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ERV’s and how they work – core

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How it Works - Water Vapor - Capillarity

Grains of water in vapor hold temperature.

The larger the temperature difference, the more active the movement.

While capillarity is well documented in nature, it's slow - given what we want to accomplish with ERV's.

How it Works - Water Vapor - Diffusion

Water vapor diffusion is the movement of water vapor through vapor-permeable materials.

Vapor diffusion happens through a solid material even when the material appears to have no holes.

The speed of diffusion can be variable depending on surface temperatures.

How it Works - Water Vapor Detail

Within the ERV - Air passes through a pathway surrounded by a **specially formulated and compressed, yet microporous paper membrane.**

As the airflows move along the pressurized airflow path, either out of, or into the habitable spaces, they will 'give up or gain' grains of moisture-depending on temperature and vapor density within the core. The water vapor will move via diffusion through the our specially formulated paper membrane.

This is because when heat energy drains away, grains of water vapor will collect (cohesion/condensation) on a surface's colder (Exhaust Air or Supply Air) side. This feature of the ERV is critical because it continuously balances humidity inside to outside.

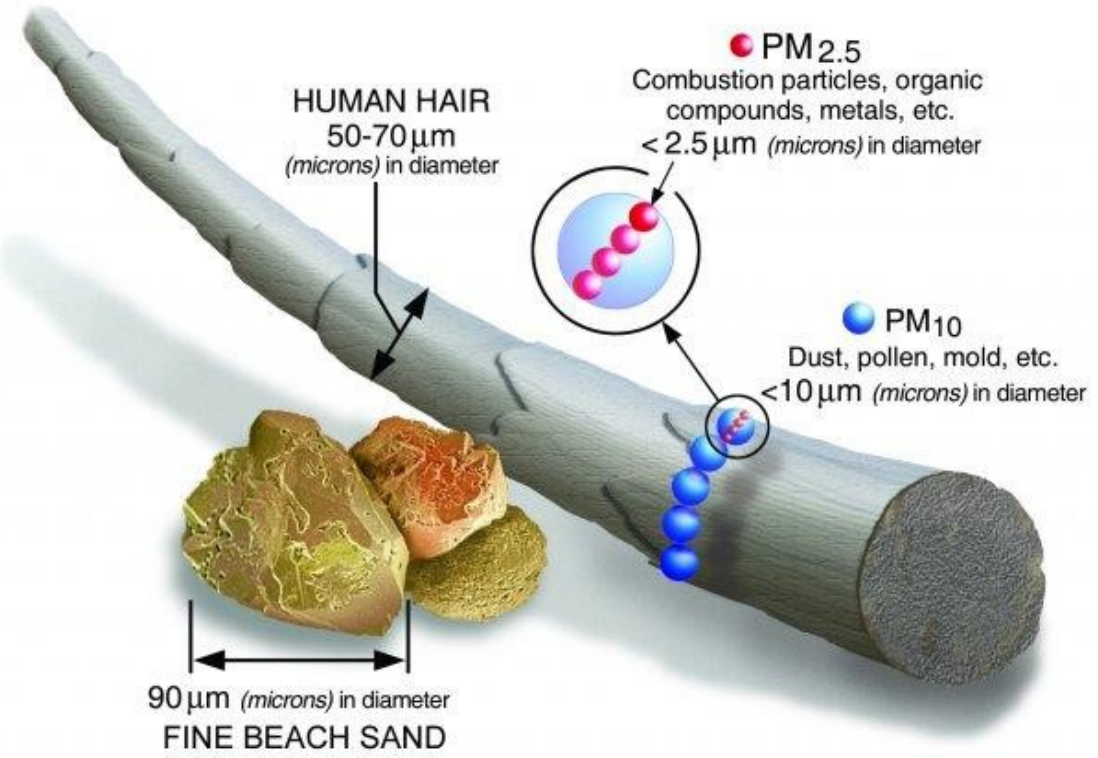
How it Works – Energy transfer through a hygroscopic pathway

Microporous paper membrane

Each square inch of the ERV Core's <u>specially processed paper</u> has millions of pores. Each of these tiny holes is 20,000 times smaller than a water droplet.

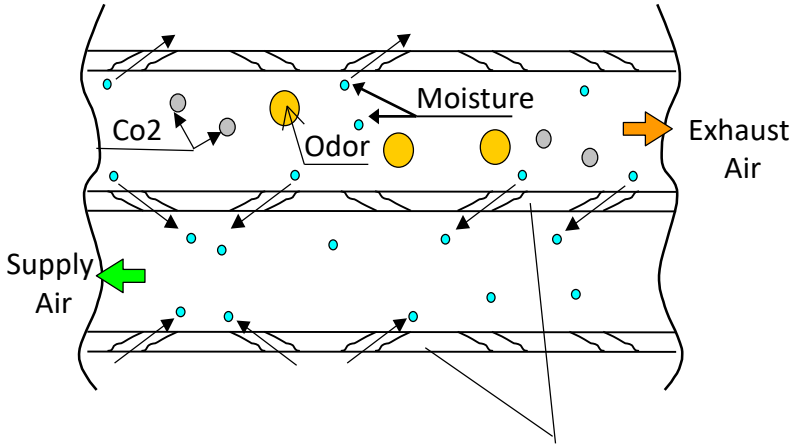
This is a thin, relatively delicate paper membrane that's hygroscopic (water-loving), which allows water vapor, <u>but not liquid</u>, to pass through .

The hygroscopic paper layer absorbs the excess moisture and transports it, by diffusion, to the lower temperature (lower pressure) airstream:

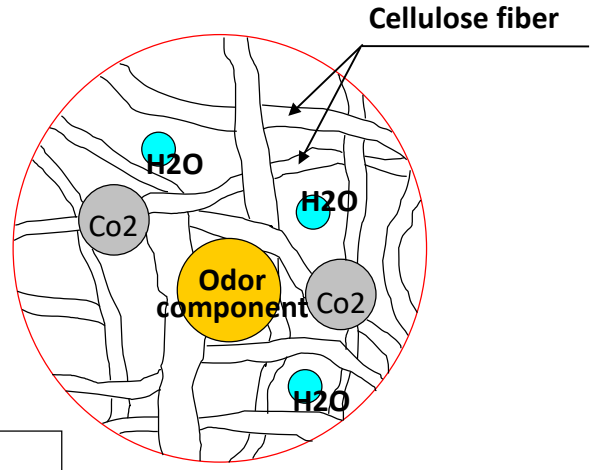


E.G., Goretex Membrane pores are around .5 µm.
ERV Core pores are about .0028 µm.

Structure and function of our ERV Core



Cross-section view during transfer



Top view

[1] A heat exchanger core simultaneously exchanges temperature and moisture between Supply Air (SA) and Exhaust Air (EA) across heat exchanger plates through fine pores.
[2] Sheets of specially processed paper inside the core allow small molecules of water vapor to pass
[3] Odor components are larger and therefore won't pass.

	formula	molecular diameter (nm*)
water	H_2O	0.288
ammonia	NH_3	0.308
carbon dioxide	CO_2	0.324
methane	CH_3	0.324

(*1 nm is one thousandth of 1 micron)

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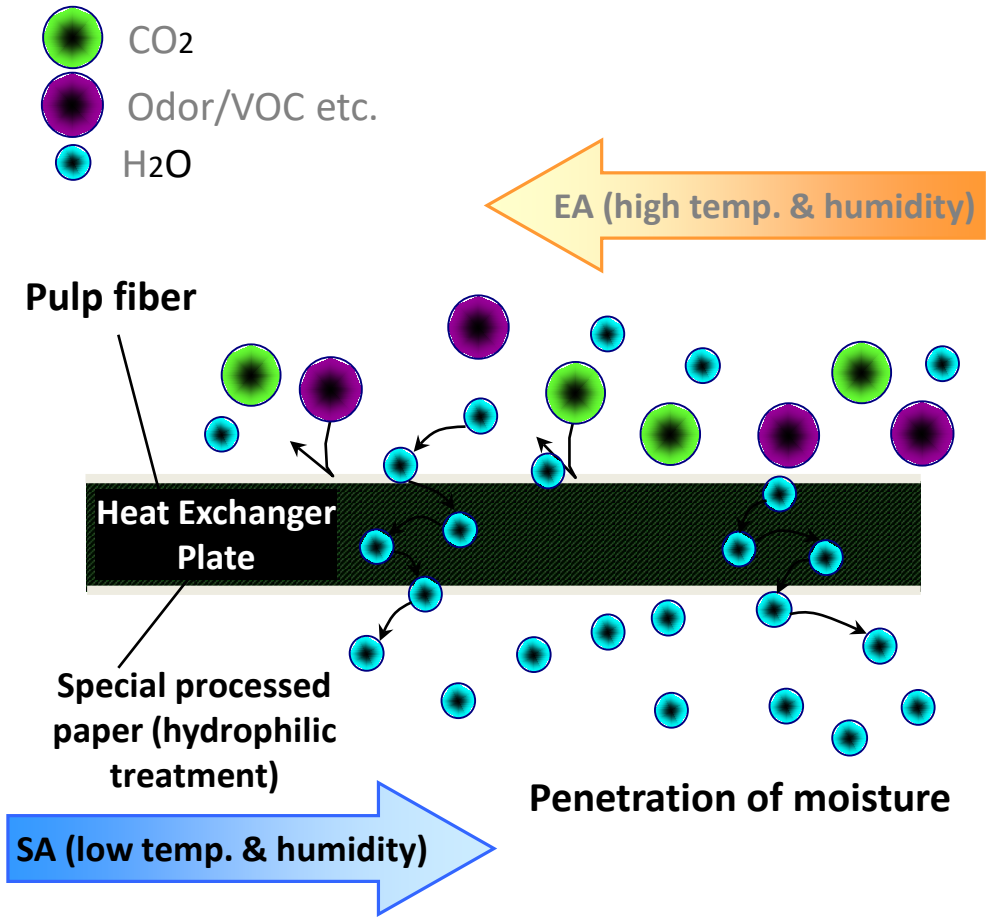
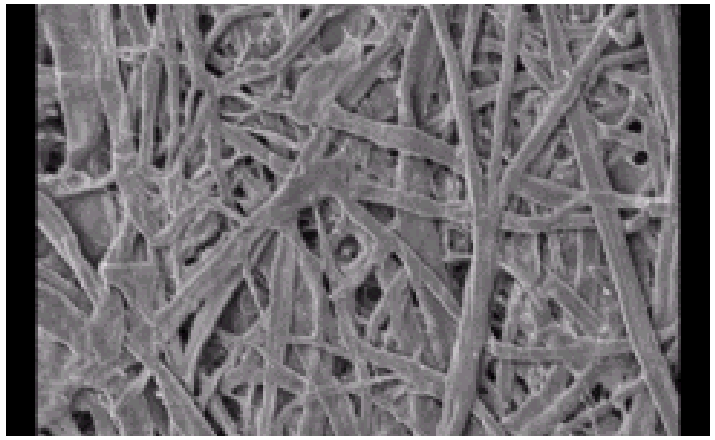
Structure and function of our ERV Core

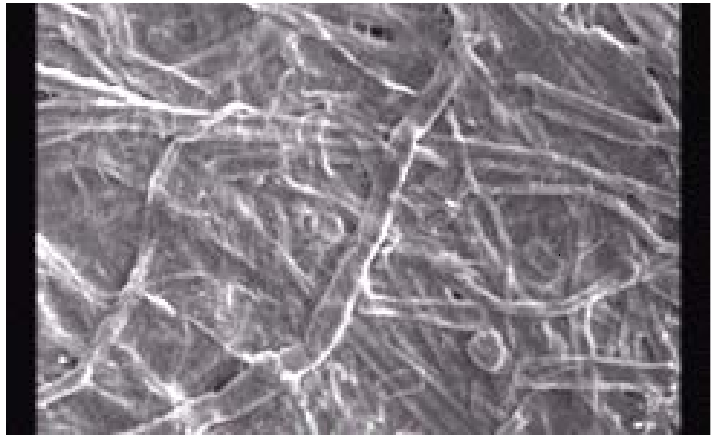
Moisture Permeability of Heat Exchanger Plate



Gas Barrier Property



Sheet surface of normal copy paper (200 times)



Sheet surface of special processed paper (200 times)

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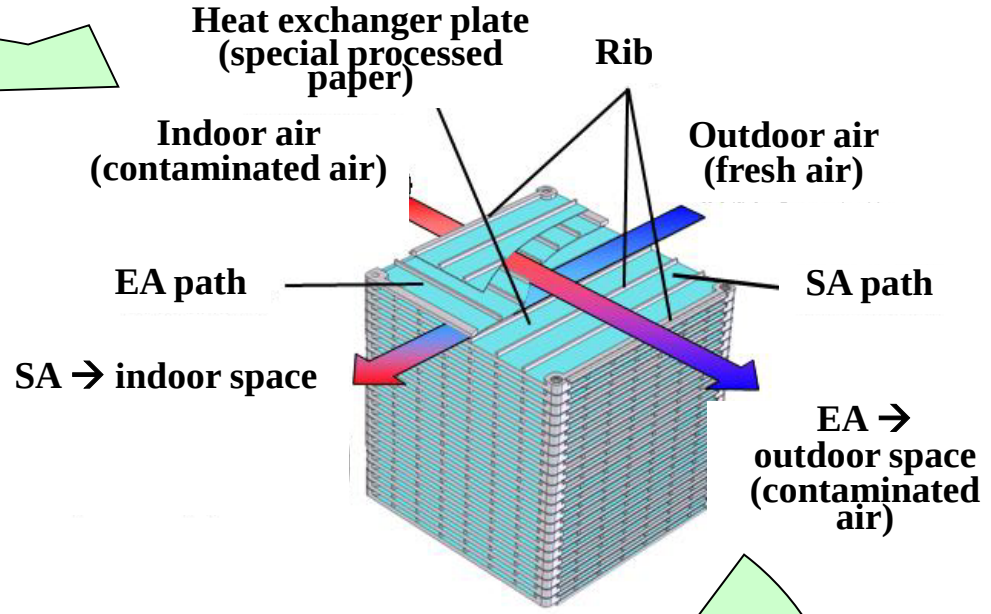
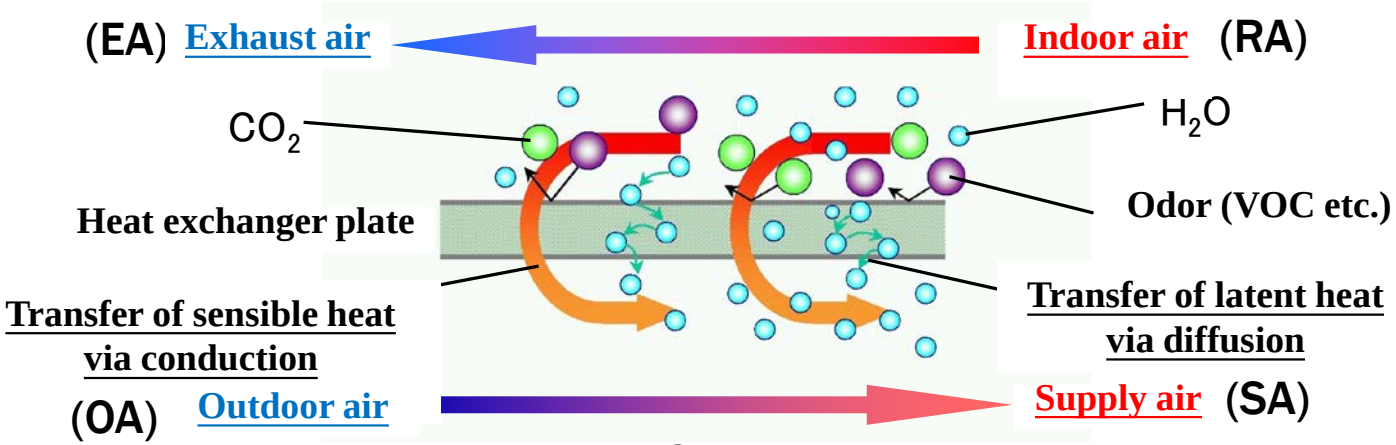
Structure and function of our ERV Core





Principle of heat exchange core (heating)

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How it Works - Intelli-Balance 100 & 200 Core Design

Transfer Performance

- Air passes alongside of the opposing airstream through the plate material.
  - Sensible temperature is transferred through conduction.
  - Latent temperature is transferred through diffusion.

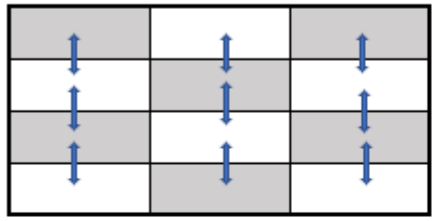
Straight Air Passages

- Low resistant laminar air flow.

Intelli-Balance 100 & 200 Core Design

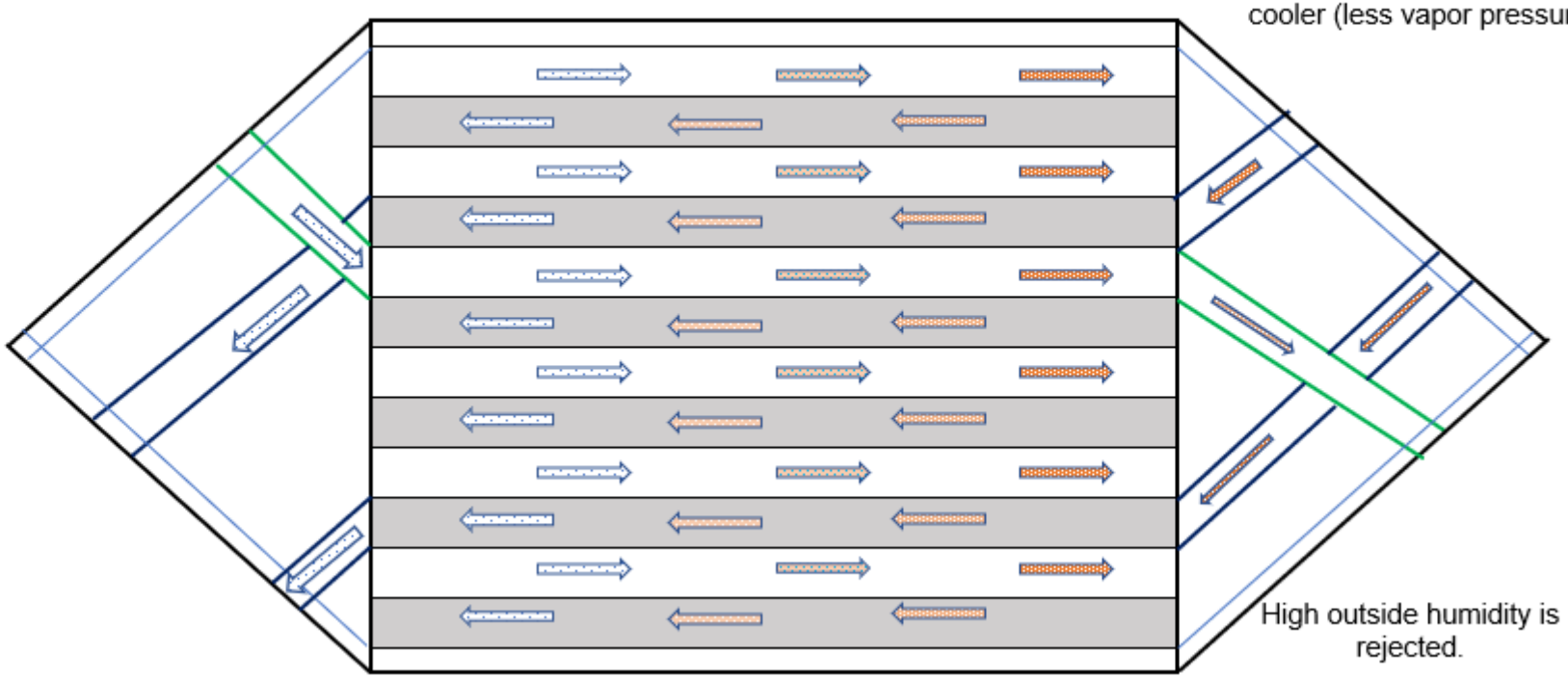
- The ERV core with water-permeable paper is configured to allow multi-dimensional transfer of moisture as well as heat.
- Multi-dimensional transfer across a water-permeable paper can provide more efficient energy recovery and allow the ERV core to be more compact.
- This feature transfers heat and moisture between the two airstreams flowing in a counter-flow configuration for more efficient energy recovery.

Cross Section



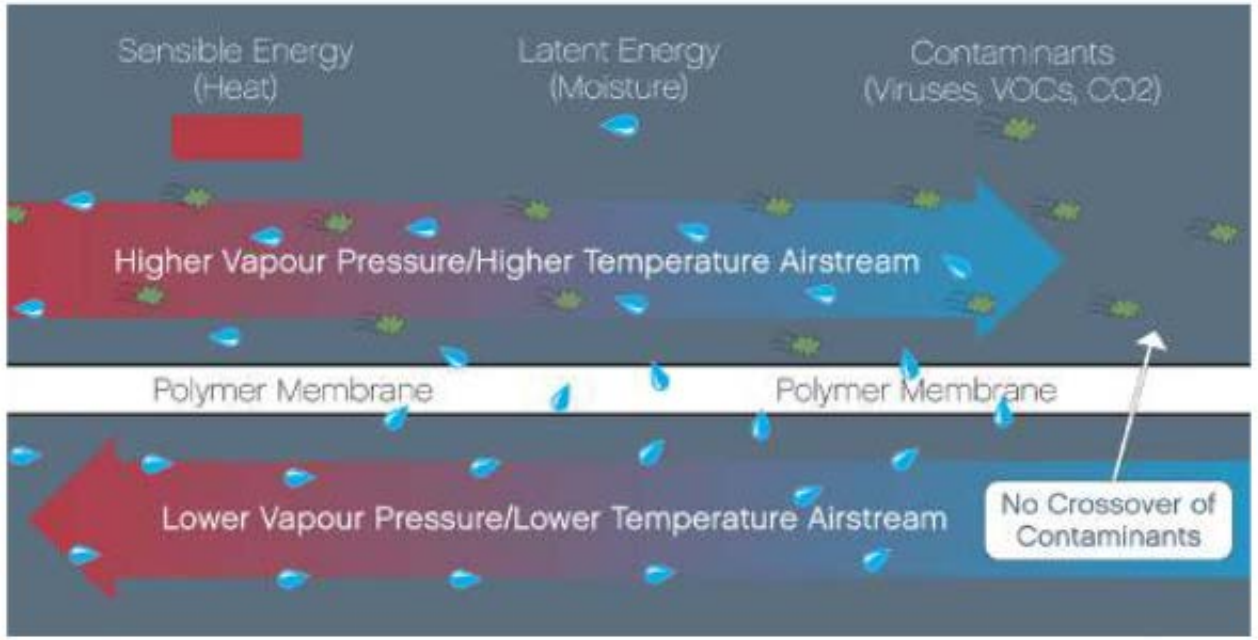
Water Vapor moves in all directions across the airflow layers.

Cross Flow through the Core



How it Works – Energy transfer through a hydrophilic pathway

Warmer (air) will **drive** water vapor

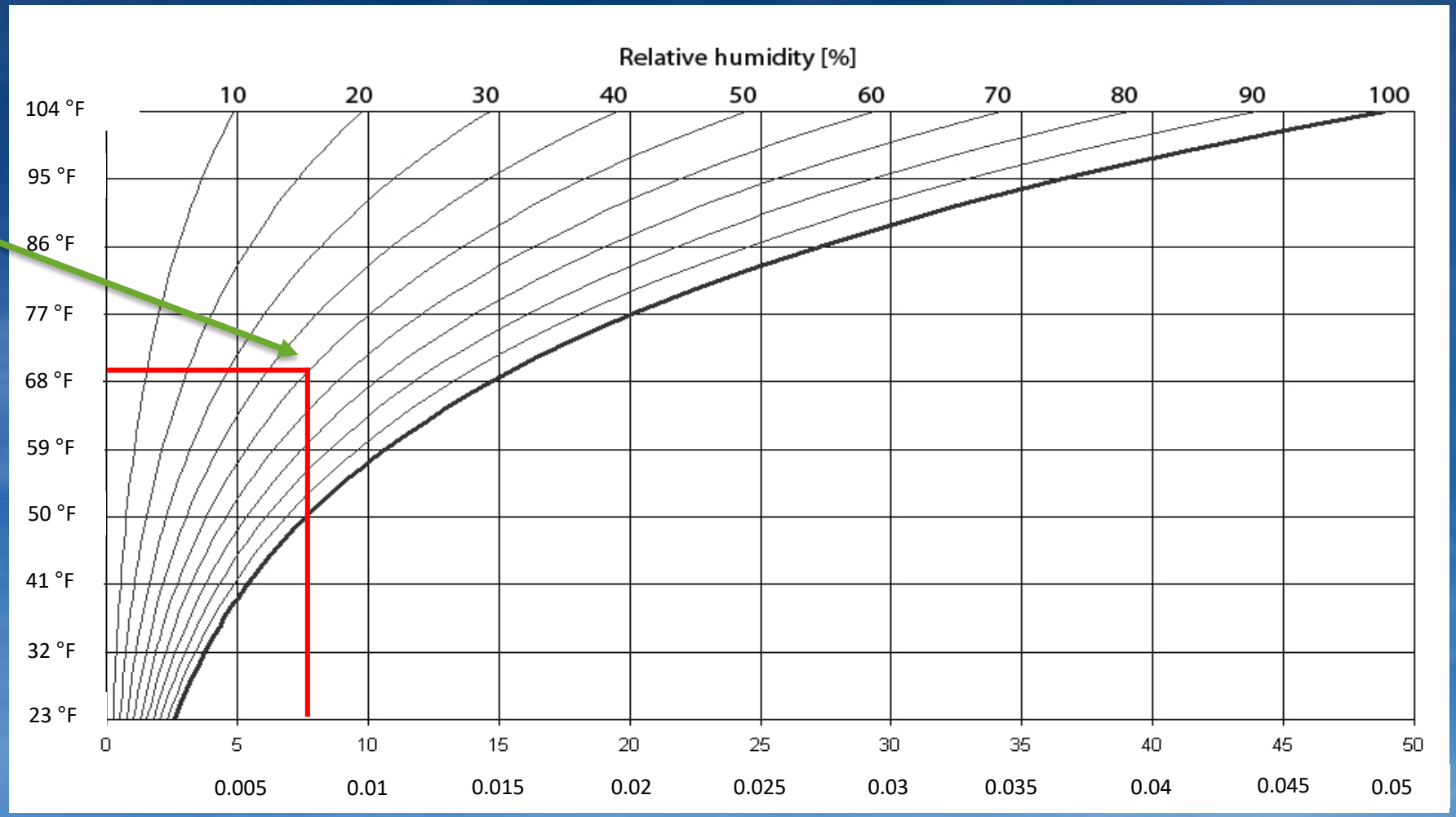


Cooler (air) will **draw** water vapor

Psychrometric Chart Tampa Example

Absolute vs. Relative Humidity

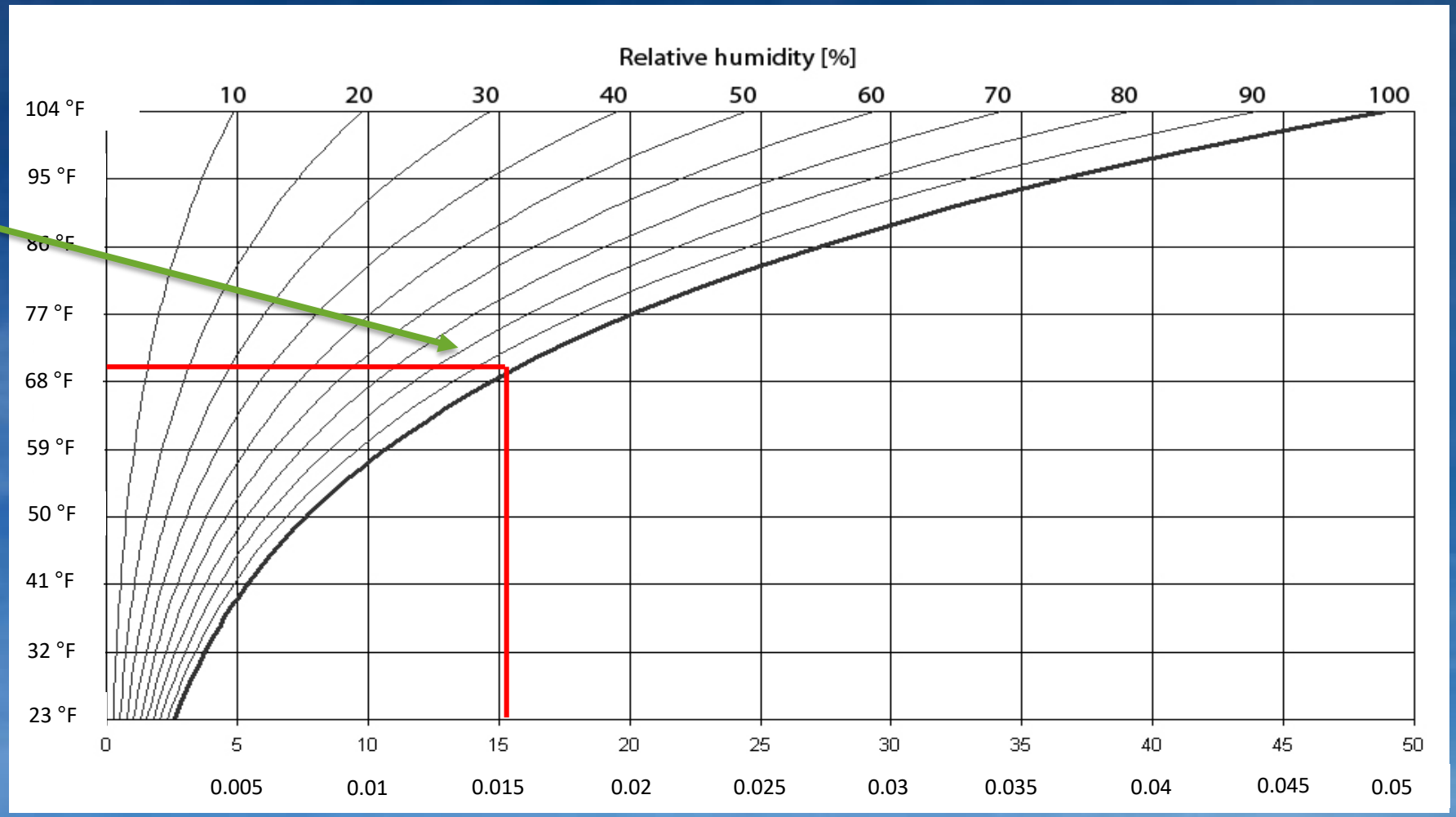
70 degrees @ 50% rh
= 54.483 grains of water ft^3



Psychrometric Chart Tampa Example

Absolute vs. Relative Humidity

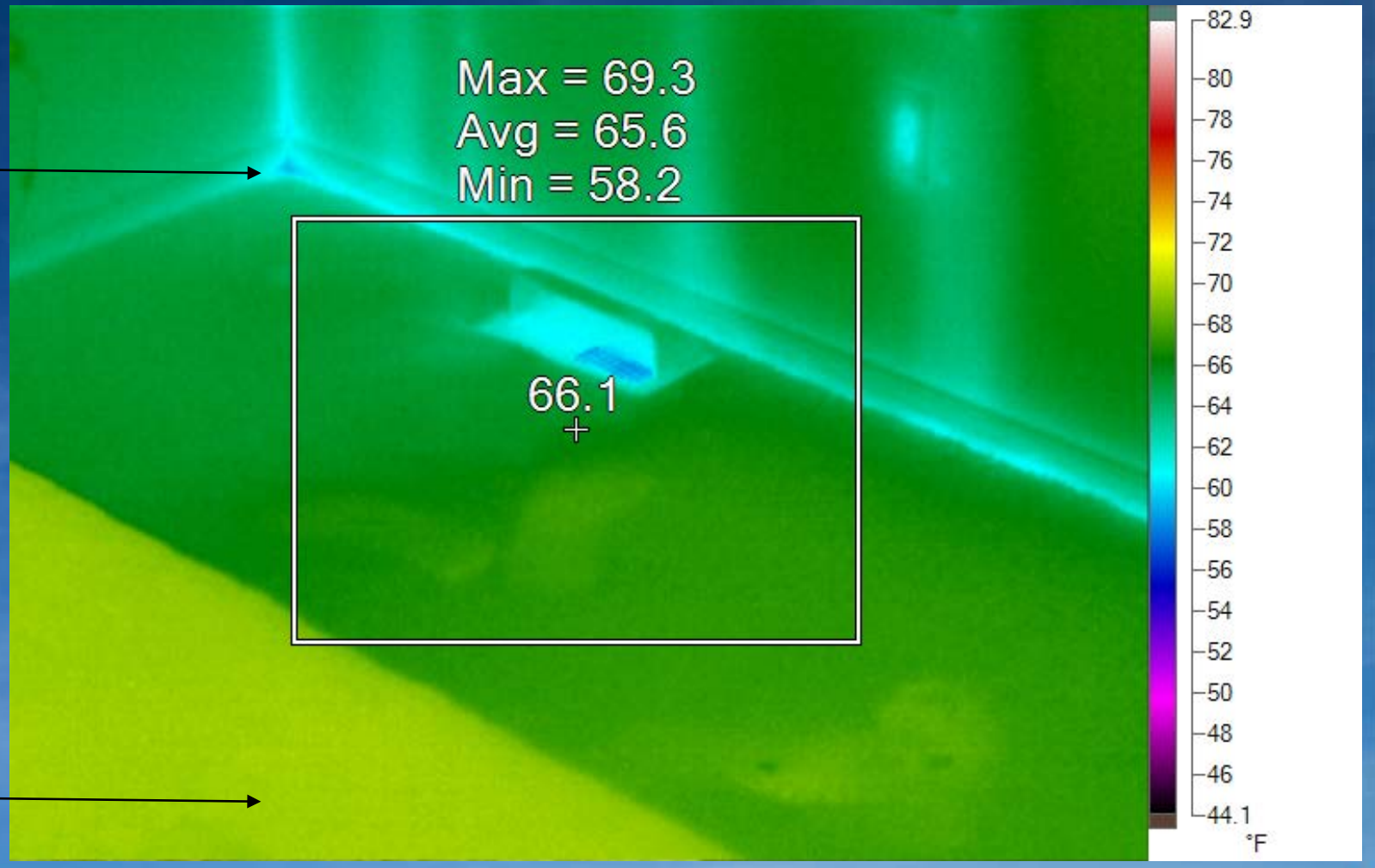
71 degrees @ 94% rh
= 107.245 grains of water ft^3



Psychrometric Chart Tampa Example

58.2 degrees “min” temp

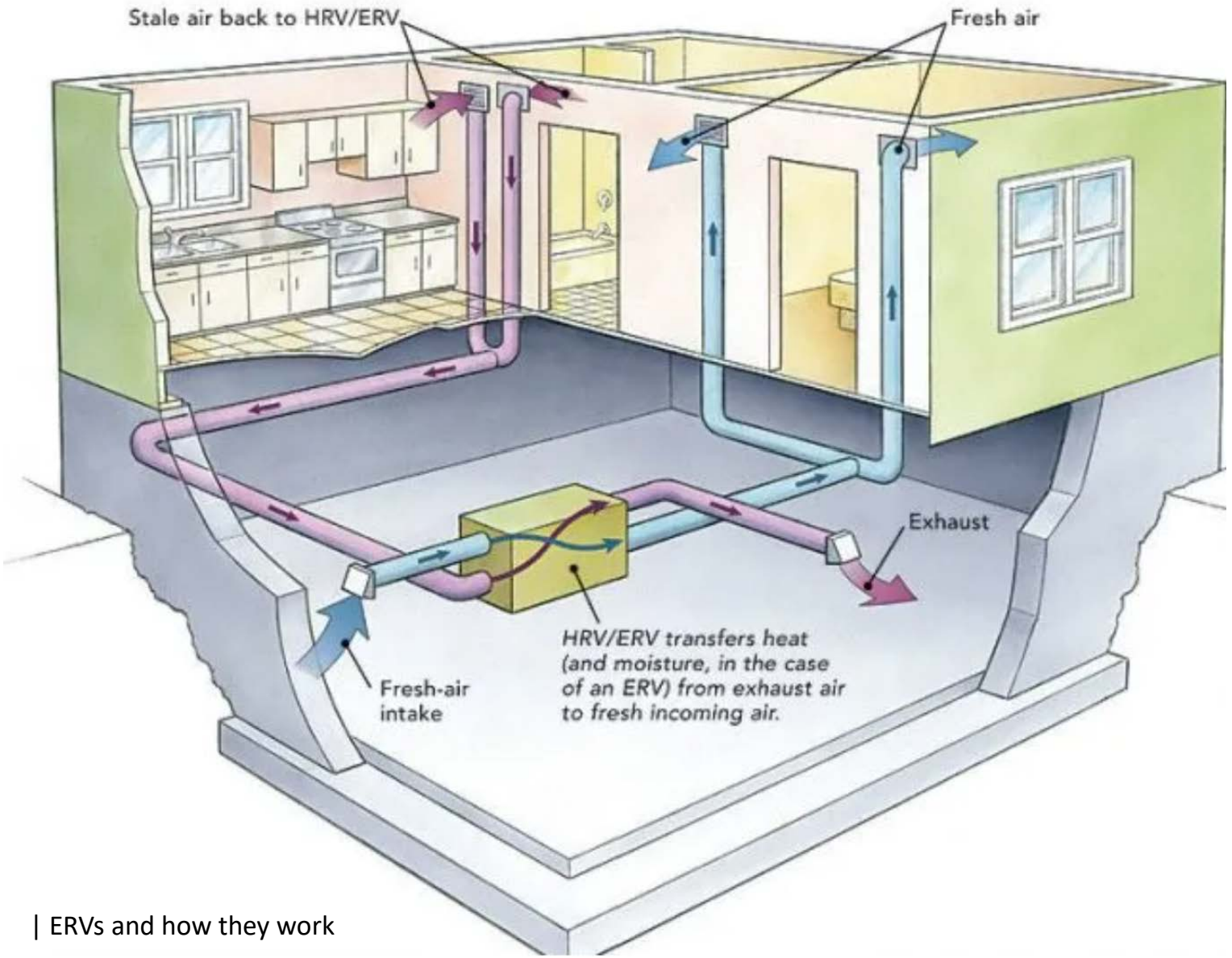
69.3 degrees “max” temp



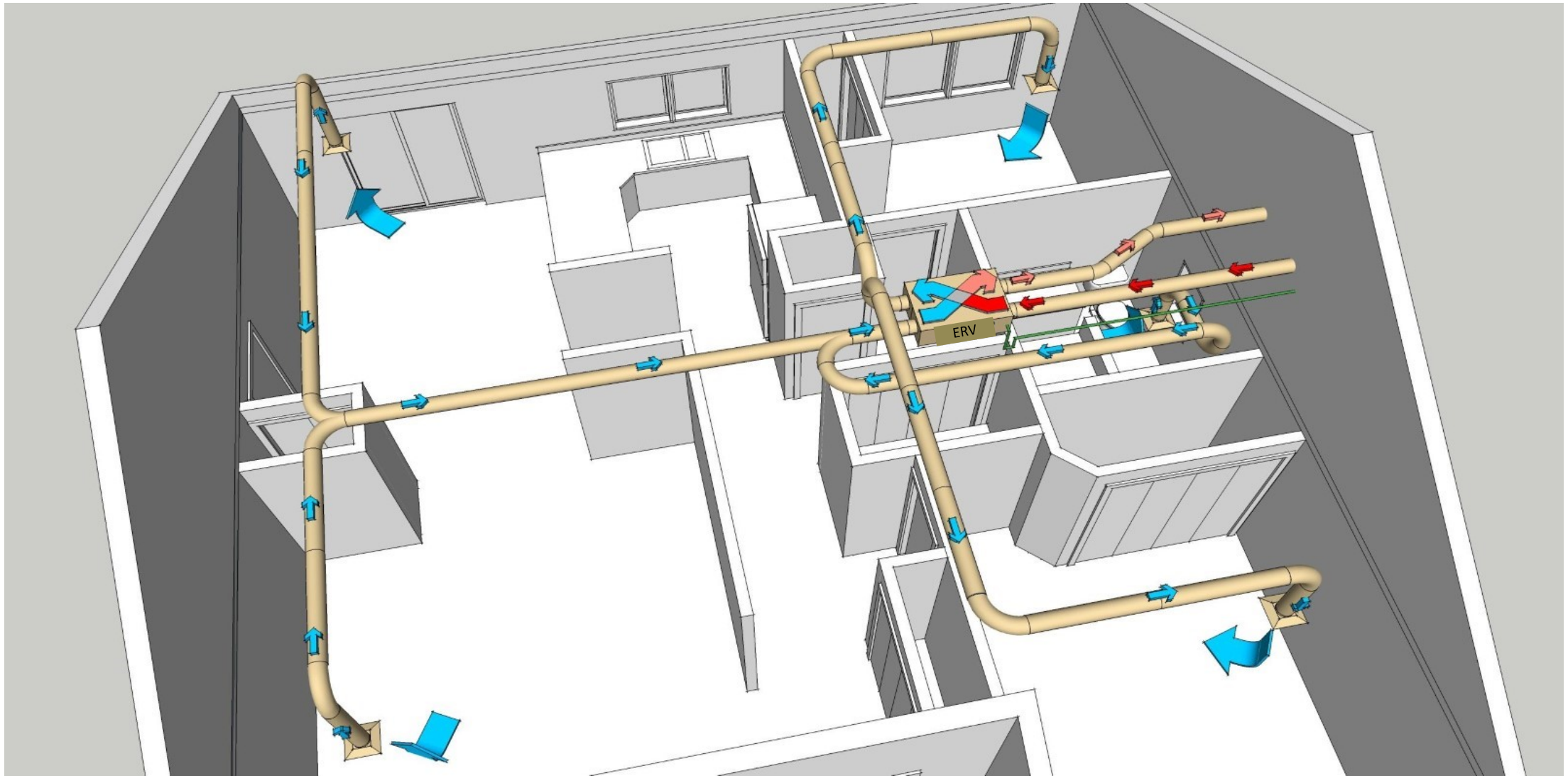
Psychrometric Chart Tampa Example

Like your favorite Chia Pet… Just add water.

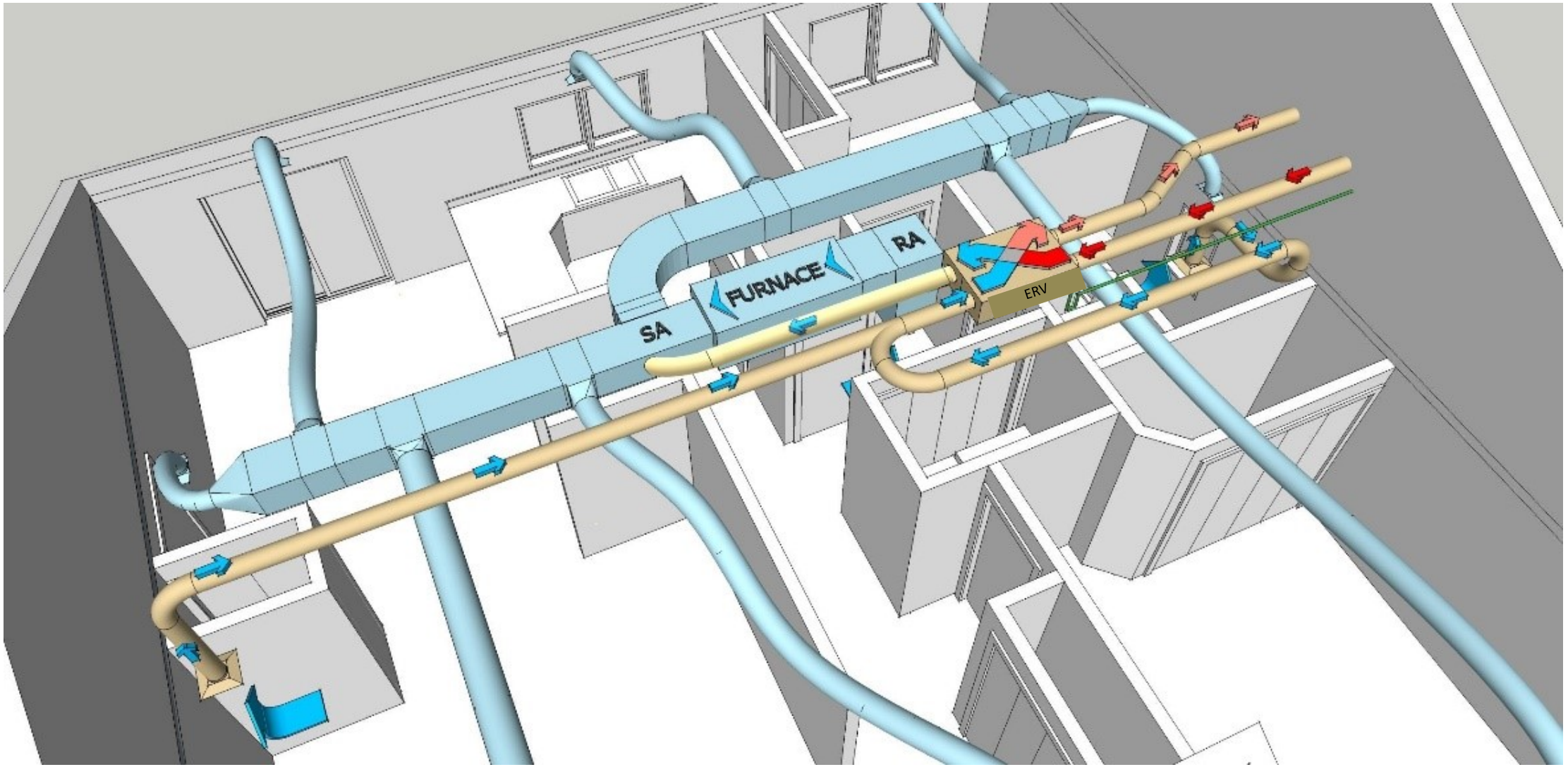
Stand Alone System



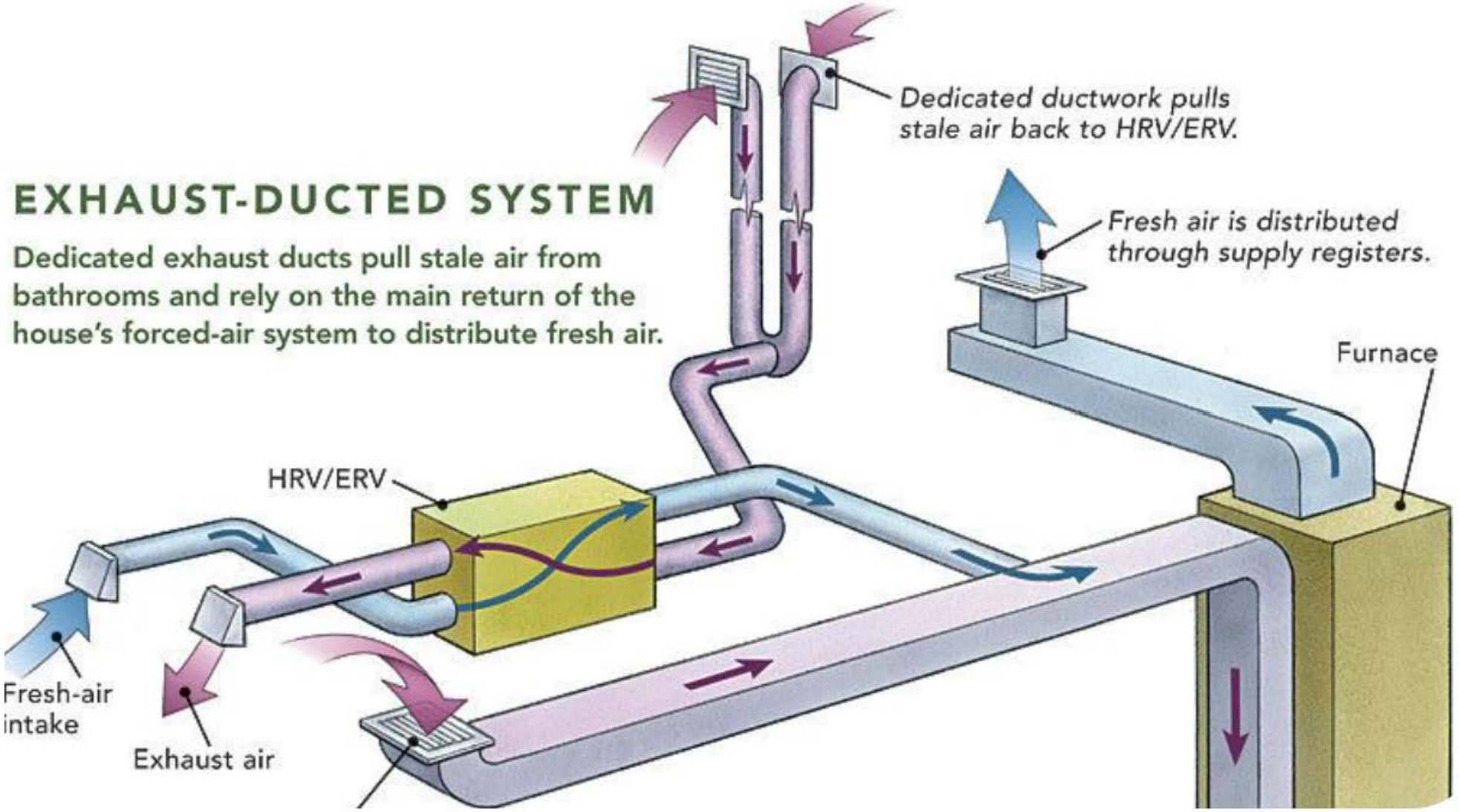
Stand Alone System



Integrated System



Integrated System



Mechanism of Action – ERV Overview

Sensible heat recovery refers to temperature, or heat, transfer.	• Heat transfer is via “conduction”.
Latent refers to moisture, or humidity, transfer.	• Latent (water vapor) transfers via diffusion.
Air flows don’t ‘mix’, but water vapor moves between airstreams seeking pressure balance.	• Narrow, alternating, heat exchange plates with cross-current airflow

Woot!