Moisture, Ventilation & Global Weirding

NEHERS Webinar Series

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Discussion Points

- Weather and Building Practices – Constant Change
- Warm Weather
  - Temperature
  - Humidity
- Ventilation issues and Observations
  - Types
  - Impacts
  - Other Factors
- Cold Weather Impacts
  - Time permitting

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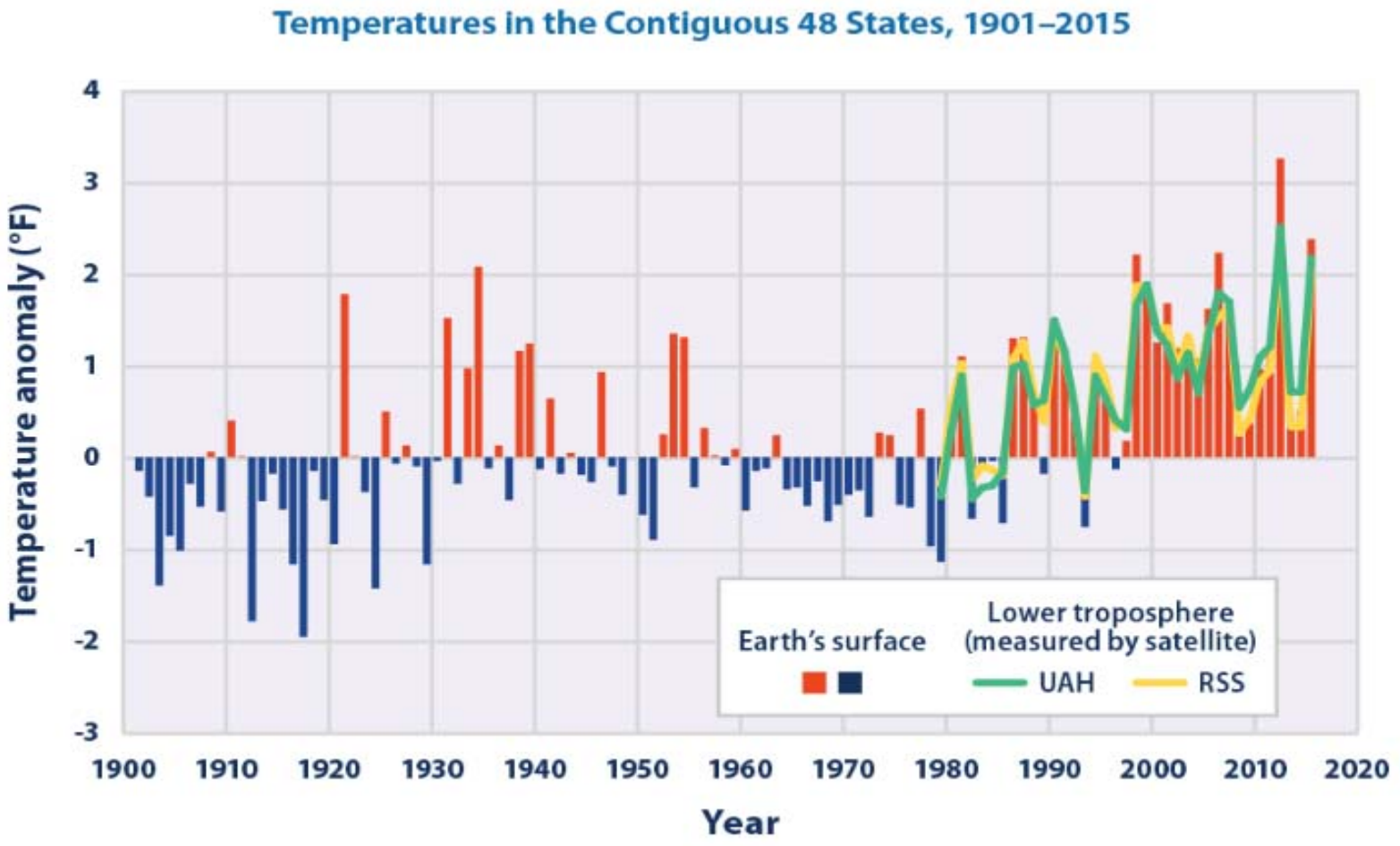
Warmer



Data source: NOAA (National Oceanic and Atmospheric Administration). 2016. National Centers for Environmental Information. Accessed February 2016. www.ncei.noaa.gov.

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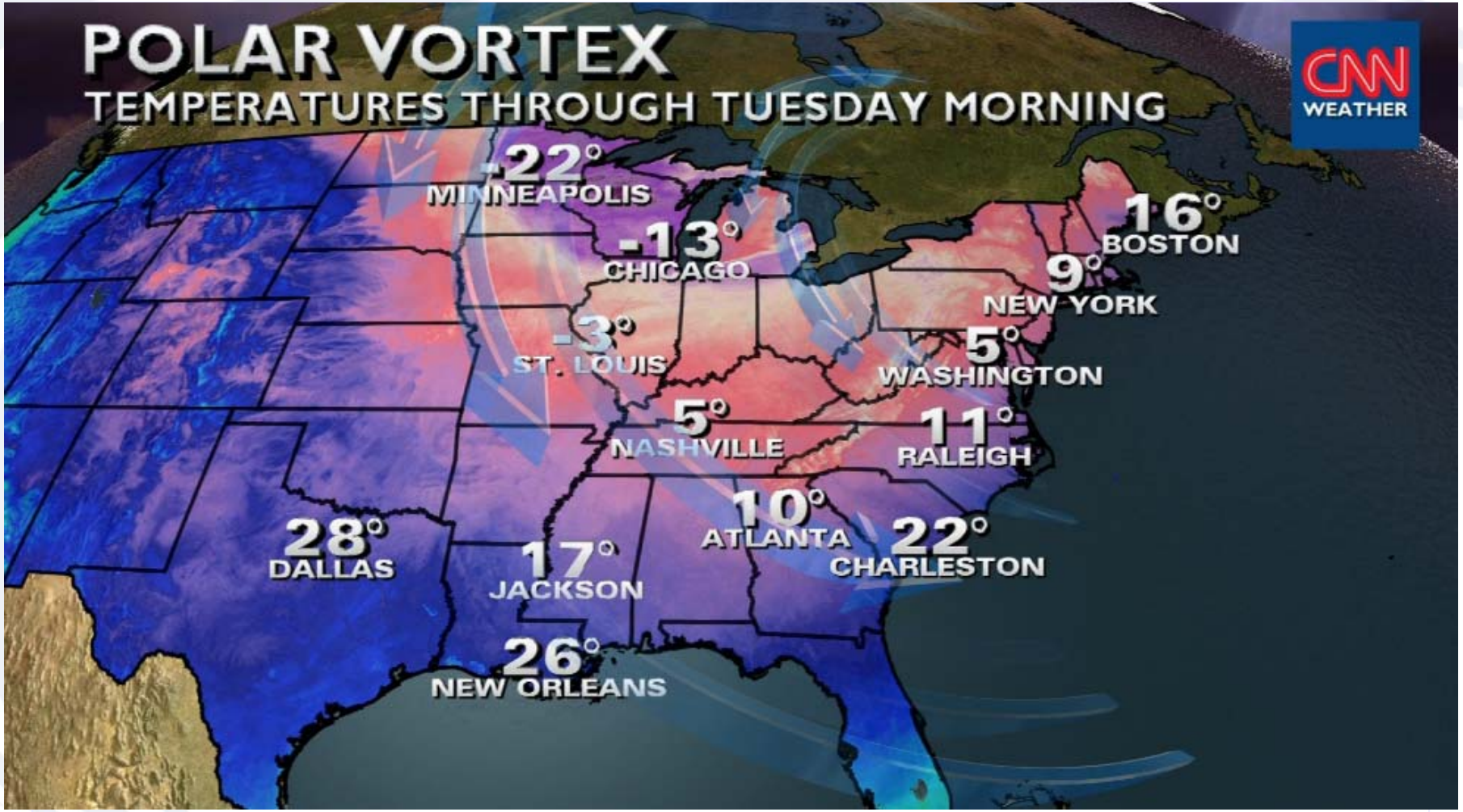
Colder



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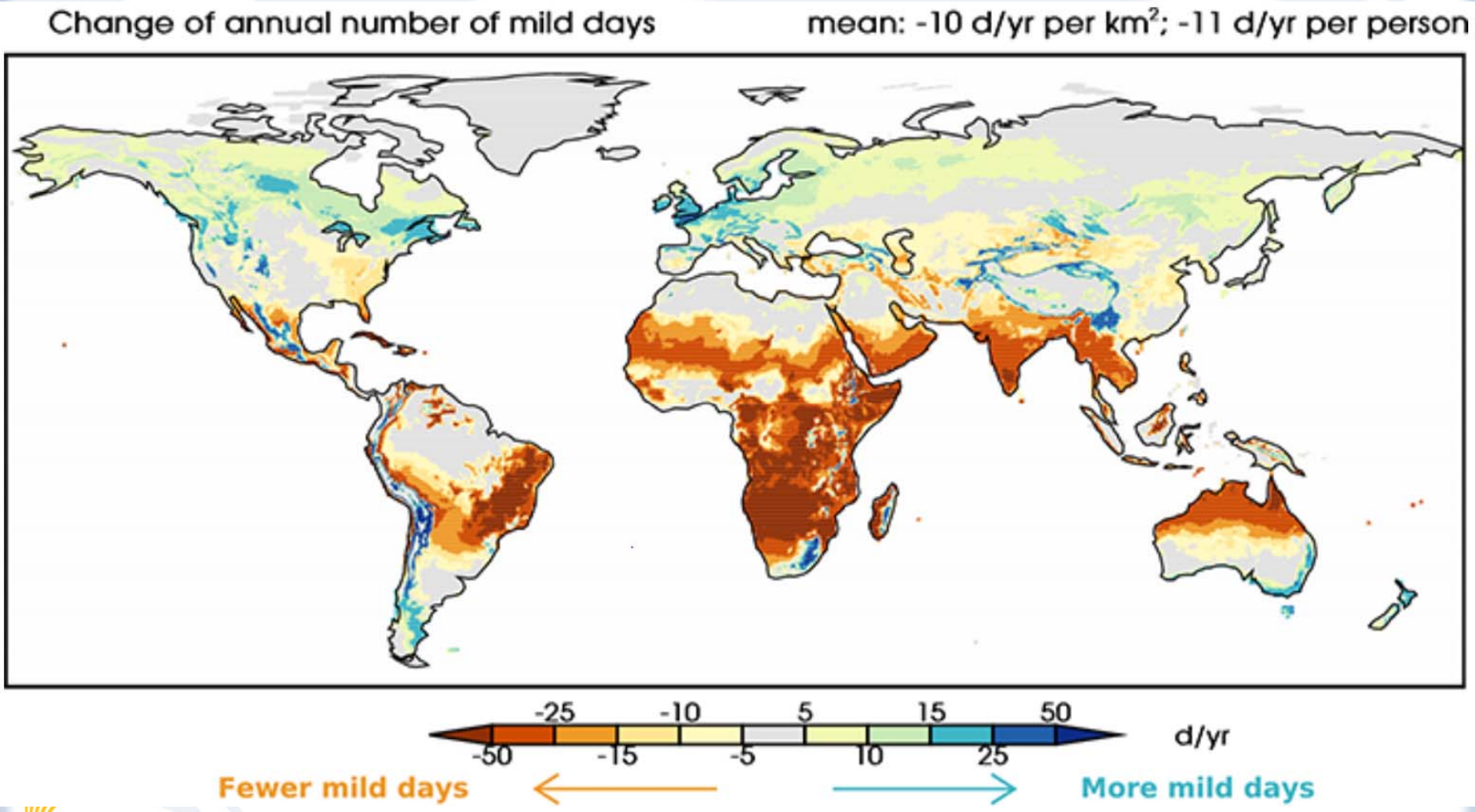
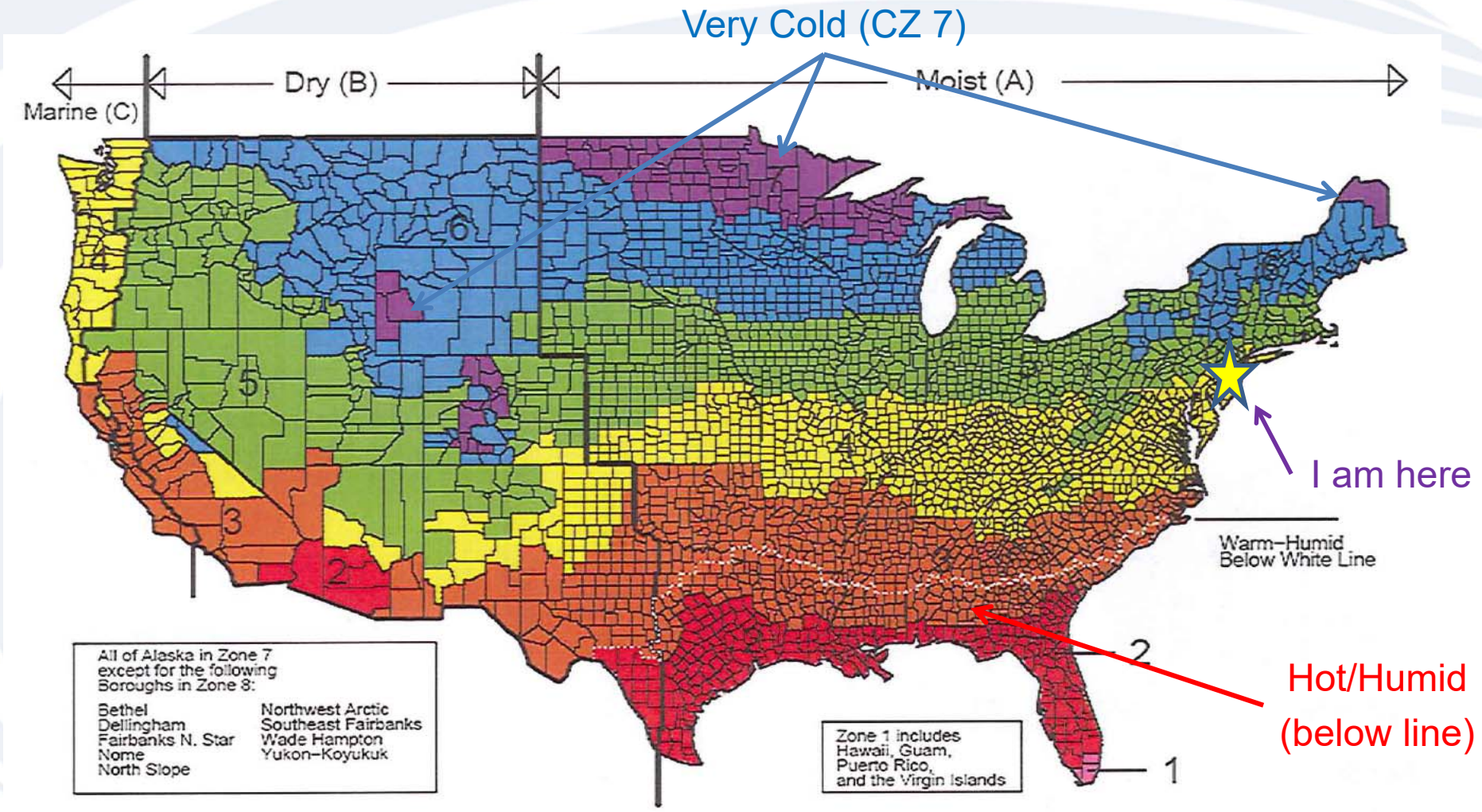
Weirder



2017 NOAA/Princeton University Study

Mixed Climate



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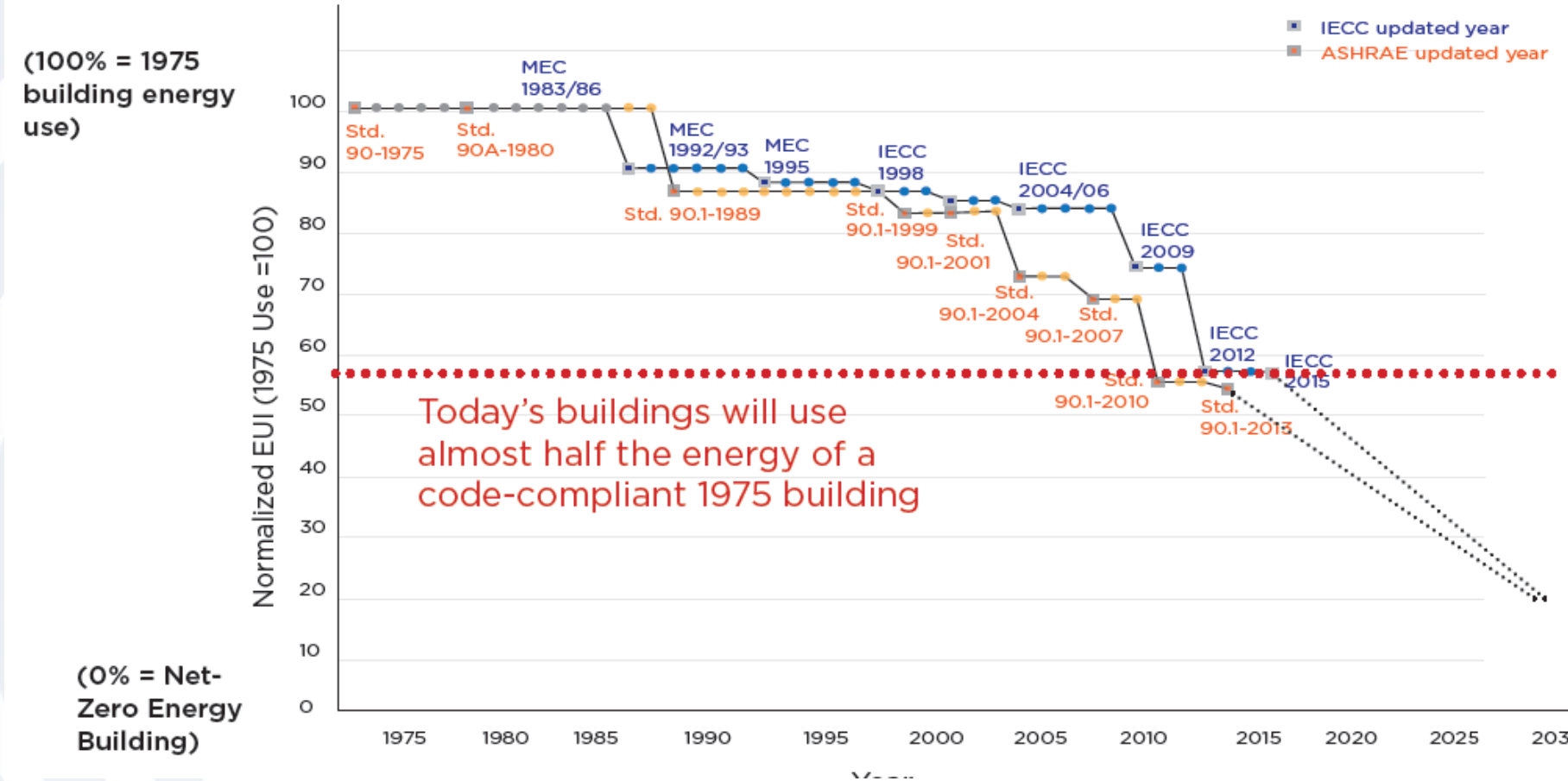
Changing Built Environment



Courtesy of NYSERDA/Urban Green "Conquer the Code"

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Changing Built Environment

- Insulation levels are high and getting higher
- We have made them tighter
- We have added more windows
- We have added more and larger fans
  - Forced air HVAC systems
  - Exhaust fans - How about a 1500 CFM range hood?
  - Clothes dryers
- We build them taller and attach them in strange ways

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Changing Built Environment

- Curb appeal – multiple roof lines, claddings…
- We added air conditioning – now we need to protect against moisture in two directions
- Less maintenance
- Harder to shed water
- Higher expectations from buyers
- More or less stress on our homes?

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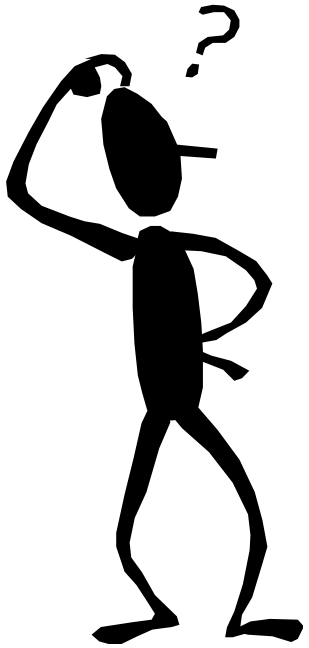
Let's Look at Ventilation

A house has got to breathe, right? Why?

- Provide fresh indoor air
- Dilute indoor air pollutants
- Moisture control



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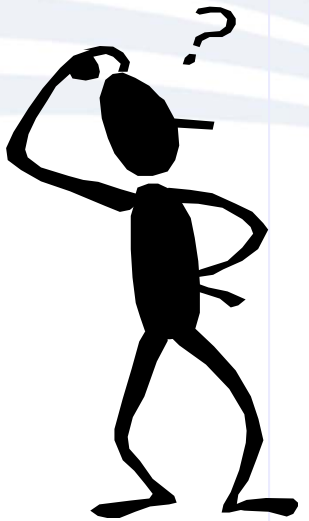
Ventilation

- And why it matters…

So Many Questions

- How much air do you need?
- How much air are you getting?
- Where does it come from?
- How big a hole do you leave?
- Where do you put the hole?
- Can the air hurt us or the house?



How about a few answers:

1. The inside of the house needs to "breathe" but the walls, ceilings and floors do not
2. We can't rely on passive systems to get it right

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What are we doing?

- Smarter Building Systems
  - Control dew point
  - Less air movement
  - Better bulk water management
- Controlled movement of air and moisture
  - We call this ventilation
  - We can do this better

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Ventilation

Intentional Outcomes

- Controls odors
- Controls mirror fogging
- Dilutes indoor pollution
  - Smoke
  - Dust
  - Chemicals
  - Carbon Dioxide
  - Moisture
- Provides fresh air for occupants

Unintentional Outcomes

- Pressurize/Depressurize
  - What's the lowest CFM50 you have ever measured?
- Can increase indoor pollution
  - Air is dumb
  - Where is it coming from?
  - Moisture
- Combustion problems

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Ventilation

- Anyone ready to leave it out?

ASHRAE 62.2 Definition

Ventilation: the process of supplying outdoor air to, or removing indoor air from, a dwelling by natural or mechanical means. Such air may or may not have been conditioned.

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Whole Building Ventilation

- ASHRAE 62.2 requires mechanical ventilation for the whole building to provide no less than the required rate of air based on the size of the conditioned space and the number of occupants
- 2012 and 2015 I-Codes have followed this lead.

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ENERGY STAR for Homes

- Whole-Building Ventilation

Required Ventilation Rate (cfm) =
(0.01* x Conditioned Floor Area) + 7.5 x (bedrooms + 1)

Example (2,000 sq. ft., 4 bedroom house):
Ventilation rate = (2000 x 0.01) + (7.5 x 5) = 58 cfm
*Ventilation rate = (2000 x 0.03) + (7.5 x 5) = 98 cfm

- 2013 version refers to 0.03 x CFA with credit for air infiltration in single family

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ENERGY STAR for Homes

- Whole-Building Ventilation
  - Exhaust only, supply only or balanced system
  - Local exhaust fans can be used
  - Outdoor air can be supplied to the return of an air handler if the air meets manufacturer's return air temperature criteria
  - "Fan On" can be used as a control strategy by ASHRAE 62.2, but not ENERGY STAR

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ENERGY STAR for Homes

- Whole-Building Ventilation
- Intermittently operated systems permitted, but ventilation rates must be increased if:
  - Cycle time is greater than 4 hours and
  - Fractional on time is less than 100%
- Intermittently operated systems must be larger to overcome off cycles and reduced ventilation effectiveness
- Limitations for extreme weather conditions
  - < 7.5 cfm/100 sq.ft. net exhaust in hot humid climates
  - < 7.5 cfm/100 sq.ft. net supply in very cold climates

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Observations of Summer Moisture

- Over the past 2 to 3 summers
- Small Low Rise Apartments and Townhomes 800 to 1200 square feet

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Observations

- Condensation on cold surfaces, i.e. uninsulated supply ducts, registers, refrigerant piping
- Dripping onto sheetrock – some failures experienced
- General high indoor humidity 70%RH+
- Outdoor mechanical closets a problem in some cases

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Cause 1 - Depressurization

- Exhaust only ventilation systems – mostly continuous
- Some over-ventilation – 70 CFM in 600 SF in one case (5+ Pa)
- Quiet exhaust fans in kitchens run continuously in some cases

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Cause 2 – Leak Location

- Floor/ceiling assembly leakier than other systems
- Outdoor mechanical closets a problem in some cases
- Remember – air is dumb. It will use the path of least resistance

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Cause 3 – Not enough Dehumidification

- High Cooling Coil temperatures
  - 3 ton air handlers with 1.5 ton condensers factory set at high speed for cooling
  - Improper charge
- Oversized cooling systems
  - The smallest size is too large in many cases (1.5 ton split systems
  - Oversized on top of that
    - End units upsized
    - Larger units upsized

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Cause 4 – Inhospitable Environment

- Duct systems in floor/ceiling assembly
  - Soffited systems on top floors don't seem to be a problem
- Low cooling temperature setting in some problem units (as low as 65F)
- Floor/ceiling assembly leakier than other systems
- No insulation on supply ducts in conditioned spaces
- Tight duct systems
  - Duct leakage tends to clear moisture

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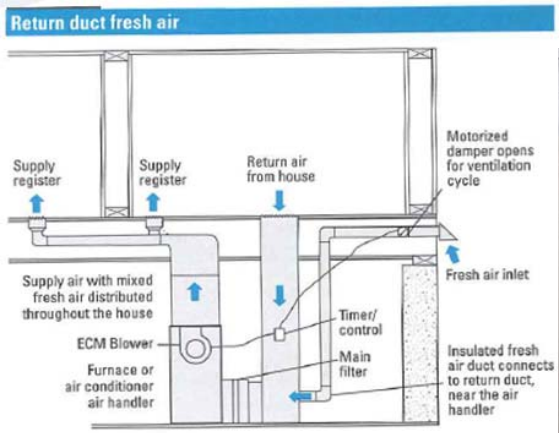
Solutions

- Supply side ventilation systems
- Passive ducted supply air source with exhaust systems
- Timers on kitchen fans
- Dehumidifiers
  - Ducted – needs to be wired to air handler
  - Stand-Alone – wall mounted



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Solutions

- ERVs to define outdoor air path and remove some of the moisture
- Temperature limited thermostats (minimum setpoint 70 to 72)
- Soffited system design
- Insulated supply ductwork
- Extra attention to band joist air sealing

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Ventilation – Summary

- Let's Recap
  - Current insulation and moisture levels dictate better moisture control
  - Uncontrolled air movement doesn't work in modern homes
  - Define the outdoor air path
  - Avoid depressurization
  - Understand pros and cons beyond first cost
  - Protect condensing surfaces in the building

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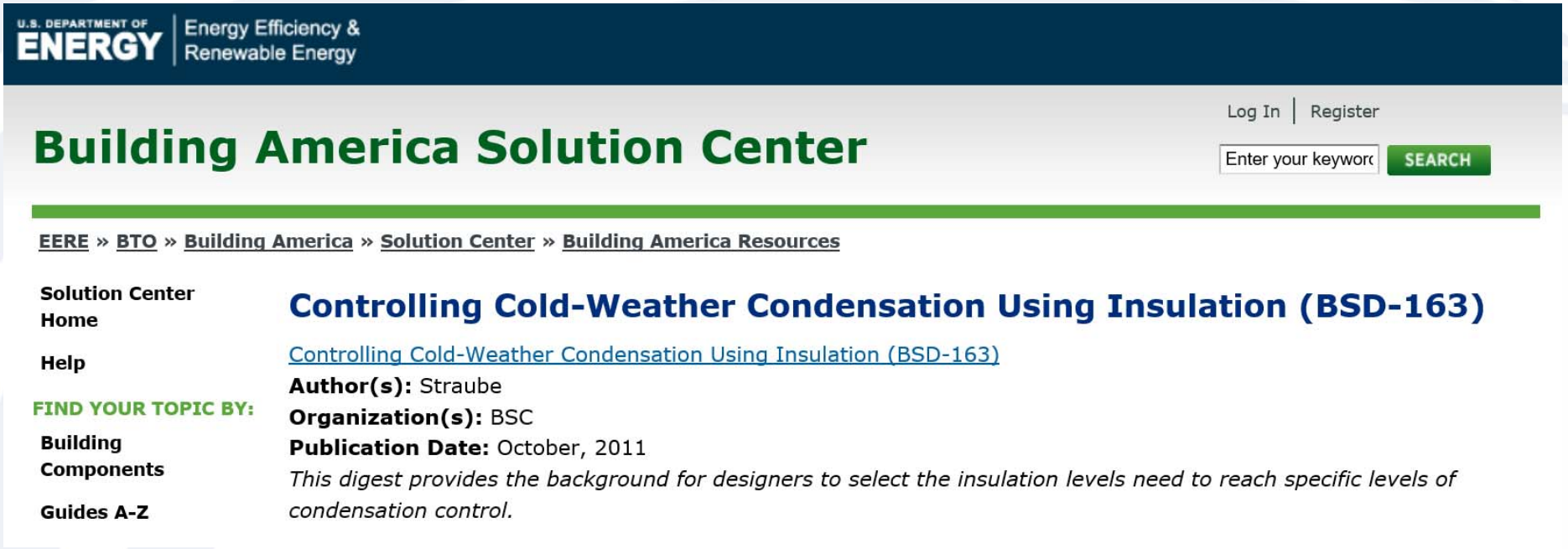
Meanwhile, What's Happening in Our Walls?



https://basc.pnnl.gov/resources/controlling-cold-weather-condensation-using-insulation-bsd-163

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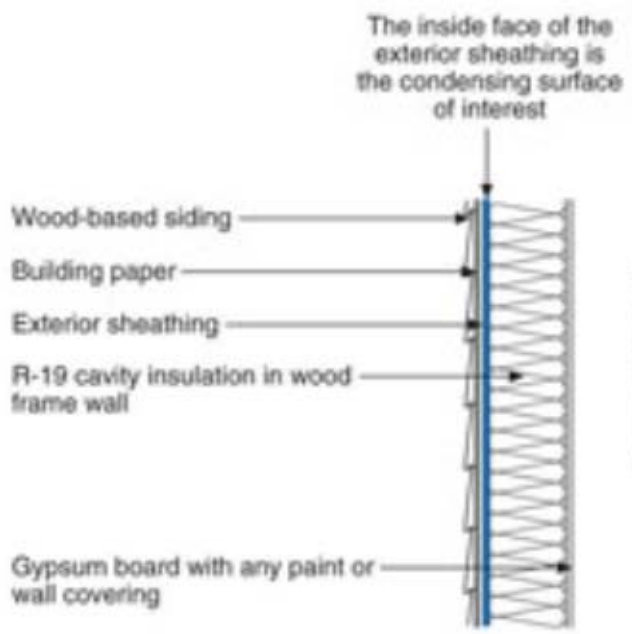

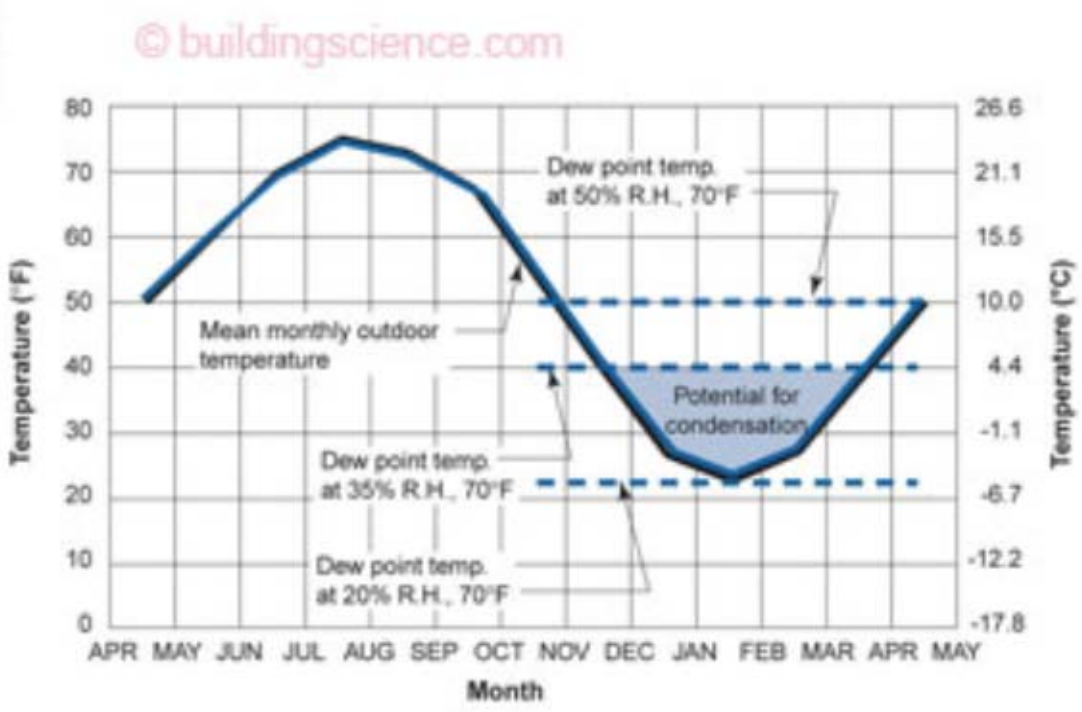

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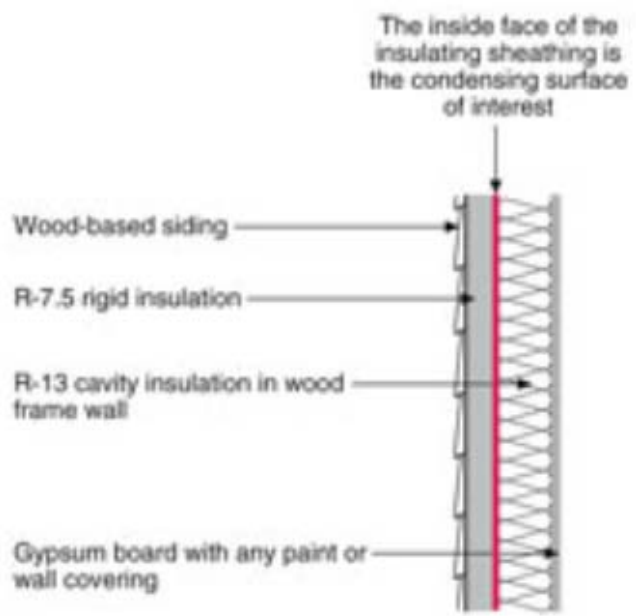

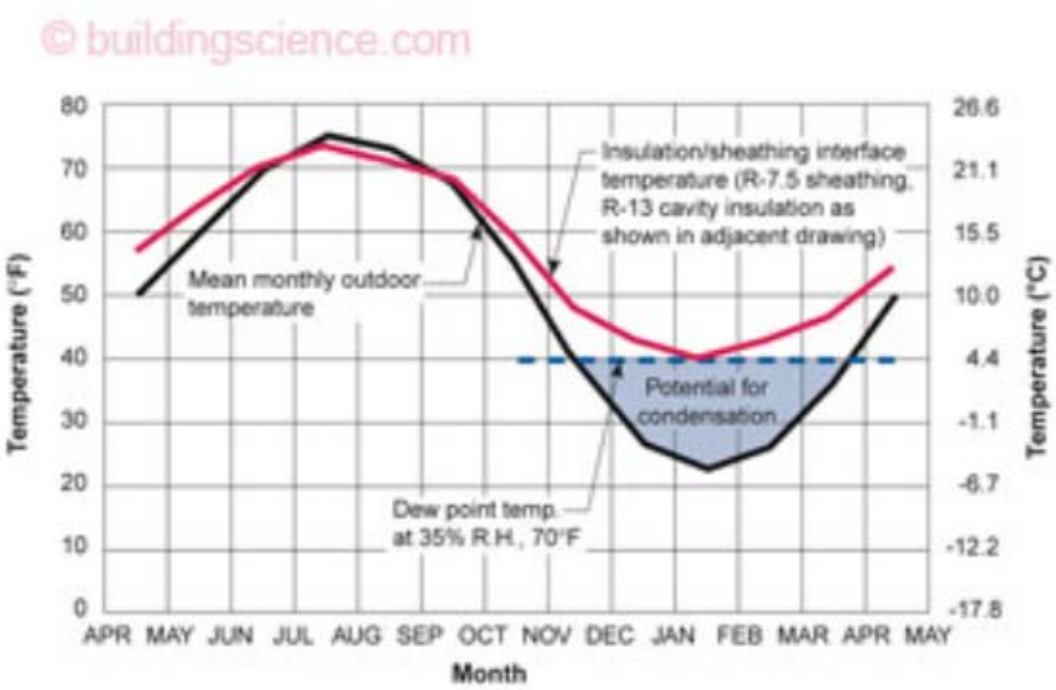

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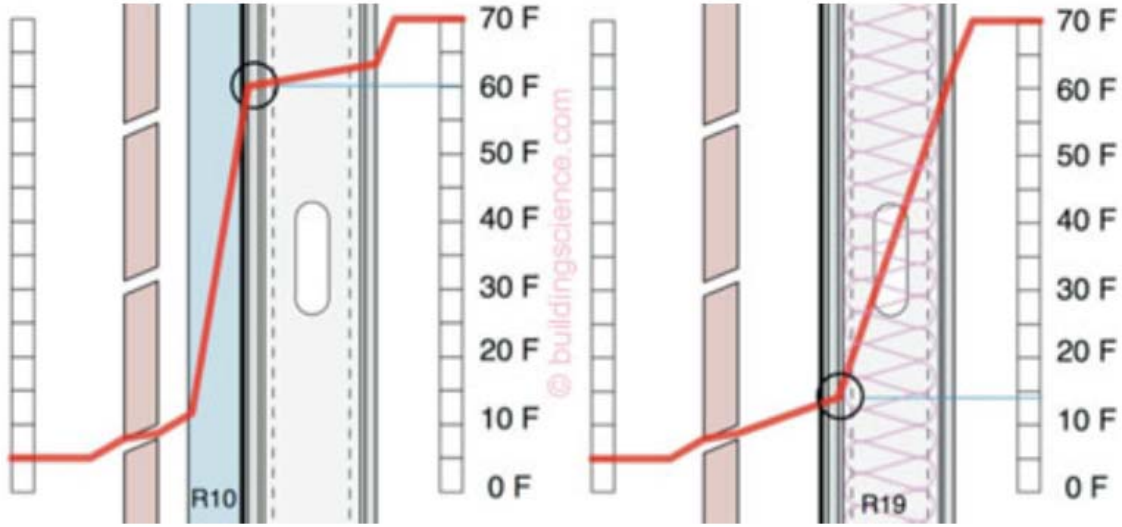

Figure 3: Insulating sheathing as condensation control measure. Continuous exterior insulation on the left, framing cavity insulation on the right. The red line plots the temperature through the two assemblies on a 4°F (-15°C) night. Blue line shows back side of sheathing temperature.

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For Further Information…

Questions?

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