In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 code/energy hours** of credit toward **Building Officials and Residential Contractors** continuing education requirements."

For additional continuing education approvals, please see the continuing education credit section in the conference agenda booklet.

IAQ & Ventilation

Indoor Air Quality is Important to our Clients

20% of households have someone with asthma, allergies or respiratory problems

…poor IAQ may cost 10's of billions annually in lost productivity
EPA

Air cleaners are a $1.2 Billion industry

IAQ Control Strategies

REMOVE
SEAL
VENTILATE
FILTER
and more….

IAQ…Why is it a bigger issue than ever?

Change in the
way we build
- Tighter
- More chemicals
- Air conditioning

Change in the
way we live
- 90% of time indoors
- Don't open windows
- More moisture

Change in
products we use
- Carpets &furnishings
- Cleaners & hygiene
- More "stuff" inside

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IAQ Control Strategies

1. **Remove Pollutants**
2. **Source control**
   - "Seal" or Isolate
   - If you can't remove it find a way to isolate or seal it
3. **Ventilate**
   - Dilute pollutants with "fresh" outdoor air
   - Point source removal
4. **Filter**
5. **Humidity Control, UVG, and more….**

HVAC and Ventilation

Ventilation system considerations:

- A ventilation system does NOT provide make-up air.
- A ventilation system does NOT provide combustion air.
- Balanced ventilation systems are not affected by opening or closing windows.
- Forced air heating (and cooling) alone does not provide ventilation.

HVAC and Ventilation

Why can’t I just open a window?

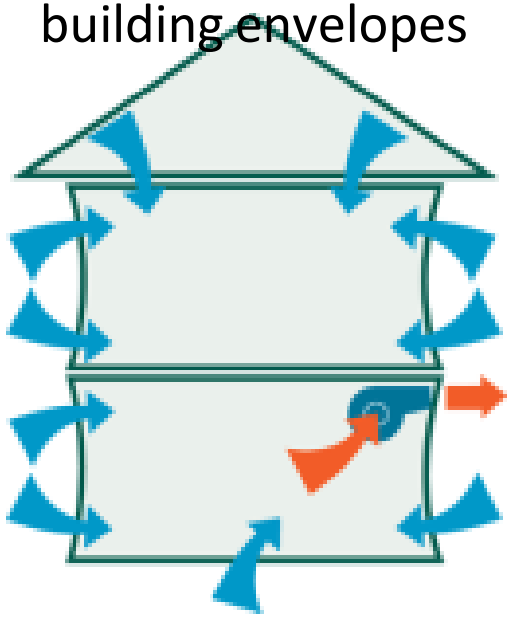
Why natural ventilation is inadequate:

- Is minimized by better design and construction practices.
- Will not be provided unless pressure differences are at work.
- Is incapable of removing high moisture and contaminant loads.
- Implies cold drafts and discomfort during the heating season.
- Is not evenly distributed. Some areas may not be ventilated and others possibly over ventilated.

Ventilation Strategies may impact air leakage patterns

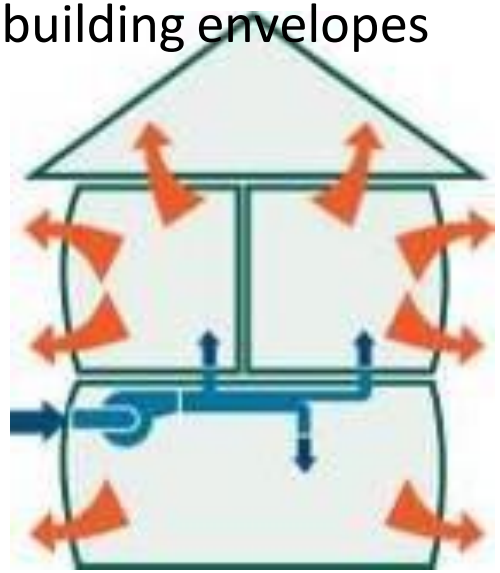
Negative Pressure(Exhaust only)

- In humid climates can pull moist air into building envelopes



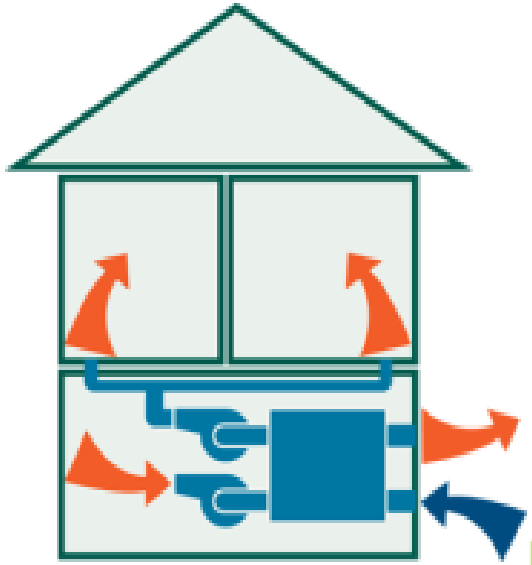
Positive Pressure (Supply only)

- In cold climates can force moist air into building envelopes



Balanced

- Best in all climate zones



The tighter the house, the greater the pressure effect

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How Much Ventilation?
ASHRAE 62.2 - 2013

Whole House - Continuous "Capacity"

Based on # of occupants & size of home

$$CFM = (\#\ of\ bedrooms + 1) \times 7.5 + (0.03 \times cond.\ ft^2)$$

OR USE THE TABLE

Controls moisture and common occupant pollutants

Floor Area Sq. ft	# of Bedrooms		
	1	2-3	4-5
<1500	60	75	90
1501 - 2500	90	105	120
2501 - 3500	120	135	150
3501 - 5000	165	180	195

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Local Exhaust Ventilation

ASHRAE 62.2 minimum requirements for bath rooms & kitchens

ASHRAE 62.2 Minimum Exhaust Flow Rate		
	Continuous	**Intermittent**
Kitchen	60 CFM	100 CFM
Bathroom	20 CFM	50 CFM

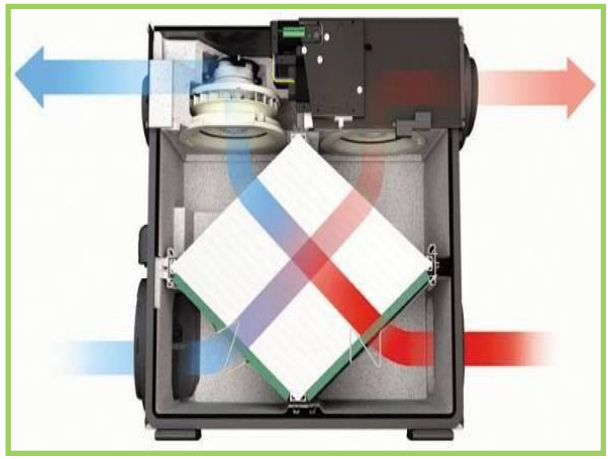
HVI Kitchen Range Exhaust Flow Rate		
Location of Range	**Recommended per Linear Ft of Range**	**Minimum per Linear Ft of Range**
Against a Wall	100 CFM	40 CFM
In an Island	150 CFM	50 CFM

For Gas Ranges recommend 100 CFM / 10,000 BTUs of burner capacity

Ventilation Opportunities

Rated, Tested, Labeled Product

- Always use HVI Certified fans
- Choose ENERGY STAR Qualified Fan and HRVs



Ventilation & High Performance Homes

Ventilation is an important part of the House as a System

- Allows for houses to be built tighter
- Provides interior moisture and pollutant control

Ventilation will impact other HVAC systems

- Impact on HVAC load calculations
- Impact on moisture balance
- Impact on house pressures
- Impact on control strategies

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Ventilation Impact on Heat / Cool Loads

75 CFM of ventilation will increase HVAC loads

Cold Weather

At -20 ^{0}F

- Ventilation adds 7300 BTUs to heating loads
- Ventilation can remove up to 7 gallons of water per day

Hot Weather

At 105 ^{0}F and dry

- Ventilation adds 2500 BTUs (1/5 of a ton) to cooling loads
- At 95 ^{0}F and humid
- Ventilation adds 4500 BTUs (just over 1/3 of a ton) to cooling loads
- 2/3 of this load is latent (moisture)

These loads can be reduced by up to 80% through the use of heat / energy recovery technology

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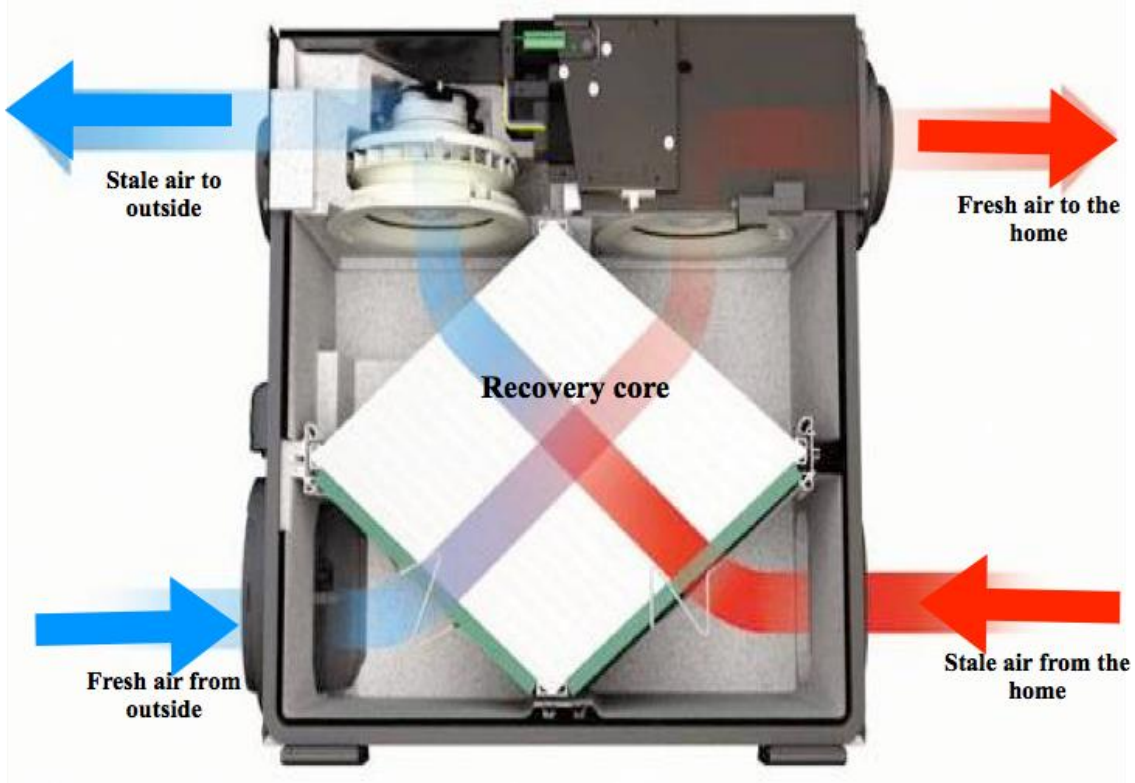
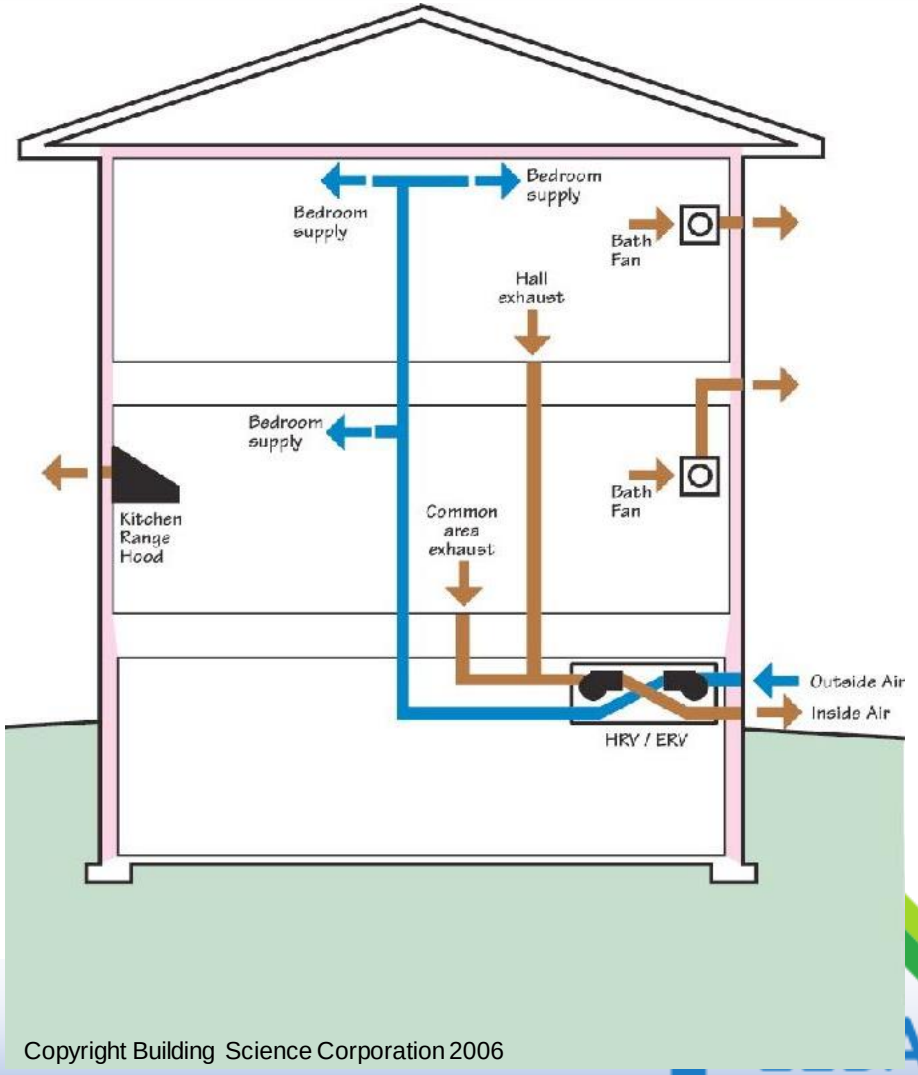
The Lungs of the Home: HRV or ERV
"Fresh Air Machine"



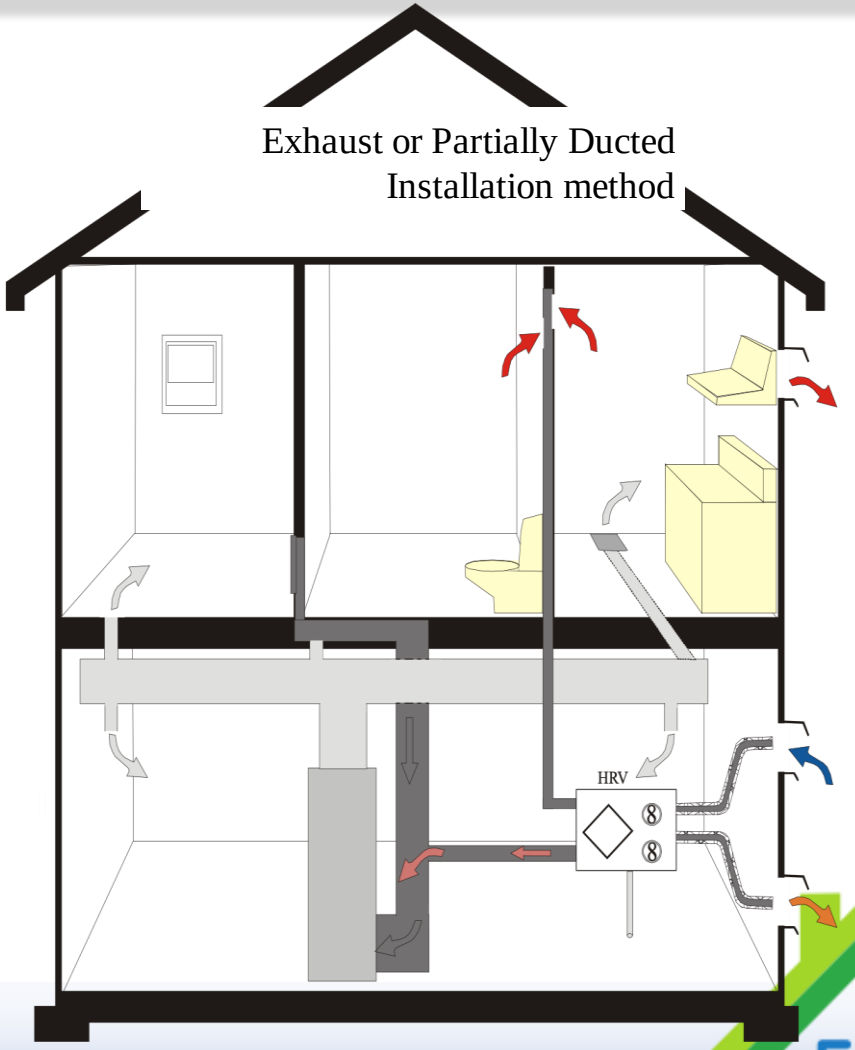
Balanced ventilation with heat or energy recovery

- Remote mounted multiple room pick-up and delivery
- Draw from the common area and supply to all bedrooms
- Central fan integration is also used



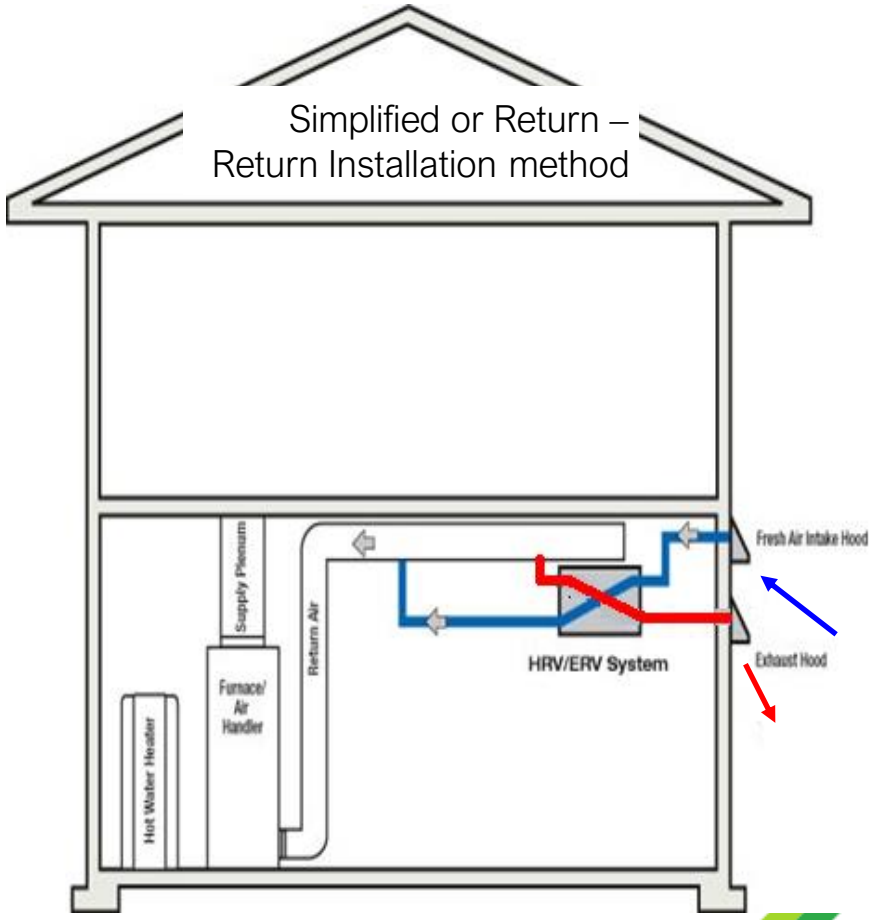
Installation Options

- There are different options for installation depending on application needs
- Often the furnace duct system is used to distribute fresh air
- When possible, run exhaust ducts from bathrooms & kitchens



Balanced Ventilation with Heat Recovery

- HRVs / ERVs for continuous ventilation
- Choose Home Ventilating Institute (HVI) certified
- Select units with the right air flow.

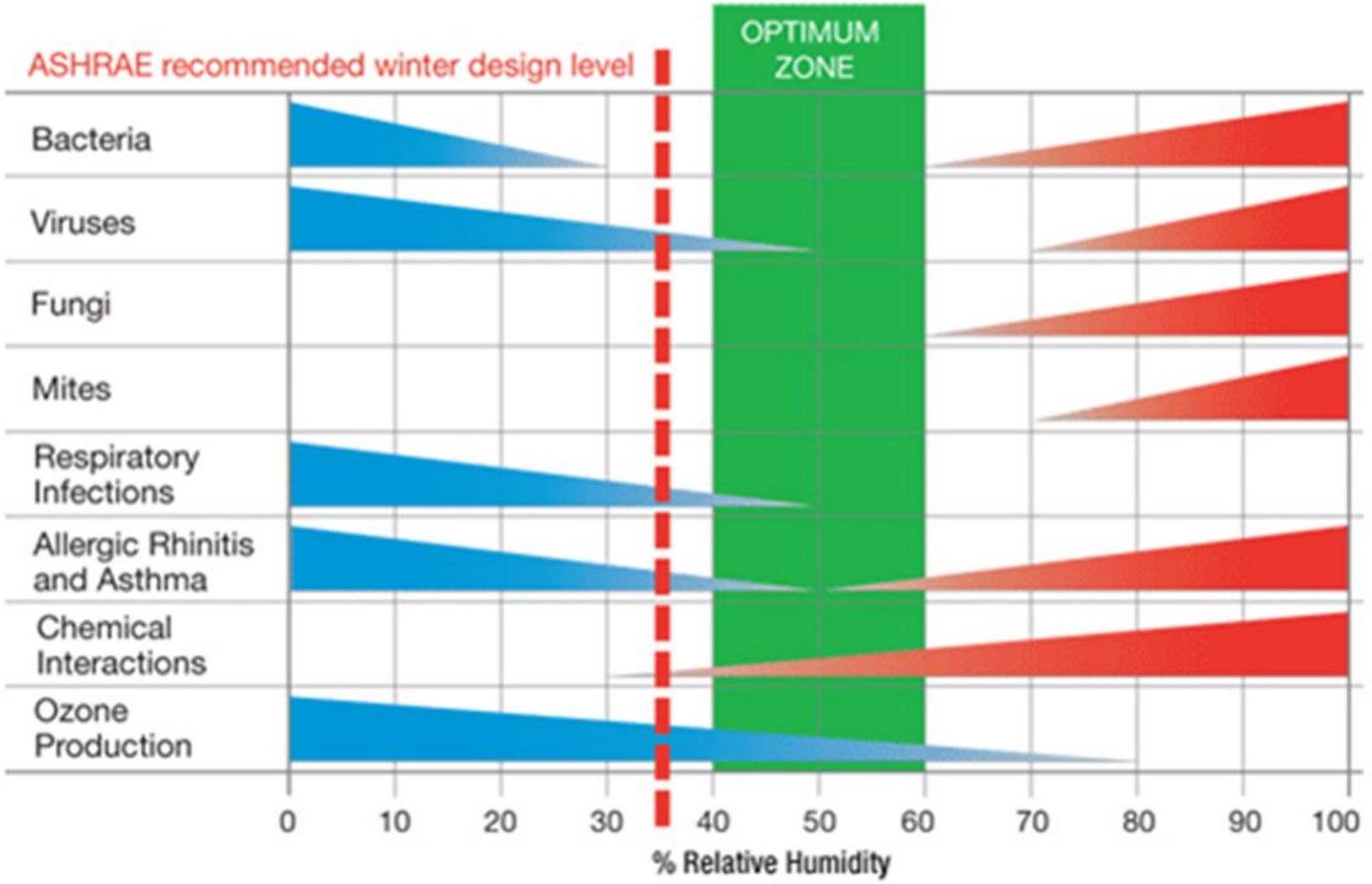


HVI
HOME VENTILATING INSTITUTE

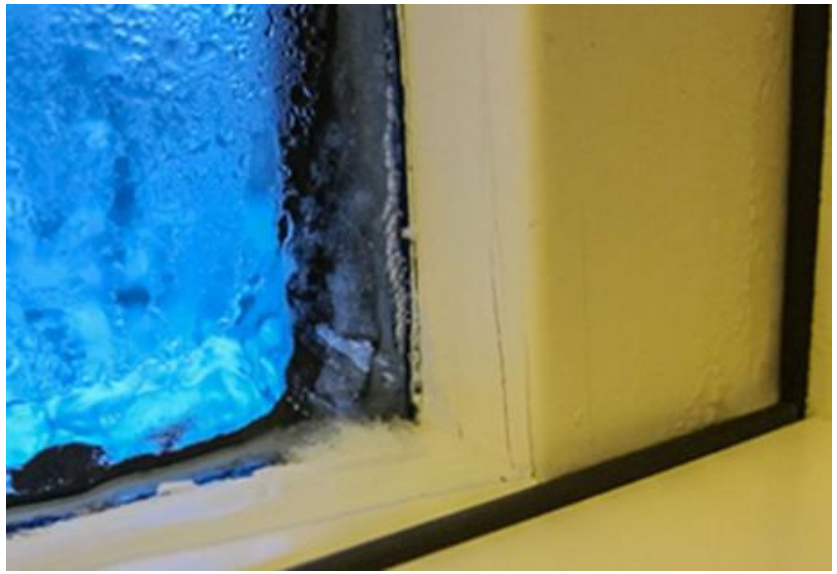
EEBA

Ventilation: IAQ & Humidity

How much humidity do we assume in the winter …Or how much humidity do we need?

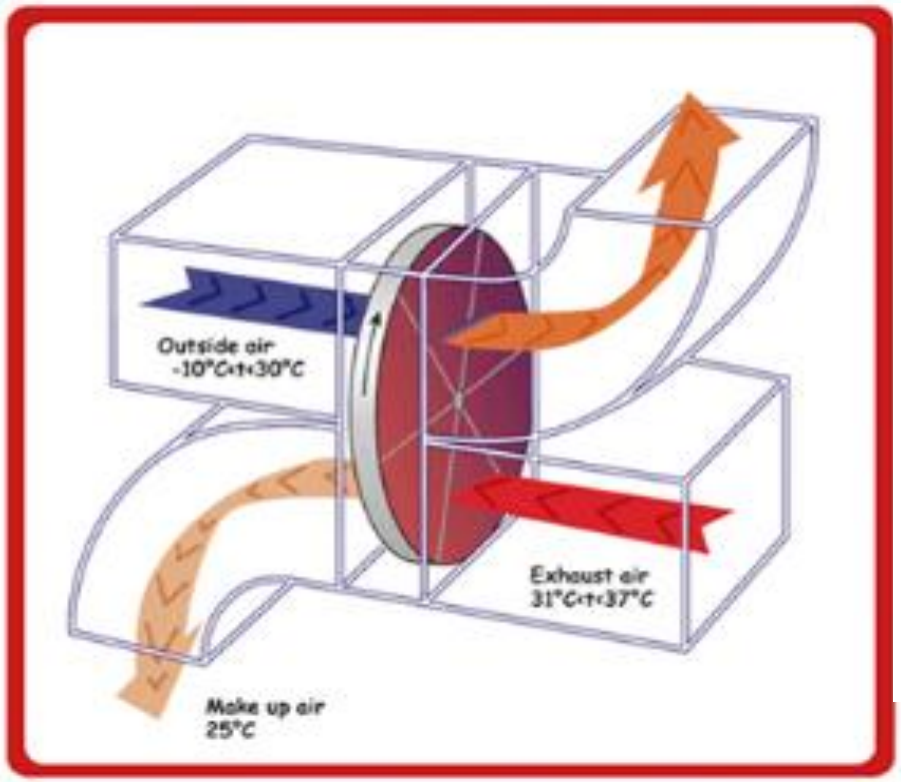


Just how important is RELATIVE HUMIDITY CONTROL?
OUR CLIENTS DON'T LIKE THIS…



HVAC and ventilation: What is an ERV?

Energy Recovery Ventilation

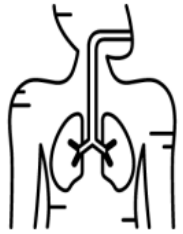


Ventilation: IAQ & Humidity

RELATIVE HUMIDITY AND HEALTH

When RH<40%, humans suffer!

Sitting in room air with 20% RH, the average person becomes clinically dehydrated in 8 hours



more infections & asthma attacks

impaired brain function

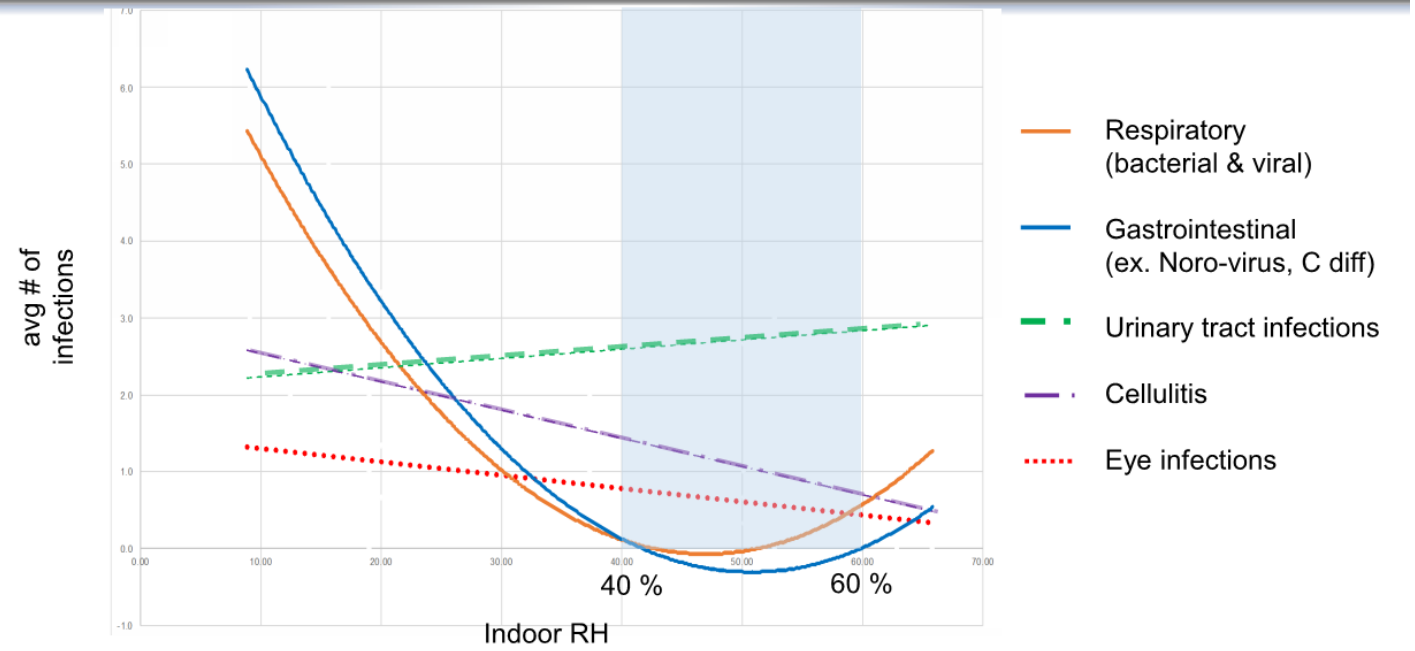
skin cracking, decreased wound healing

dry eyes, excessive tearing

Ventilation: IAQ & Humidity

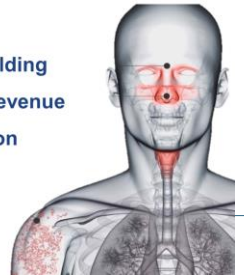
RELATIVE HUMIDITY AND HEALTH

Respiratory & GI infection rates were lowest when indoor RH = 40-60%



HARVARD MEDICAL SCHOOL

Optimize Occupant Health, Building Energy Performance and Your Revenue Through Indoor-Air Hydration

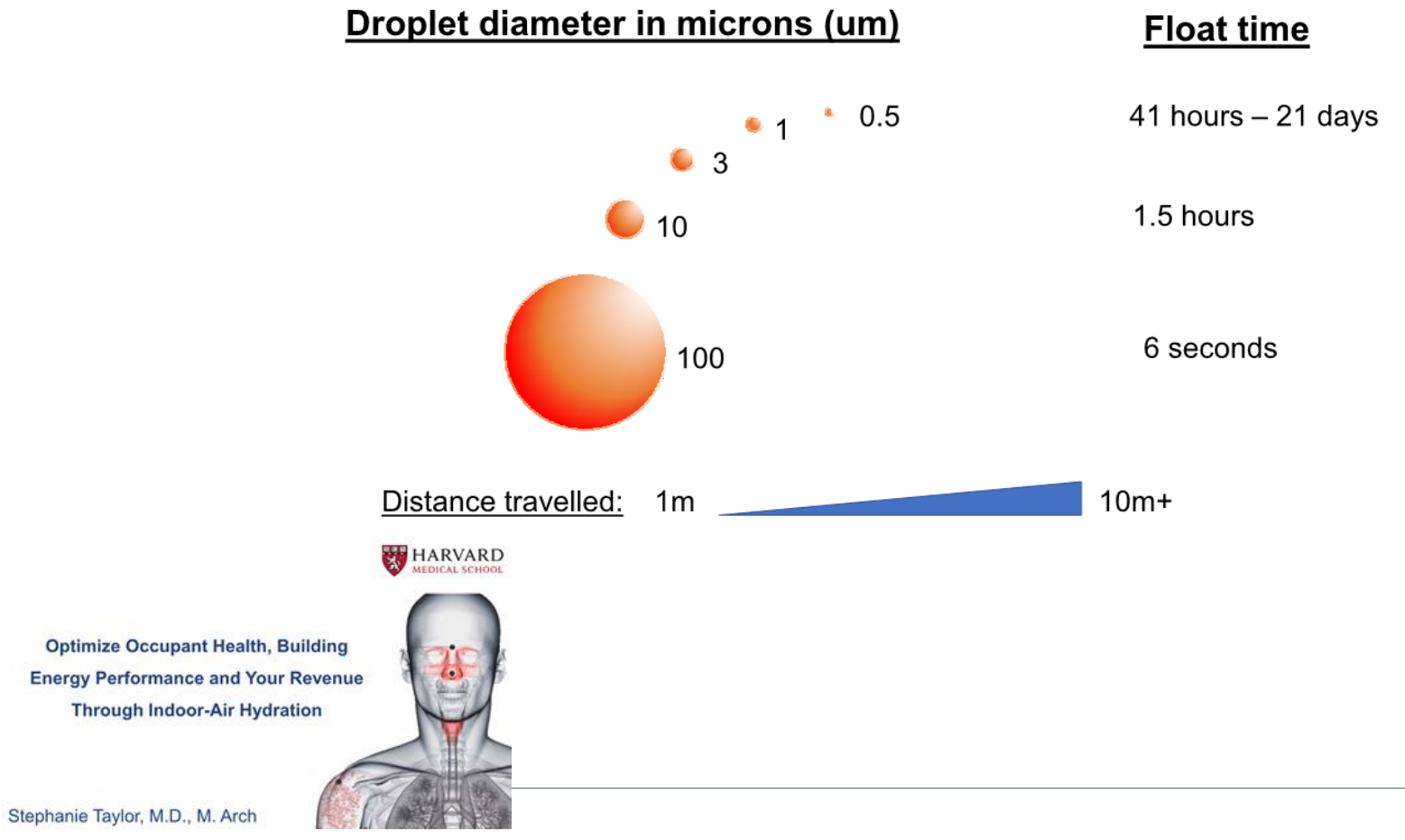


Stephanie Taylor, M.D., M. Arch

Ventilation: IAQ & Humidity

Humidity affects the size and weight of the virus

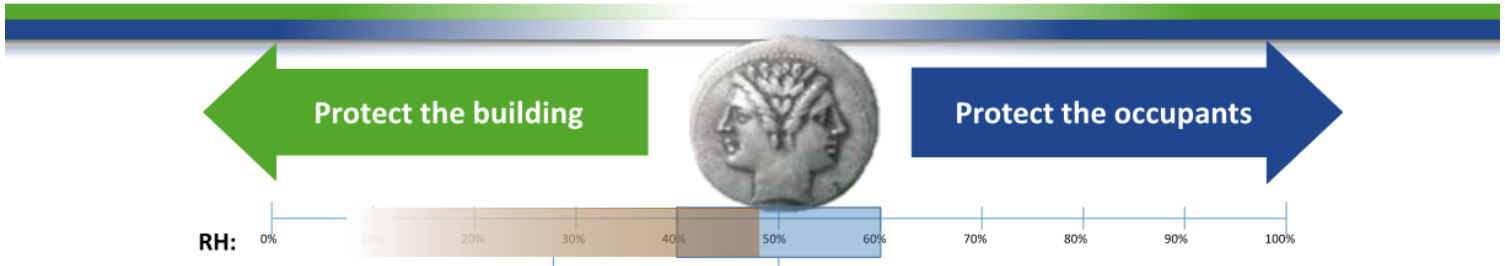
Infectious droplets shrink, travel far and evade surface cleaning when the air is dry



Ventilation: IAQ & Humidity

RELATIVE HUMIDITY AND BUILDINGS

The great indoor air RH debate!

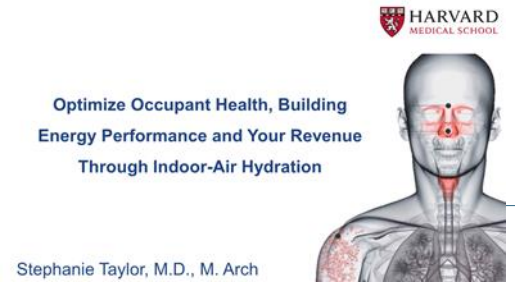


Buildings don't care about humidity

- The drier the air the better
- Easier to dry the air than fix the envelope construction
- Humidification will cost more

Occupants need RH between 40% and 60% for health

- Decreased infections
- Fewer allergies
- Improved hydration
- Improved wound healing
- Increased work performance



Humidification Applications

- Winter in cold climates
- Large homes with low occupancy levels

Sizing:

- **Required capacity is a function of:**
  - Air tightness of the home
  - Ventilation strategies
  - Occupancy generation

Depressurization in High Performance Homes

Air Tight Homes: Need to watch for

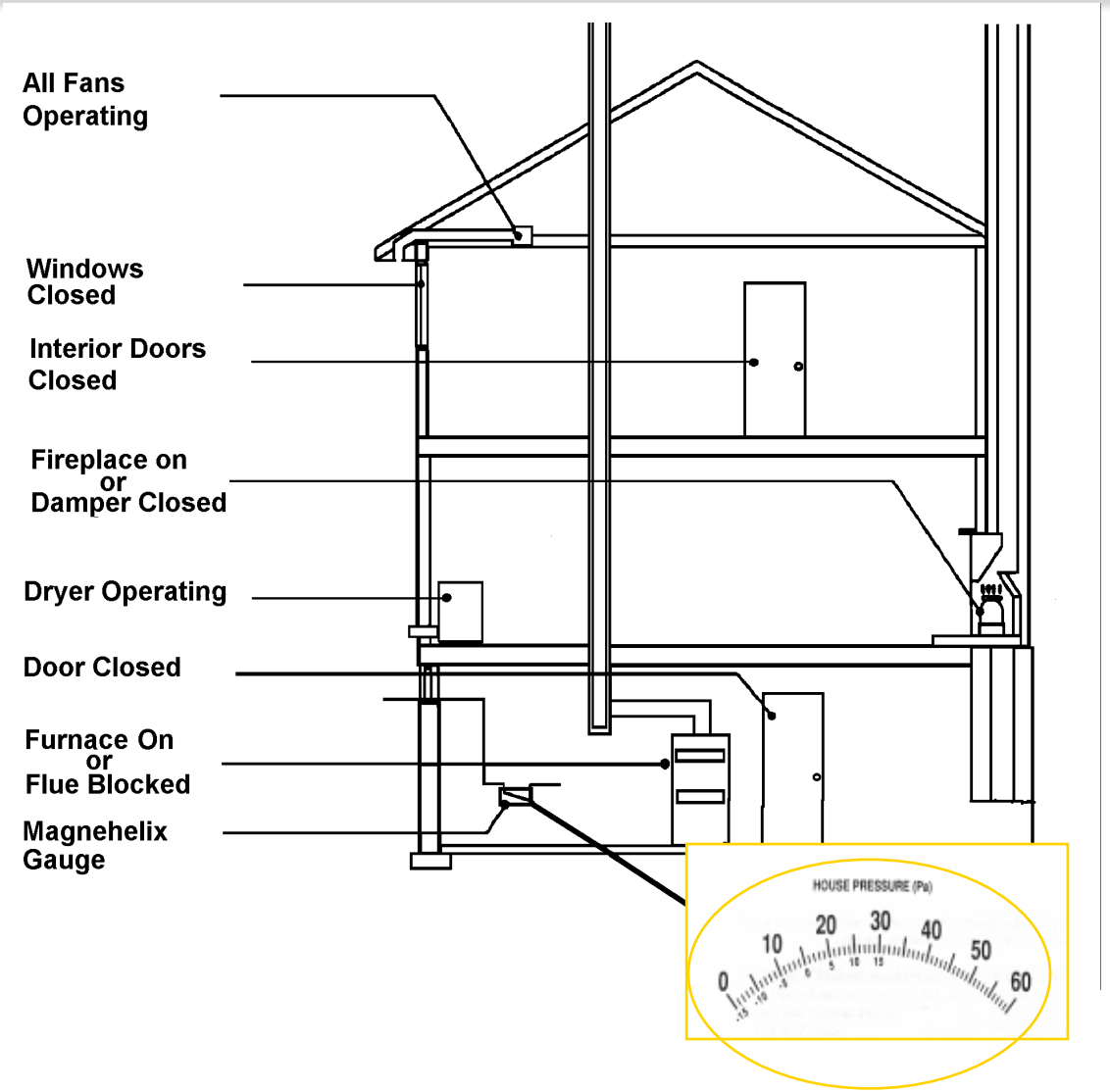
1. **Backdrafting of "spillage susceptible** combustion appliances: 3 to 5 Pa< limit

2. **Proper operation of the exhaust appliance**
   - 25 to 50 Pa limit
   - Know the fan curves of the exhaust appliances

   - IRC: 400< CFM Range Hood will require MUA

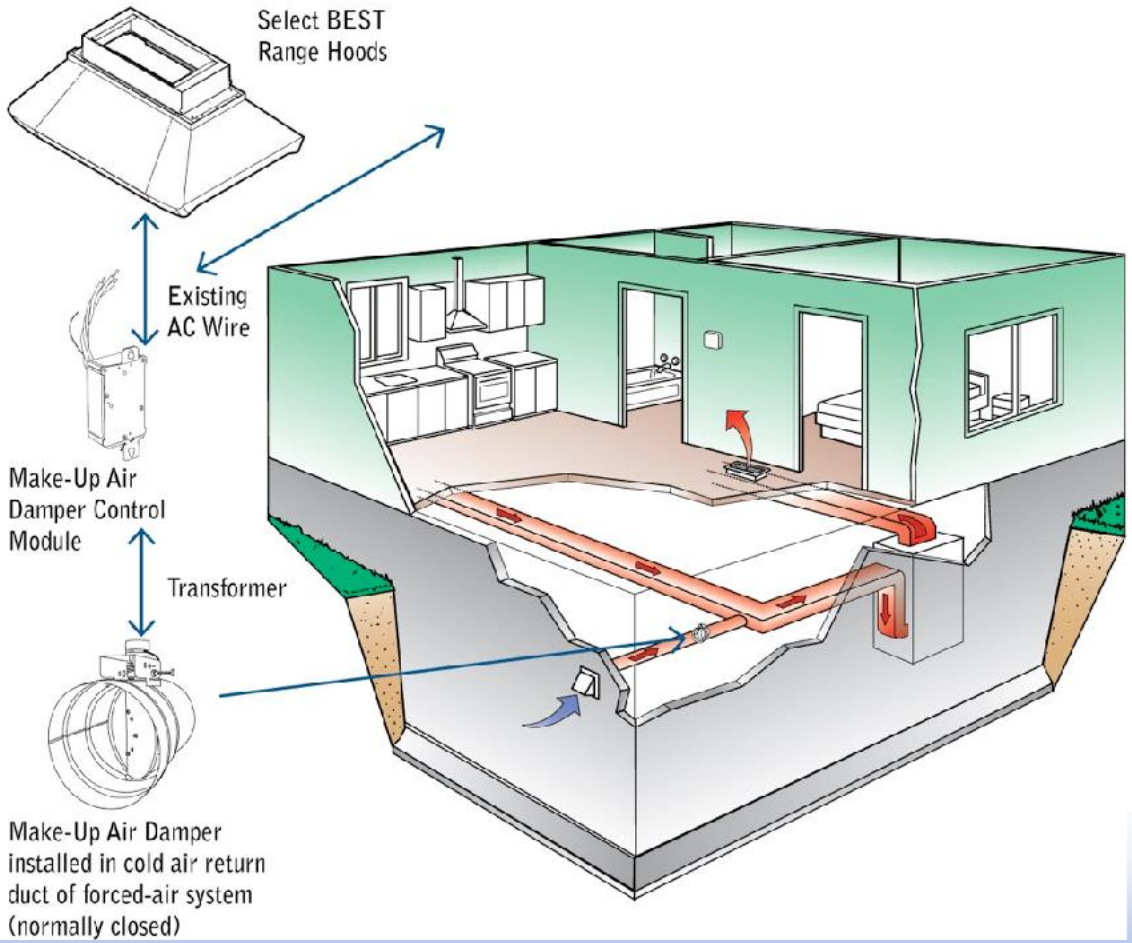
Depressurization Testing

- Use a pressure gauge to measure pressure between outside and inside
- Turn on exhaust fans
- If pressure is below 5 Pa (0.02” w.g.) then no action is required (typically)
- Otherwise provide make-up air



What about make-up air?

Fan manufacturers have new, helpful strategies



Over 400 CFM ??

NEW “Capture Efficiency “ Rating for Range Hoods

Tips for Successful Operation. Best Range Hood LLC.

ASTM E3087 - 18

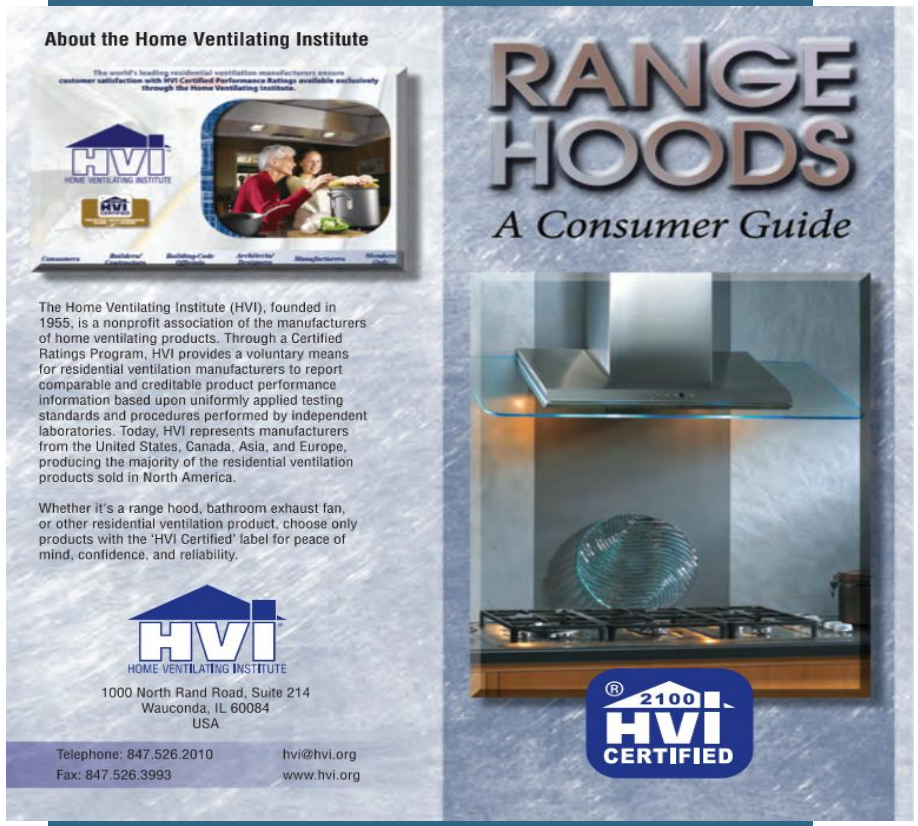
Standard Test Method for Measuring Capture Efficiency of Domestic Range Hoods

Range hood Sizing is MORE THAN CFM capacity. Capture “efficiency” is affected more by:

1. Geometry/Coverage of the hood(COVER entire stove area)
2. Distance from burner (24-32”)
3. Air availability(e.g. make-up air)
4. Consider shielding sides(w/cabinets of range box)
5. CFM : e.g Volume of kitchen area vs CFM
6. Select DEEP Hood w/ open bottom
7. Select Hood with 3 sones @ 200cfm >
8. Target 200-350cfm (depending on installation and stove type)
9. Ideal CE Capture Efficiency = 75-80%<
10. Consider OVEN VENTING

Refer to Home Ventilation Institute guidance (HVI) for range hood selection

Certified Home Ventilating Products Directory, https://www.hvi.org/proddirectory/index.cfm



Range Hood CFM Calculator

AGAINST A WALL HOOD

HVI Suggest	30"/2.5'	36"/3'	48"/4'
Recommended	250 CFM	300 CFM	400 CFM
Minimum	100 CFM	120 CFM	160 CFM

FOR ISLAND RANGE HOOD

HVI Suggest	30"/2.5'	36"/3'	48"/4'
Recommended	375 CFM	450 CFM	600 CFM
Minimum	125 CFM	150 CFM	200 CFM

Filtration

- Filtration at the furnace works and is cost effective
- Commonly located in the return duct of the air handler
- Choose a filter with a rating of MERV 13 or better
- The better the filter, the more it restricts air flow, understand the appliance needs

Filtration Options

1” – 4” Pleated Filters

- MERV 8-13
- May restrict air flow

1” Electrostatic

- MERV 6-10
- Simple, washable
- May restrict air flow

Electronic Filter

- No MERV ratings
- Good at removing small particles
- Needs cleaning every 6-8 weeks
- May give off small amounts of ozone

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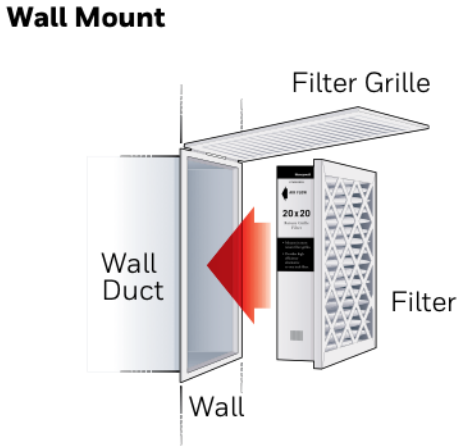
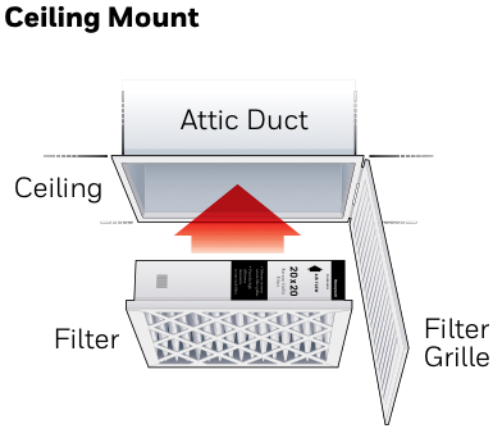
Media Filters offer flexibility

Air Handler Cabinet





Return Air Grille Filter

Consider Pressure Drop across the filter:
Less than 0.2” W.C. should be adequate

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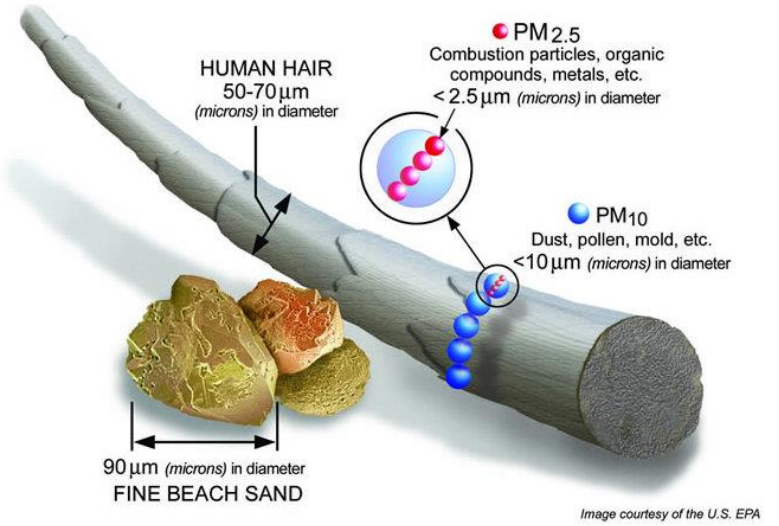
HVAC & Filtration

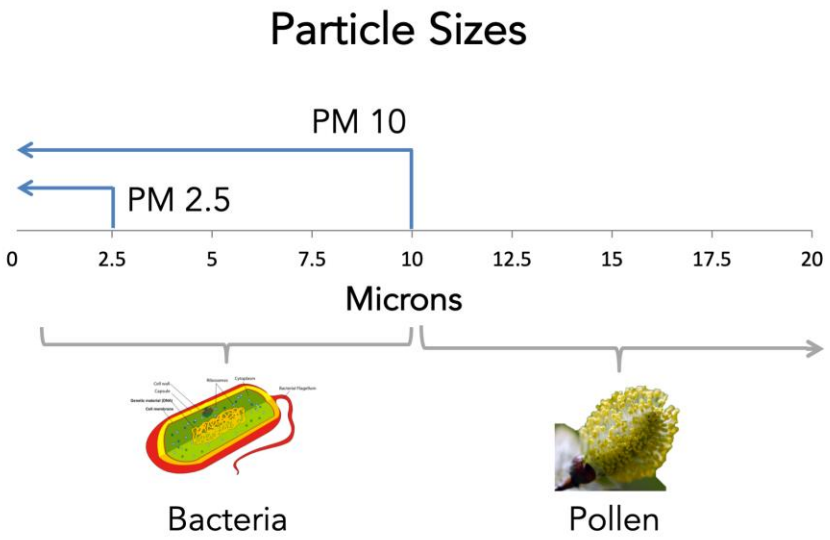
Filtration is the 4th of IAQ strategies: Remove, Seal, Ventilate, then Filter

- Filtration comes last in the IAQ hierarchy
- Commonly located in the return duct of the air handler OR provided at room-level(Space filtration units)
- Choose a filter with a rating of MERV 10 or better
- The better the filter, the more it restricts air flow, understand the appliance needs
- Remember: the first job of air handler “filters” is to protect the equipment
- HVAC designer must adjust equipment and duct design to ensure no PRESSURE DROP form filtration package.

HVAC & Filtration

Filtration is the 4th of IAQ strategies: Remove, Seal, Ventilate, then Filter





FYI: Viruses are around PM 0.1

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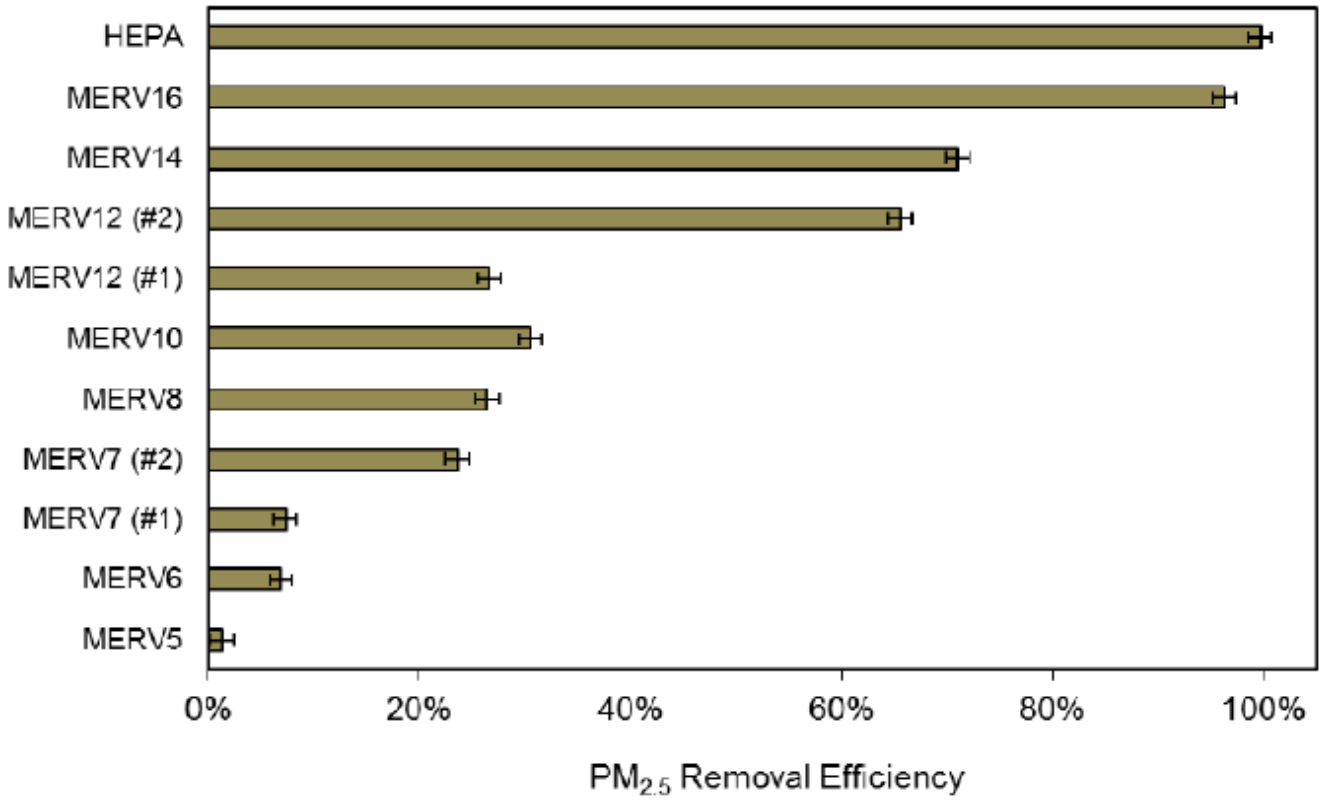
HVAC & Filtration

Filtration is the 4th of IAQ strategies: Remove, Seal, Ventilate, then Filter



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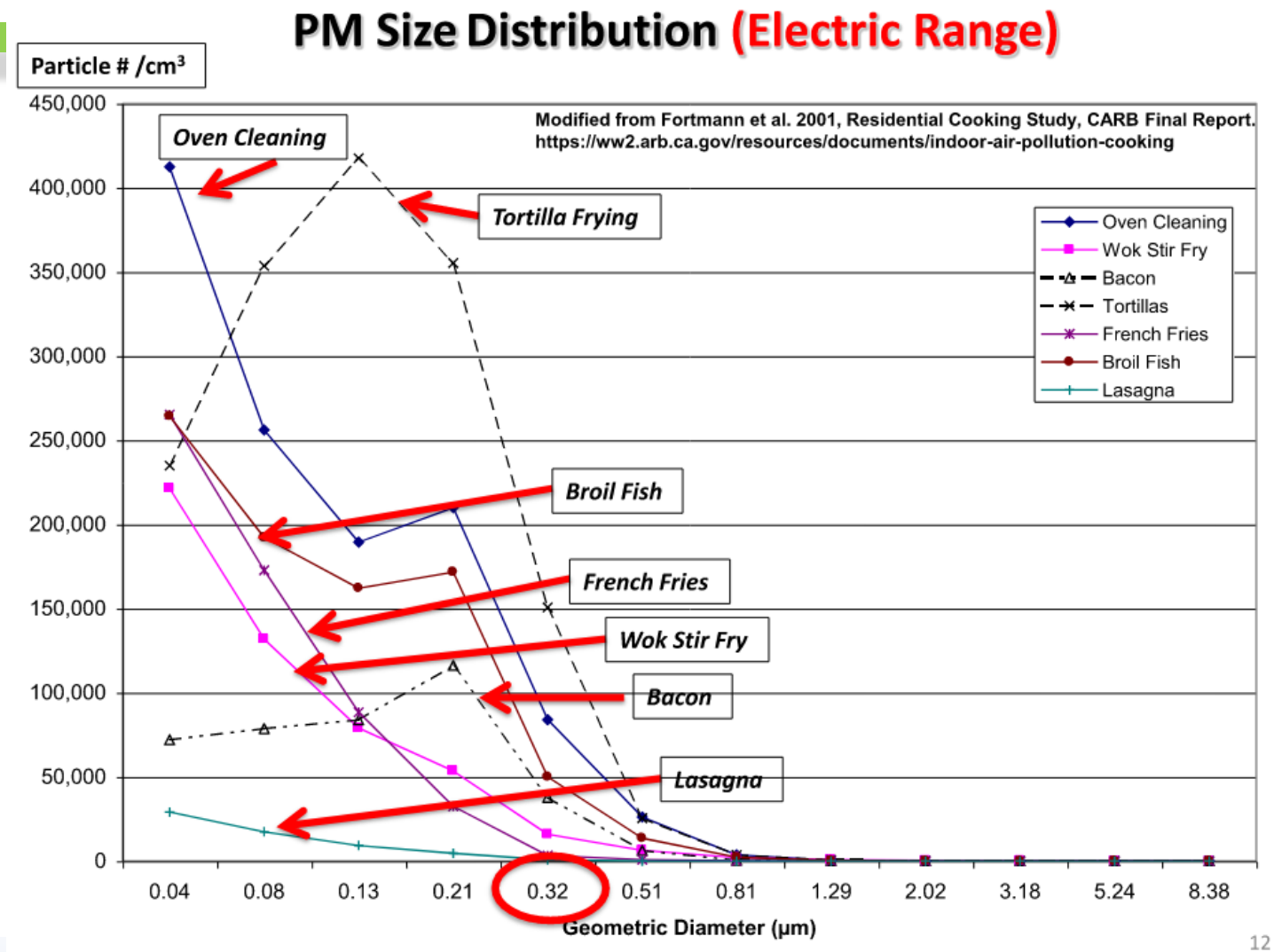
HVAC & Filtration

Filtration is the 4th of IAQ strategies: Remove, Seal, Ventilate, then Filter

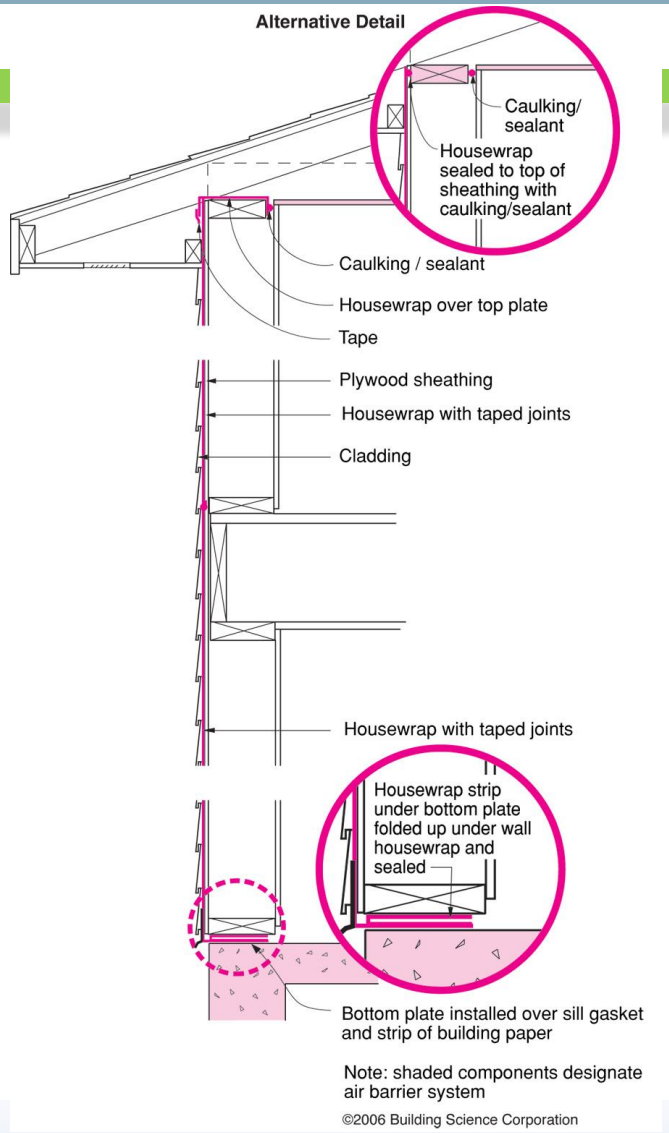


HVAC & Filtration

Space –Room air filtration:

- Effective vs Central air handler filtration
- Flexible

The right choices in the right order

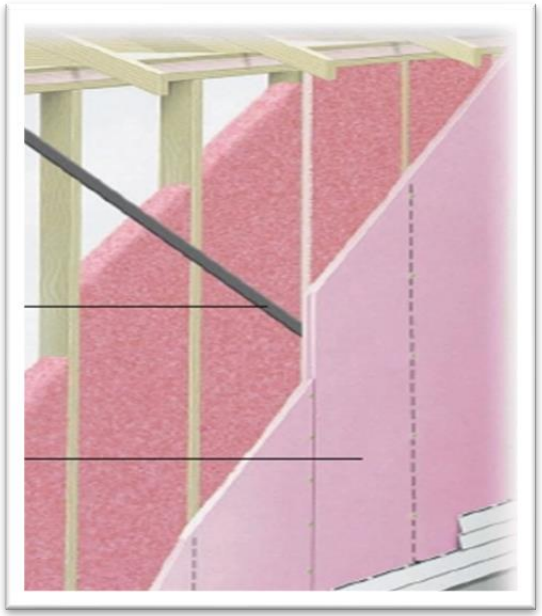


The pay off

$5,000 / kW Installed
=$4 / kWh / 1st yr generated

Energy Investments

$ 0.5 - 1 / kWh / yr 1st saved



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For Sale
GReN

Summary

- Creating better envelopes
- Include ventilation on every project, performance and rationalize costs
- Choose effective, efficient, quiet fans and appliances
- Challenge your mechanical contractor to participate in your quest improving total system performance

It’s coming

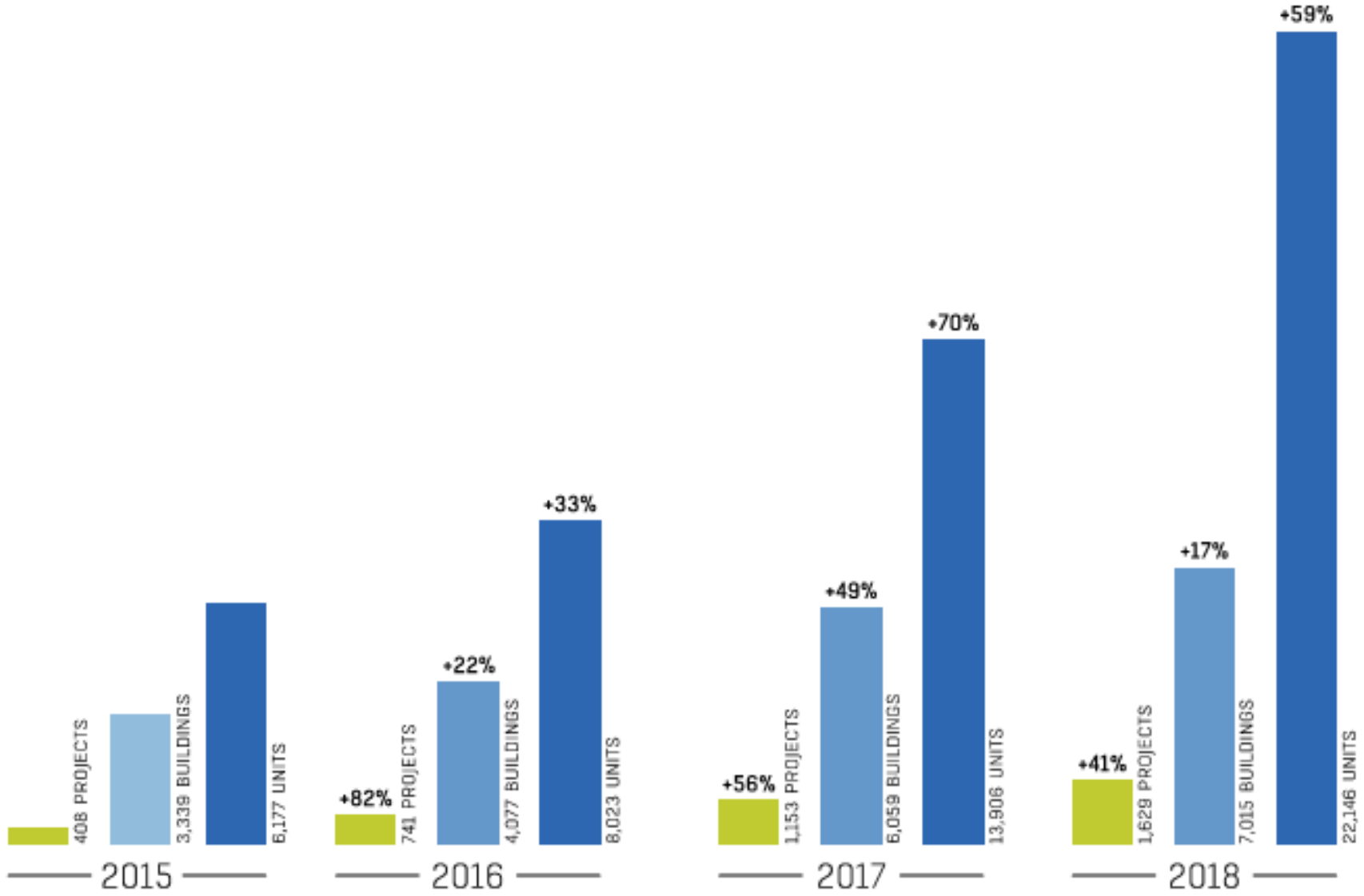
Be a leader ahead of the wave

2018 Zero Energy Residential Buildings Study

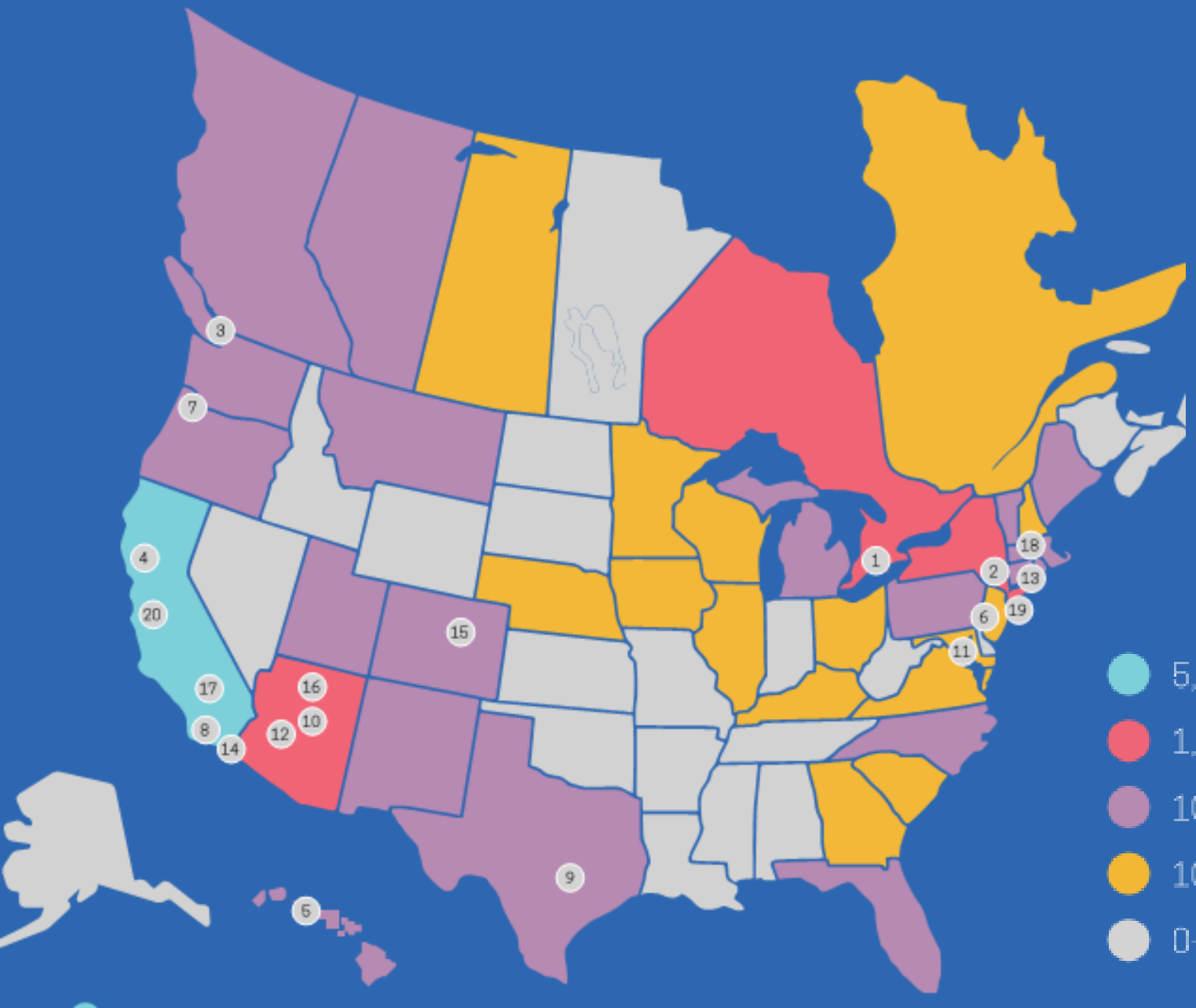
TEAM ZERO // teamzero.org

FINDINGS

The growth our contributors reported in 2018 was once again very robust – the number of ZE housing units increased by 59% over the prior year's inventory: 22,146 total units in design, in construction, and completed, as compared with 13,960 units in those combined categories in 2017.[1]

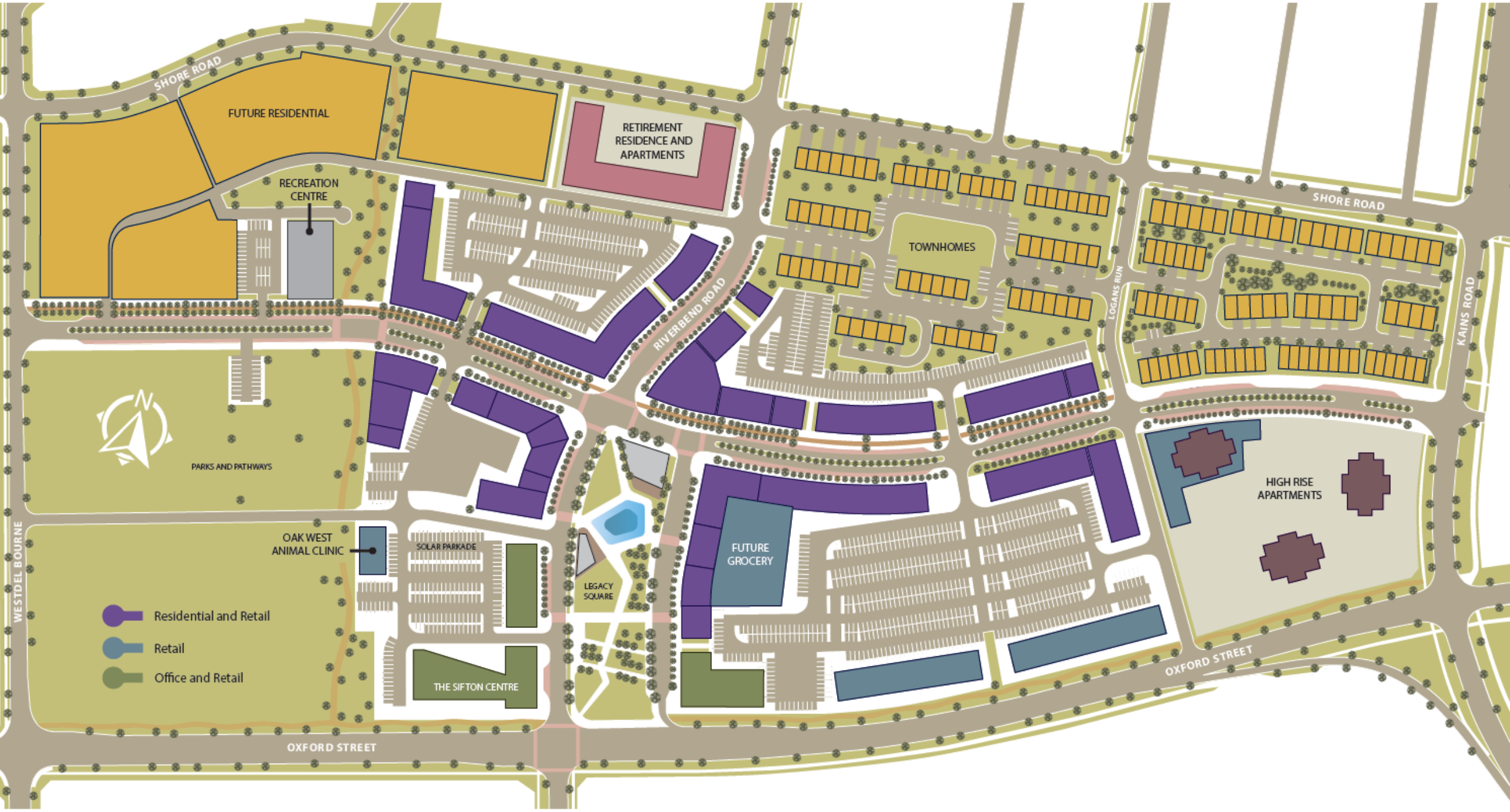


PATH TO ZERO



- 5,000+ Units
- 1,000-4,999 Units
- 100-999 Units
- 10-99 Units
- 0-9 Units

TOP 20 ZERO ENERGY CITIES BY NUMBER OF UNITS	
1. London, ON	2001
2. New York, NY	1811
3. Vancouver, BC	749
4. Davis, CA	670
5. Honolulu, HI	389
6. Philadelphia, PA	367
7. Portland, OR	366
8. San Diego, CA	352
9. Austin, TX	347
10. Clarkdale, AZ	323
11. Washington, DC	318
12. Chino Valley, AZ	308
13. Bronx, NY	308
14. National City, CA	268
15. Denver, CO	265
16. Bellmont, AZ	253
17. Rialto, CA	248
18. Townsend, MA	238
19. Far Rockaway, NY	22
20. Pleasanton, CA	210


SHORE ROAD
FUTURE RESIDENTIAL
RETIREMENT RESIDENCE AND APARTMENTS
RECREATION CENTRE
TOWNHOMES
SHORE ROAD
RIVERBEND ROAD
LOGANS RUN
KAINS ROAD
PARKS AND PATHWAYS
HIGH RISE APARTMENTS
OAK WEST ANIMAL CLINIC
SOLAR PARKADE
LEGACY SQUARE
FUTURE GROCERY
WESTDEL BOURNE
Residential and Retail
Retail
Office and Retail
THE SIFTON CENTRE
OXFORD STREET
OXFORD STREET

TOWNHOMES

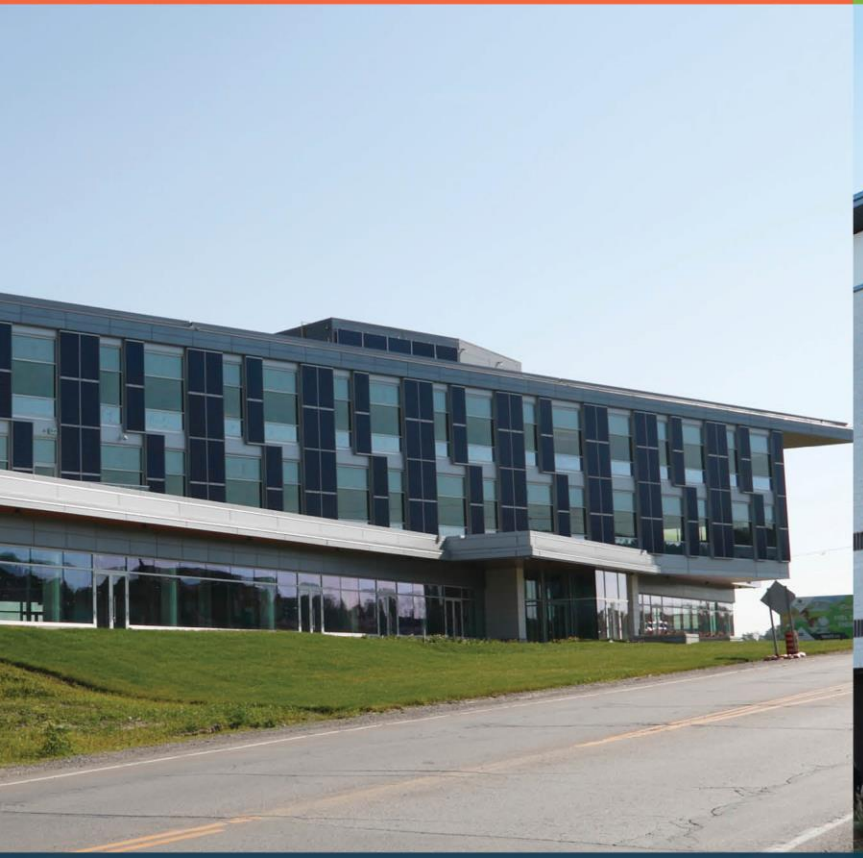
HELIO


WORK IN WEST 5
SIFTON CENTRE
NET ZERO BUILDING
DESIGNED & CONSTRUCTED TO POWER ITSELF.
SOLAR PANELS
FREE PARKING
GREEN ROOF
AUTOMATED LIGHTING
DYNAMIC GLASS WINDOWS
SECURED BIKE PARKING

275W

325W

400W

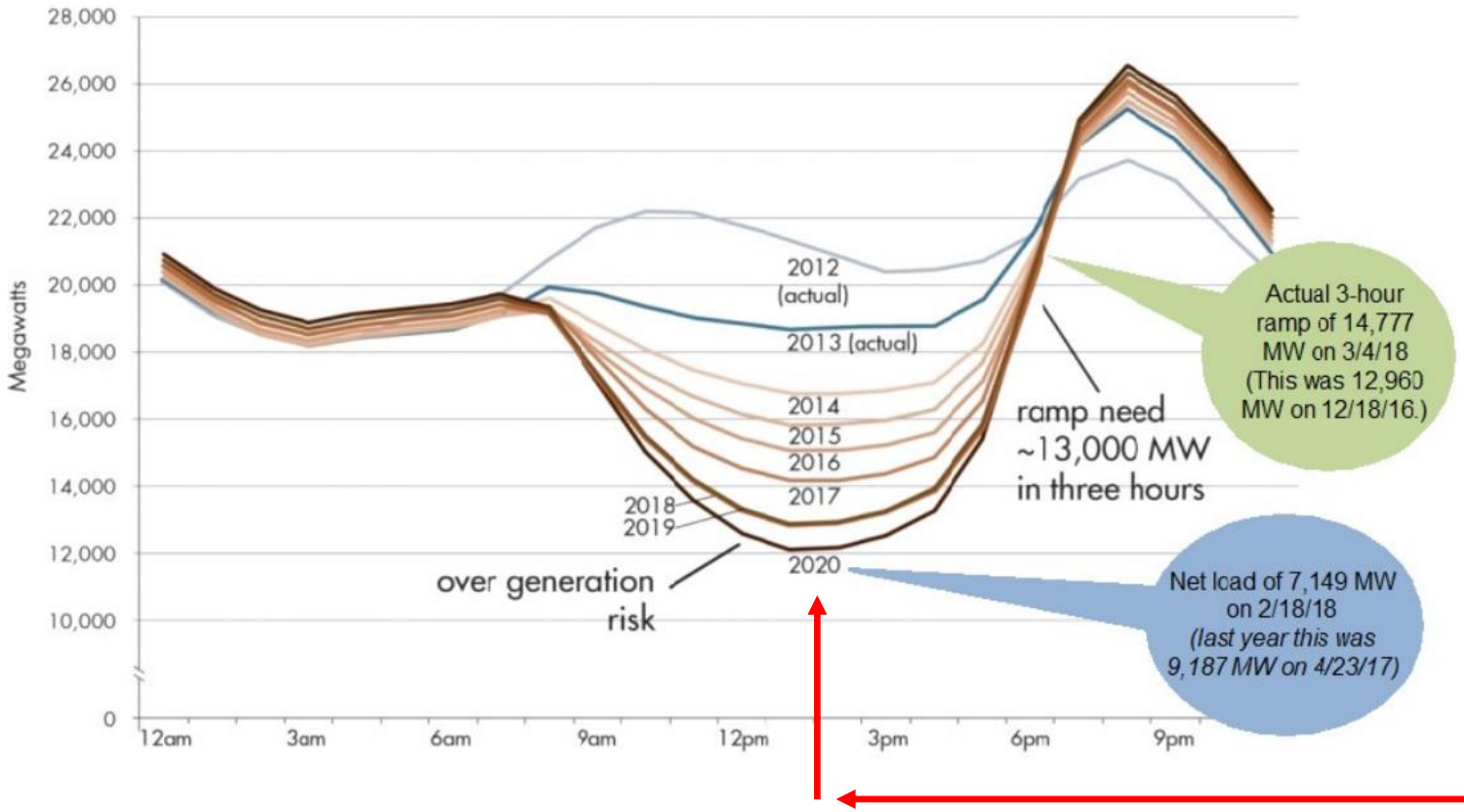


Technology is rapidly advancing, calling for renewed training and understanding more frequently.

PV (PANEL) vs BIPV (INTEGRATED ROOF)

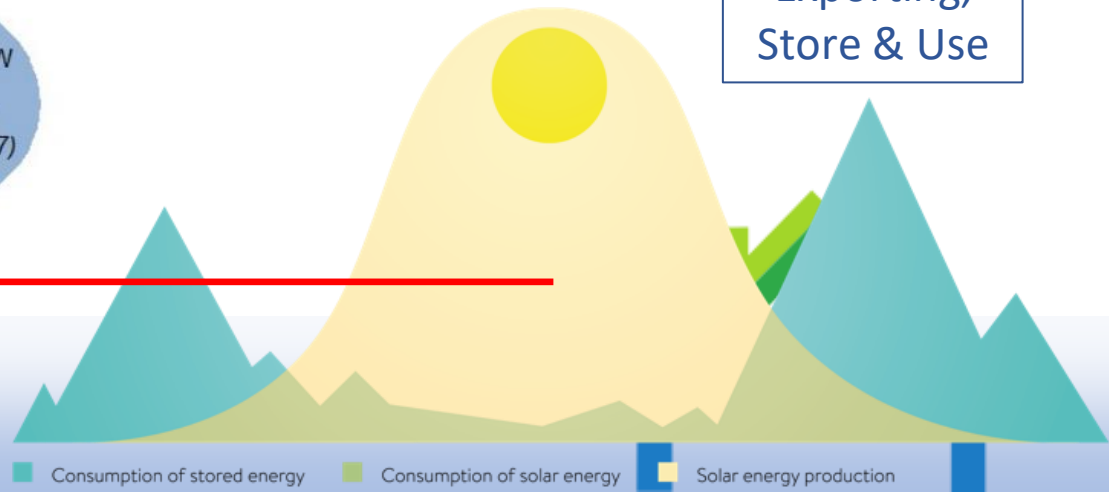
VS

Battery Storage - Benefits



Generation Exceeds Load During Day Time

Instead of Exporting, Store & Use



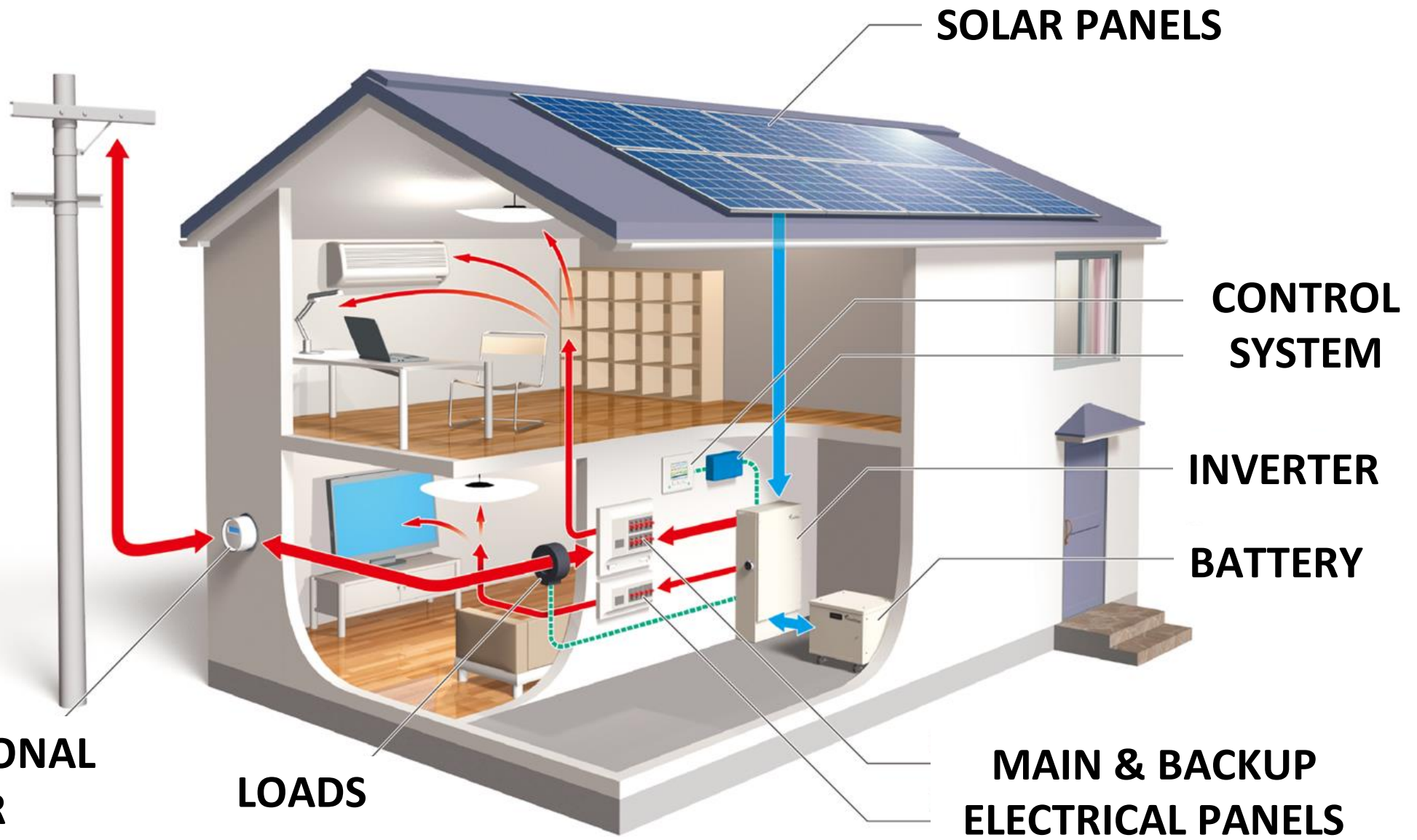
Batteries (Solar + Storage)

What battery storage was...

What battery storage is...

SOLAR ENERGY STORAGE: SYSTEM OVERVIEW

Panasonic
ECO SOLUTIONS CANADA



THE FUTURE LANDSCAPE
HOUSING AND TRANSPORTATION ARE ONE…

MODULARIZATION AND ZERH HOMES

Changing your process
Where does actual change begin?

Who will be responsible for change?

Select key people

- Top management
- Top field staff
- Key sub-contractors
- Testing professionals
- Architects & designers
- Sales management staff

Creating a plan to move forward

- Define the concerns, plan for the solution and set a timeframe