge and the glass have the same water **content**, but the water in the sponge is measurably different.

This difference is a difference in the energy state of the water. Water activity expresses this difference as a number between 0 and 1.0, with 1.0 being defined as pure, free water.

Where Microorganisms Come In

William James Scott studied food spoilage during World War II, and later focused his research on the relationship between water and microorganisms.

In 1953, he showed that microbial growth in food is governed not by water content, as most people thought, but by water activity. Four years later, he established the concept of a minimum water activity necessary for microbial growth.

Water Activity Growth Limits

In other words, he showed that each microbe and mold spore has a water activity growth limit--a water activity below which it will not grow.

Scott's work was done on food, but has proved relevant to every porous material. It applies equally to products from fresh tree nuts to tree bark, from hand lotion to carpet and insulation.

Source: 2013
Brady Carter, Ph.D.
Decagon Inc.

Water activity defined & measured

$$a_W = \frac{\text{Partial pressure of water vapor in the } \textbf{sample}\ldots \text{ when measured @ sample temperature}}{\text{Partial pressure of water vapor of } \textbf{air}\ldots \text{ when saturated @ sample temperature}}$$

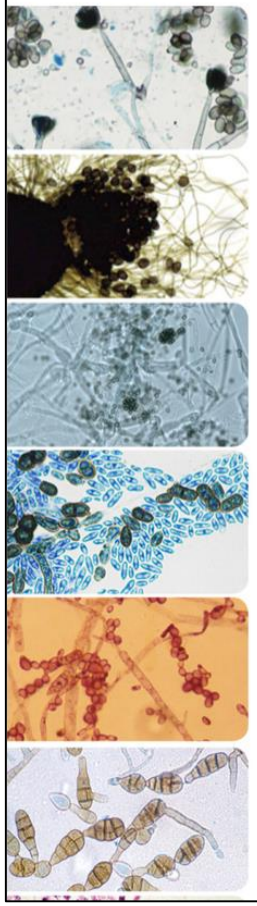
A **water activity** of 0.80 **means** the **vapor pressure** is 80 percent of that of pure water. The **water activity** increases with temperature. The **moisture condition** of a product can be measured as the **equilibrium relative humidity** (**ERH**) expressed in percentage… or as the **water activity** as a decimal.
(Technical Guide for Inspections – expressedFDA 2015)

$$a_W = \frac{\text{rh (}\textbf{when @equilibrium!}\text{)}}{100}$$

Microbial growth vs. a_w

HygroPalm - HP23-AW-A - Portable Water Activity Analyzer

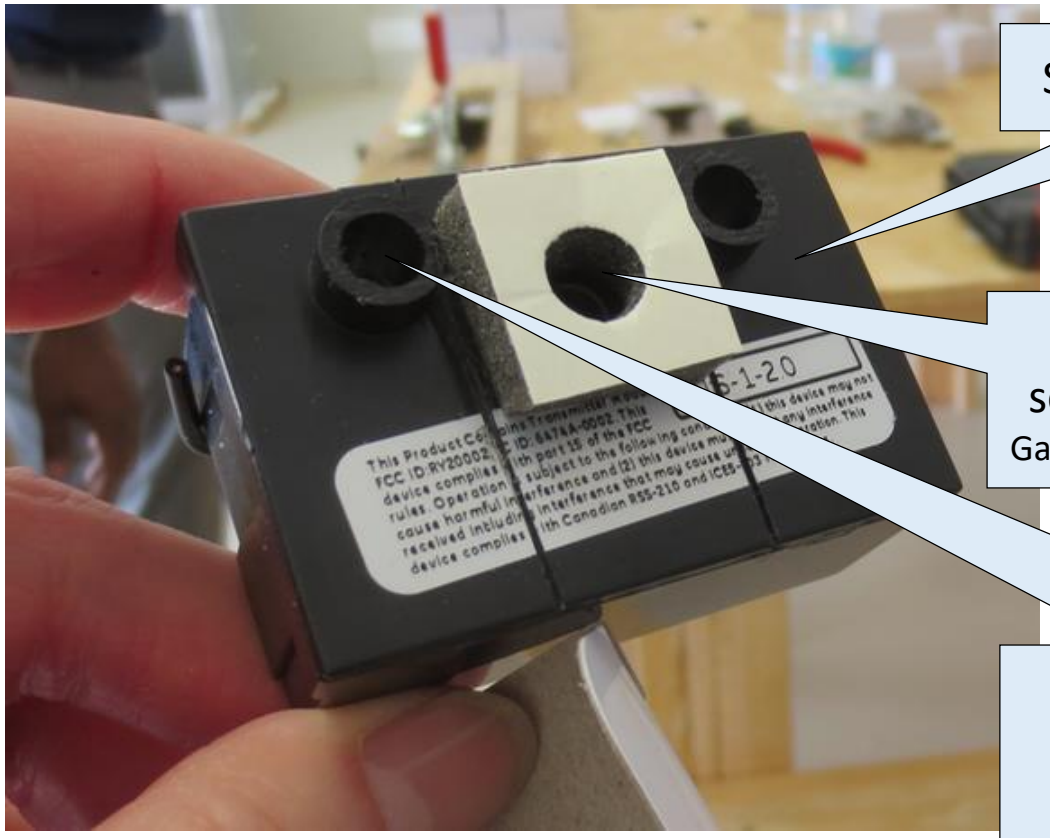
Water Activity and Growth of Microorganisms*



Range of a_w	Microorganisms Generally Inhibited by Lowest a_w in This Range
1.00–0.95	Pseudomonas, Escherichia, Proteus, Shigella, Klebsiella, Bacillus, Clostridium perfringens, some yeasts
0.95–0.91	Salmonella, Stachybotrys, C. botulinum, Serratia, Lactobacillus, Pediococcus, some molds, yeasts (Rhodotorula, Pichia)
0.91–0.87	Chaetomium, Trichodermo
0.87–0.80	Most molds (mycotoxigenic penicillia), Staphyloccocus aureus, most Saccharomyces (bailii) spp., Debaryomyces, Cladosporium, Alternaria
0.80–0.75	Most halophilic bacteria, mycotoxigenic aspergilli, Penicillium
0.75–0.65	Xerophilic molds (Aspergillus chevalieri, A. candidus, Wallemia sebi), Saccharomyces bisporus

Surface water activity in buildings

Sensor configuration: Temp + RH + WME



Same wireless sensor

Sensor on the circuit board only senses air inside ¼” diameter space

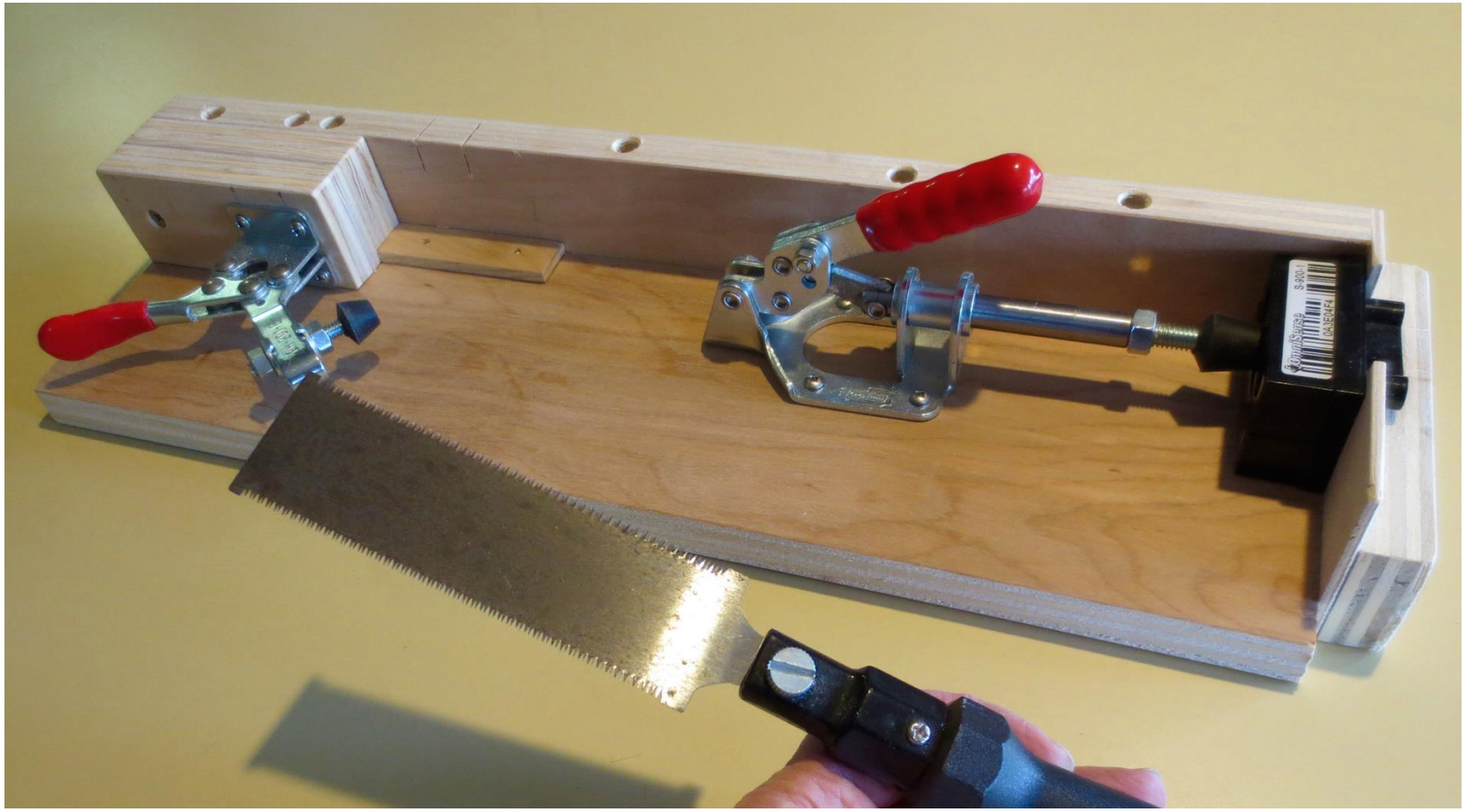
Gasket isolates the surface from surrounding air

Sensor is attached to the surface with conductive screws

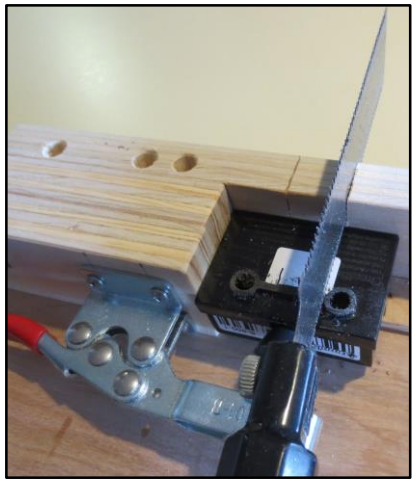
Resistance between the mounting screws is monitored and recorded as WME (Wood-Moisture-Equivalent)

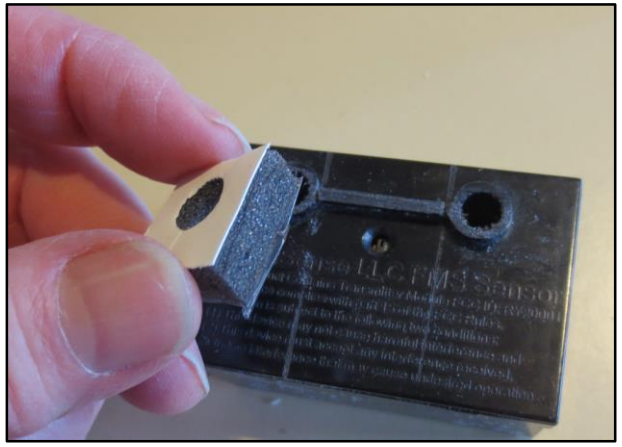
Keep in mind this fundamental limitation:
NOTHING is EVER at equilibrium in a building!

Sensor modification jig

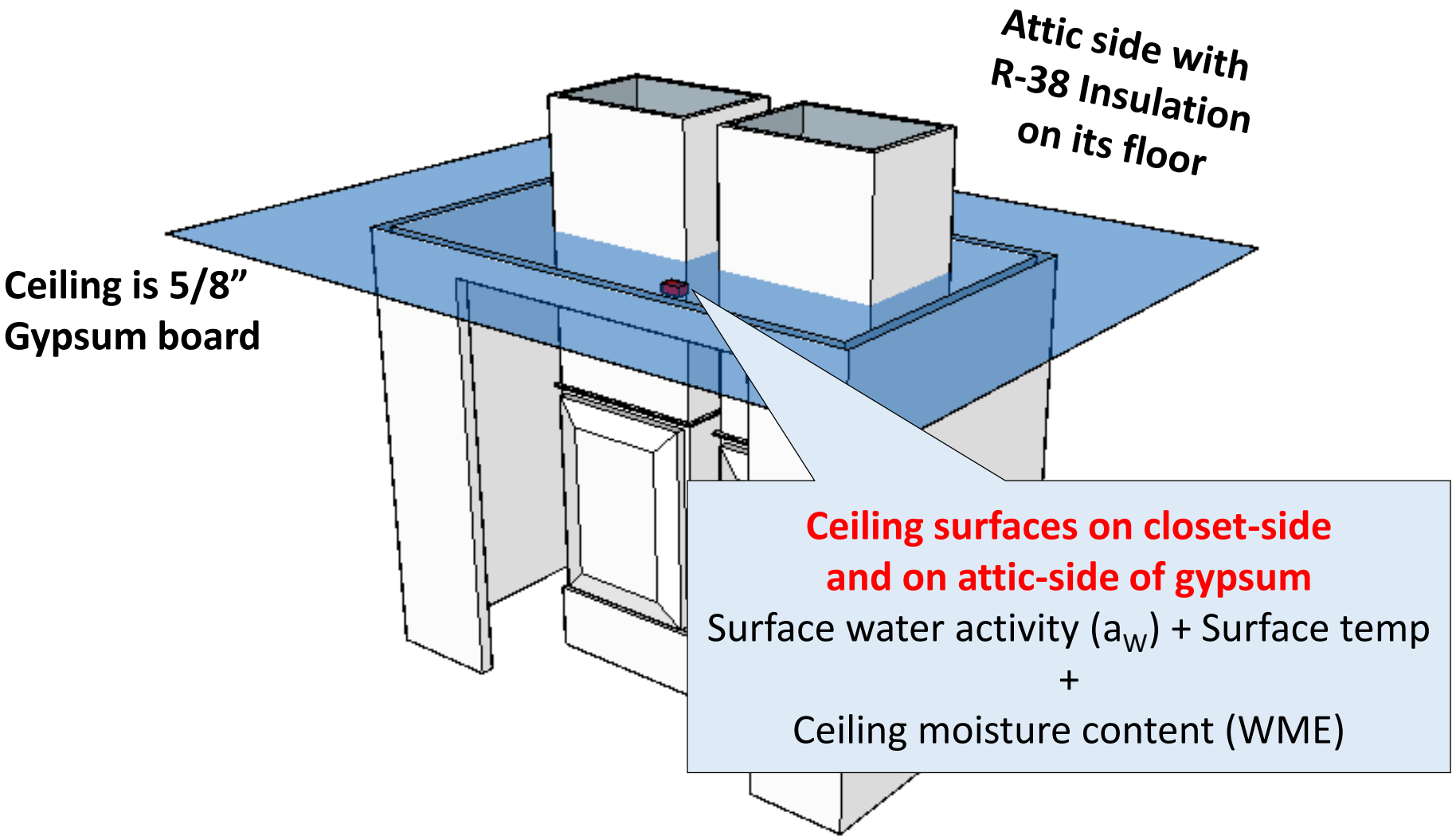


Modifications

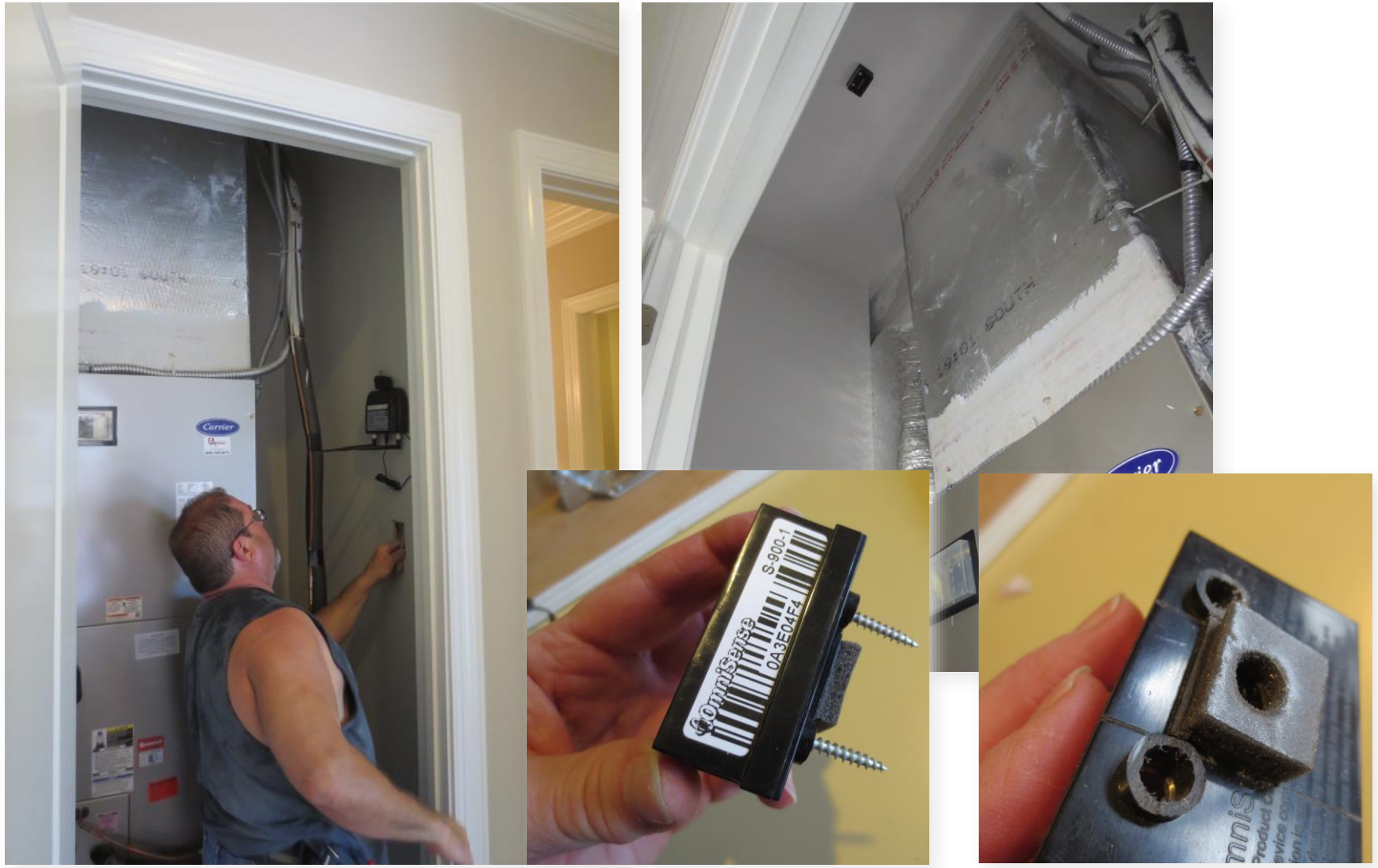




Sensors mounted on the ceiling



aW of the ceiling surface in a mechanical closet



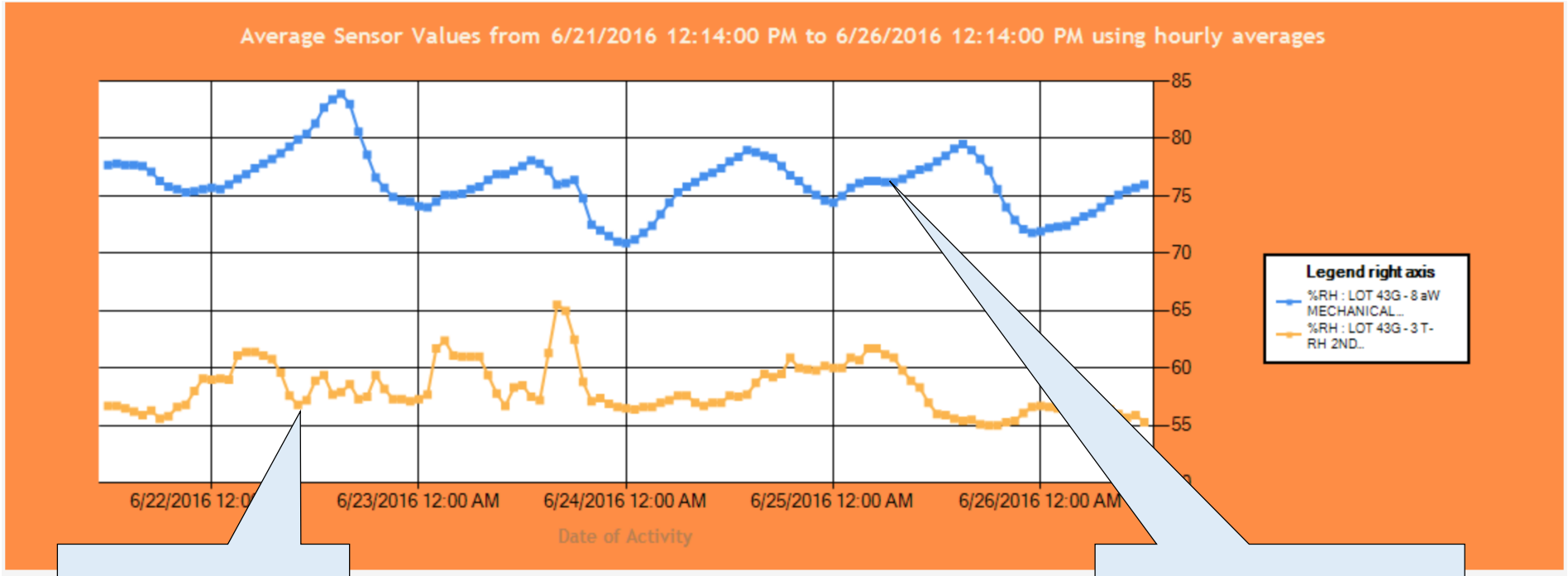
aW Monitoring
Houses in Florida

Monitoring clearly shows that **Air RH** is NOT **Surface RH**

2nd floor air T-RH
Hangs from a hook
right here

Closet ceiling aW
Screwed to the gypsum
board right here

RH of the air v. a_W at the surface



W MECHANICAL CLOSET - ATTIC - STOP 9/13	%RH : LOT 43G - 3 T-RI	/13
70.90		
83.90		
13.00		

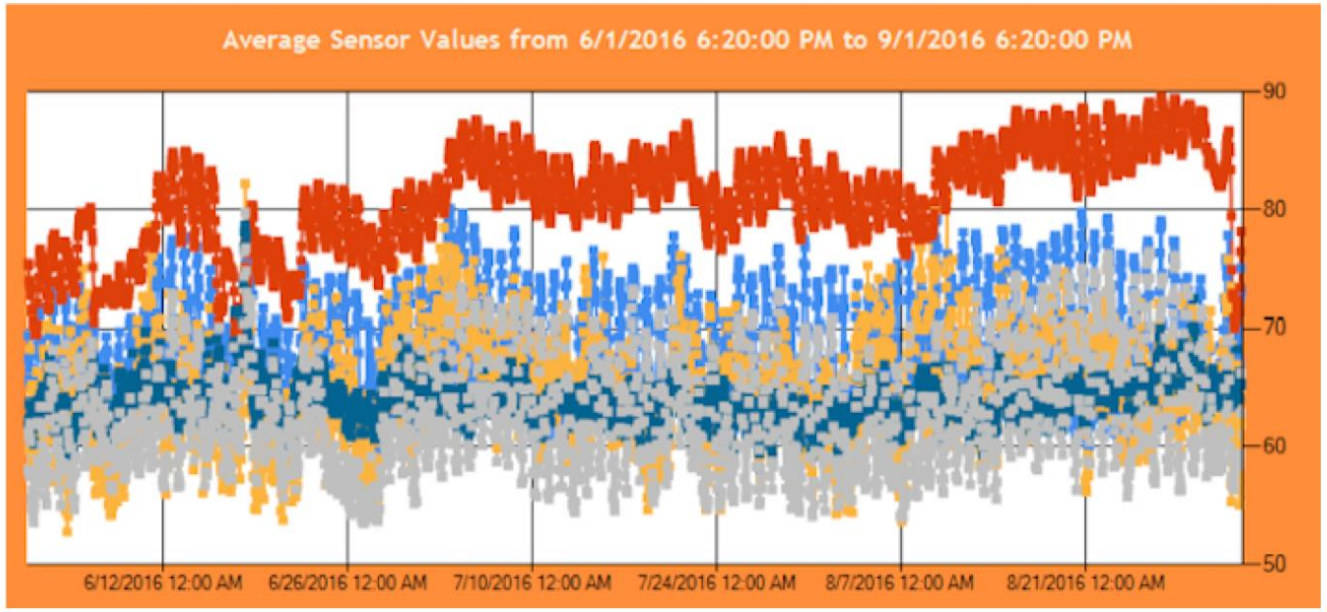
RH of the air

aW – Equilibrium RH at the surface of the ceiling

2-Story House (Type S– 20J)
NO MOLD

Occupied Spaces: Surface water activity (aW) of ceilings

(To read aW value, adjust the decimal place of the vertical axis label, ie: 70 = 0.70 aW) [1]



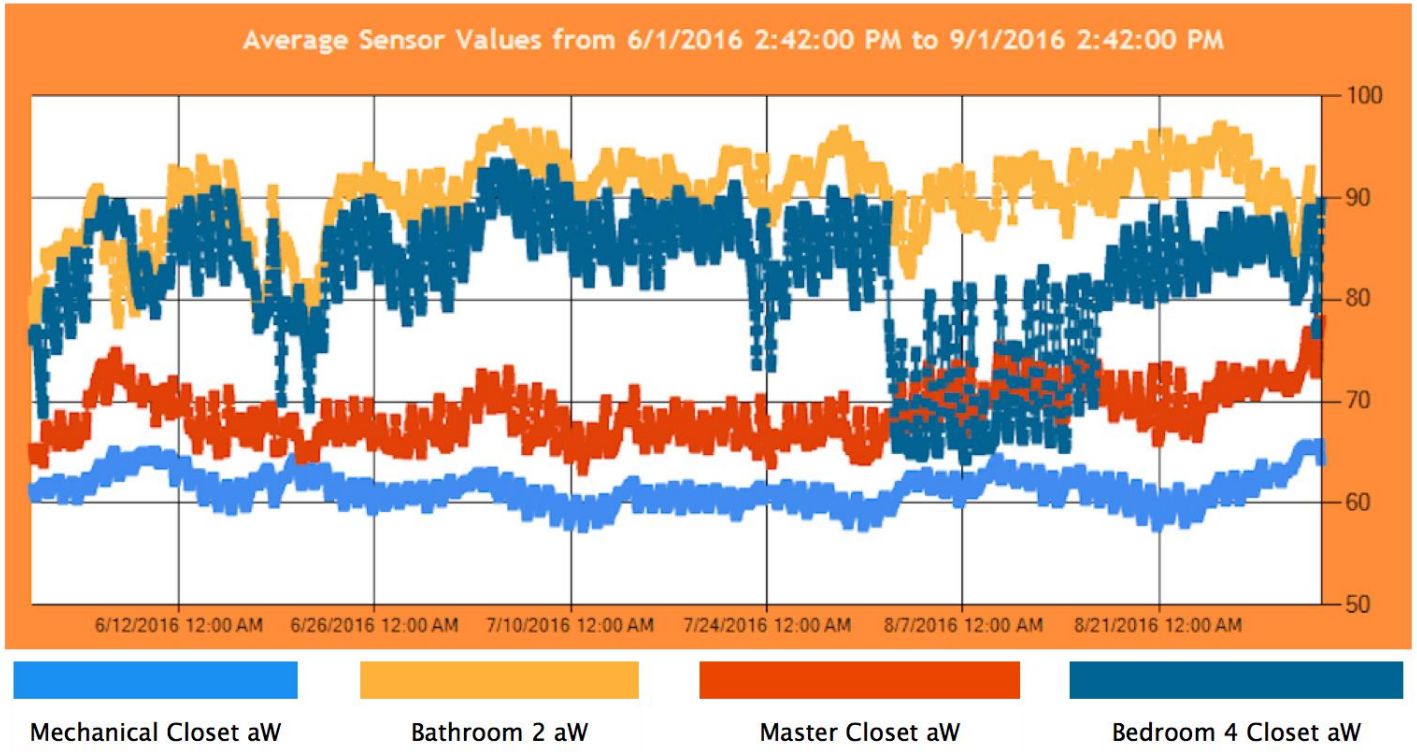
Sensor Locations: (Attached with electrically-conductive screws that measure moisture content)

- Ceiling of the mechanical closet and also the ceiling of the adjacent hall closet
- Ceiling of the 2nd floor hall bathroom
- Ceiling of the linen closet adjacent to 2nd floor hall bathroom
- Ceiling of the closet in bedroom 4 (front bedroom)

2-Story House (Type W - 14H)
NO MOLD

Occupied Spaces: Surface water activity (aW) of ceilings

(To read aW value, adjust the decimal place of the vertical axis label, ie: 70 = 0.70 aW) [1]



Sensor Locations: (Attached with electrically-conductive screws that measure moisture content)

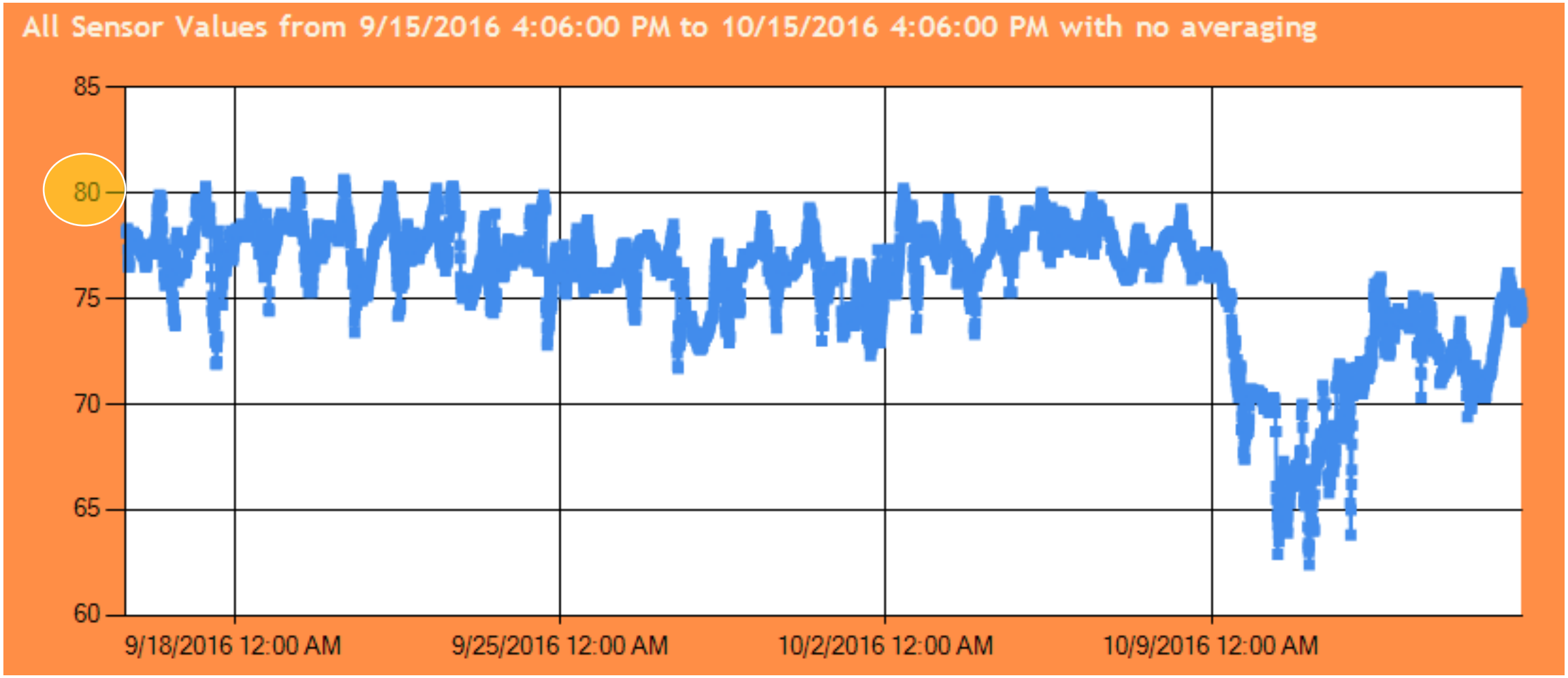
- Ceiling of the mechanical closet
- Ceiling of the 2nd floor bathroom #2
- Ceiling of the master closet, and the closet of bedroom 4 (front bedroom)

Observations about a_W and mold

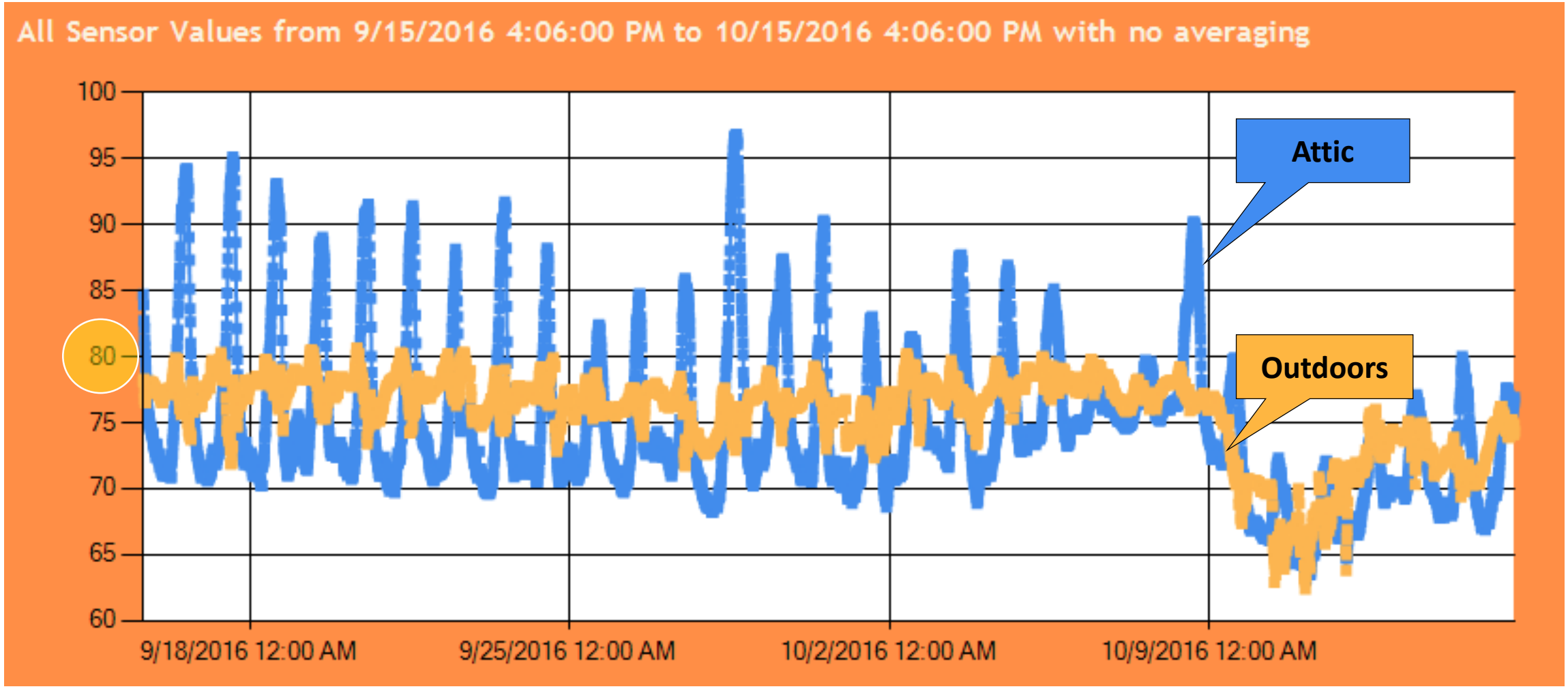
- RH in the air is ***not even close*** to the RH at the ceiling surface in occupied spaces. (Inside walls… probably much closer)
- **IF AIR TEMP STAYS ABOVE 75F**, indoor surfaces in homes with AC are quite forgiving! (Difficult to grow mold, unless indoor dew point is above 65F so that condensation occurs, or unless plumbing or walls leak.)
- The old ASHRAE 160 (30-day running average over 0.8 surface a_w) is certainly too conservative for indoor painted gypsum board.
- For indoor painted gypsum that dries, even a little bit, new ASHRAE Std 160 (Viitanen model) is ***still*** conservative: predicts mold growth that was not observed in these houses

Dew points outdoors v. inside attic

Outdoor air dew points
Sept - Oct 2016



Attic v. Outdoor air dew points
Sept - Oct 2016 (code 32a)

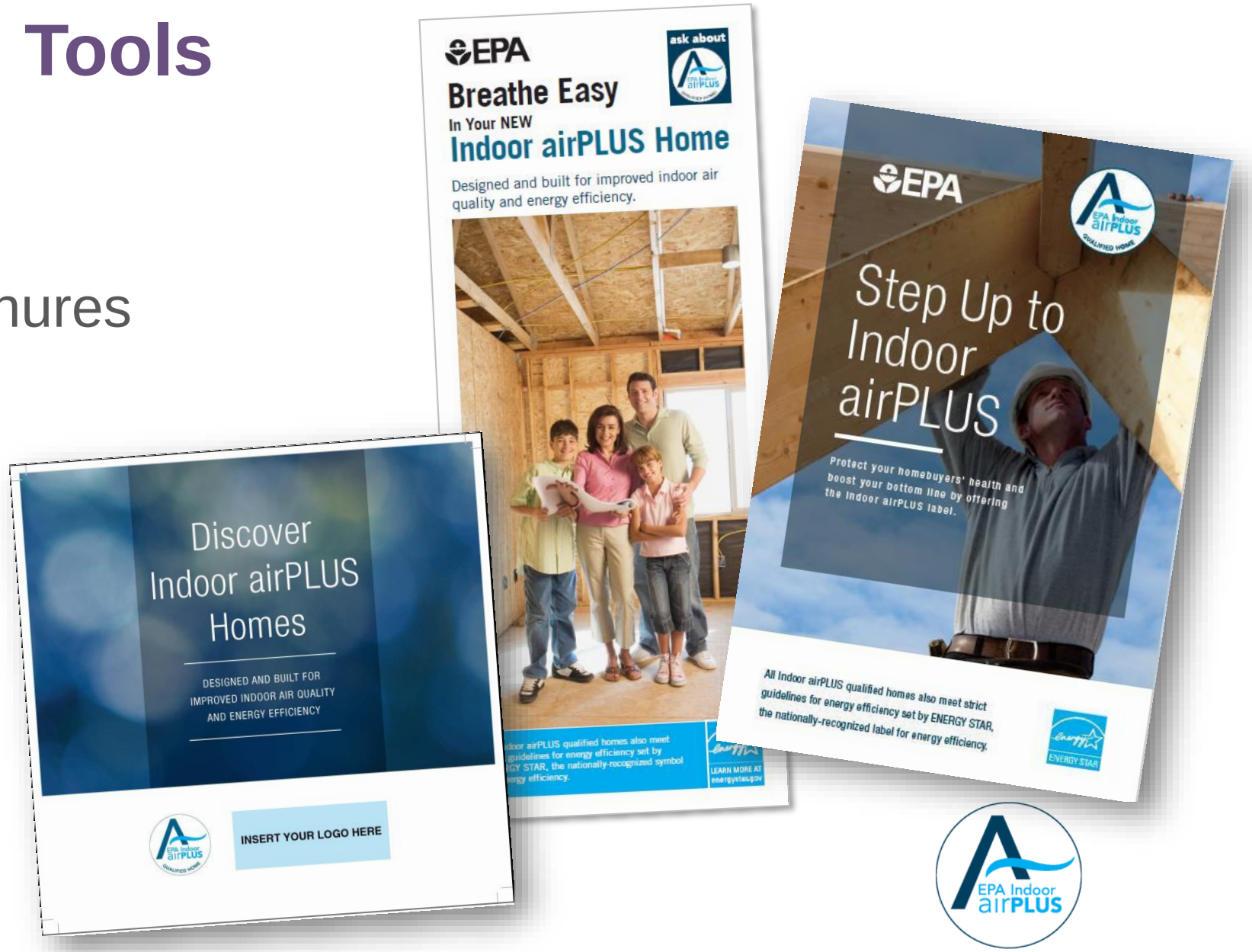


Observations about “vented attics”

- **Attic venting at the eaves alone is not effective**. Roof peak venting, and or diffusion vent at roof peak is needed in South Florida.
- Attic dew points are FAR higher than outdoor dew points during the day time, and often higher at night in South Florida. Therefore…
- Vapor barriers are important and useful between attic and occupied space in South Florida.
- It’s a poor idea to put air handlers and duct work in vented attics in South Florida (and other places).

Resources and Tools

- Partner logos
- Co-brandable brochures
- Partner locator
- Website widgets
- 100% Commitment



Indoor airPLUS Sales Training Kit – Course Materials

Resources and Tools

Multimedia tools:

- YouTube Videos
- Webinar recordings
- Podcasts
- Facebook
- Twitter

EPA Indoor airPLUS

Indoor Air Quality (IAQ)

www.epa.gov/indoorairplus/indoor-airplus-videos-podcasts-webinars-and-interviews

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The Indoor airPLUS Leader Awards were created to recognize leading program partners who build or verify IAP homes and effectively educate homebuyers using the IAP brand and tools.

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