OREGON HOUSING & COMMUNITY SERVICES

# Multifamily Energy Program

# Effective Ventilation Strategies for Multifamily

**Date:** September 13, 2018

**Presenter:** Matt Christie

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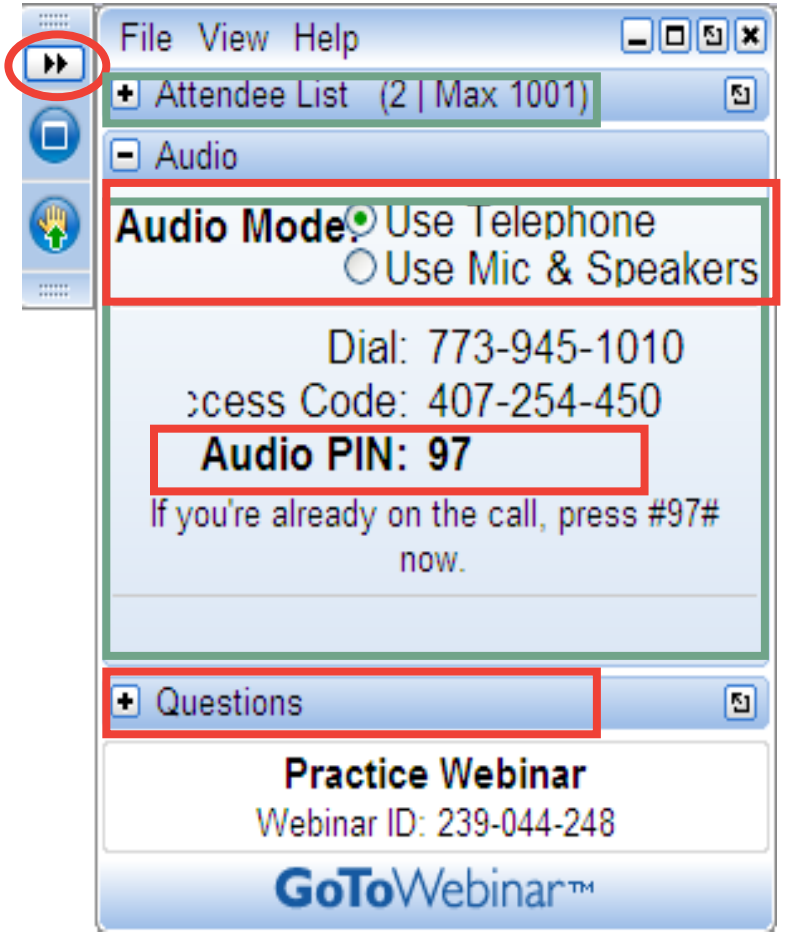
# USING GOTOWEBINAR

Open and close your **control panel**




Choose **audio mode**

Enter your **audio pin**

Type **questions** in the chat box

**Questions will be taken at the end of the presentation.**

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# REGISTER FOR UPCOMING TRAININGS

- **Thursday, September 27, 2018, 12pm:**

  ***Planning for Energy Efficiency Upgrades*** | **REGISTER NOW**

- **Thursday, October 11, 2018, 12pm:**

  ***Optimizing Multifamily Building Operations*** | **REGISTER NOW**

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# AGENDA

- Ventilation Basics
- Ventilation Strategies & Value Proposition
- Ventilation Standards & Guides
- Business Case for Prioritizing Systems
- Questions - Call to Arms

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# VENTILATION BASICS

- Why Ventilate?
- Natural vs Mechanical Ventilation
- Build Tight & Ventilate Right

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# WHY DO WE VENTILATE?

- **Buildings have changed**
  - New materials
  - Codes and standards
  - Tighter buildings
  - Siting and land development has changed

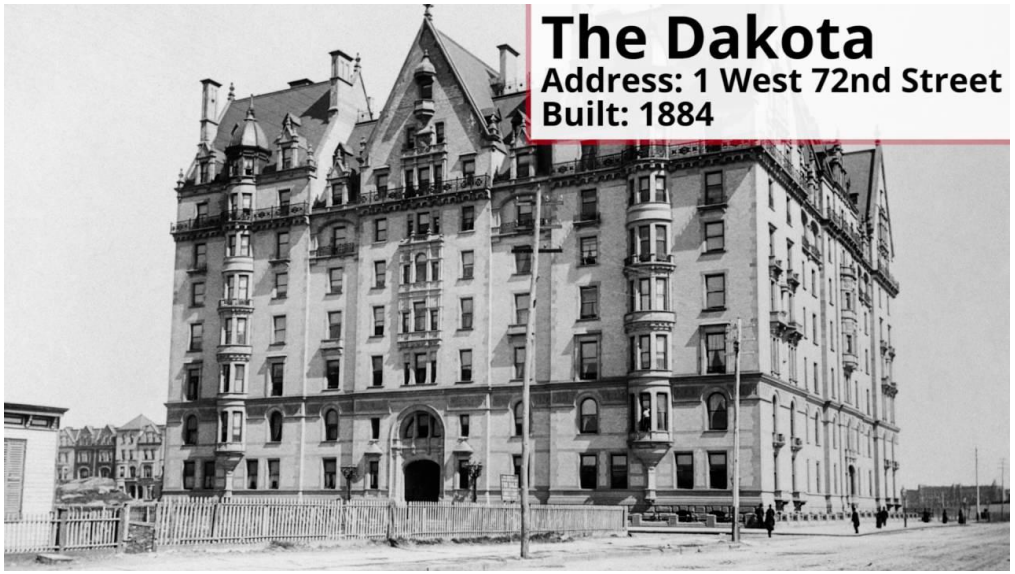
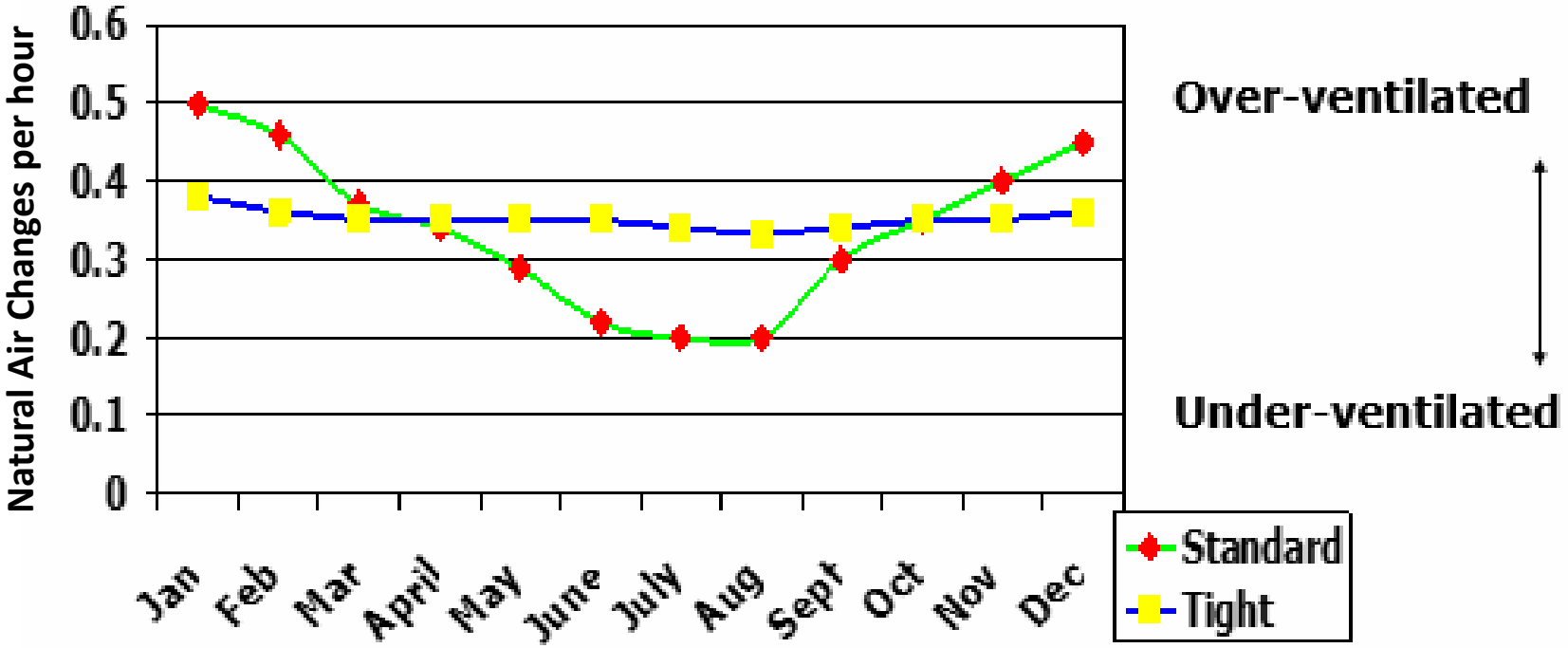



Image courtesy wiki-commons

# WHY NOT NATURAL VENTILATION?




Natural Ventilation Rates vs Average Outdoor Temperatures

Image courtesy Northwest ENERGY STAR Homes

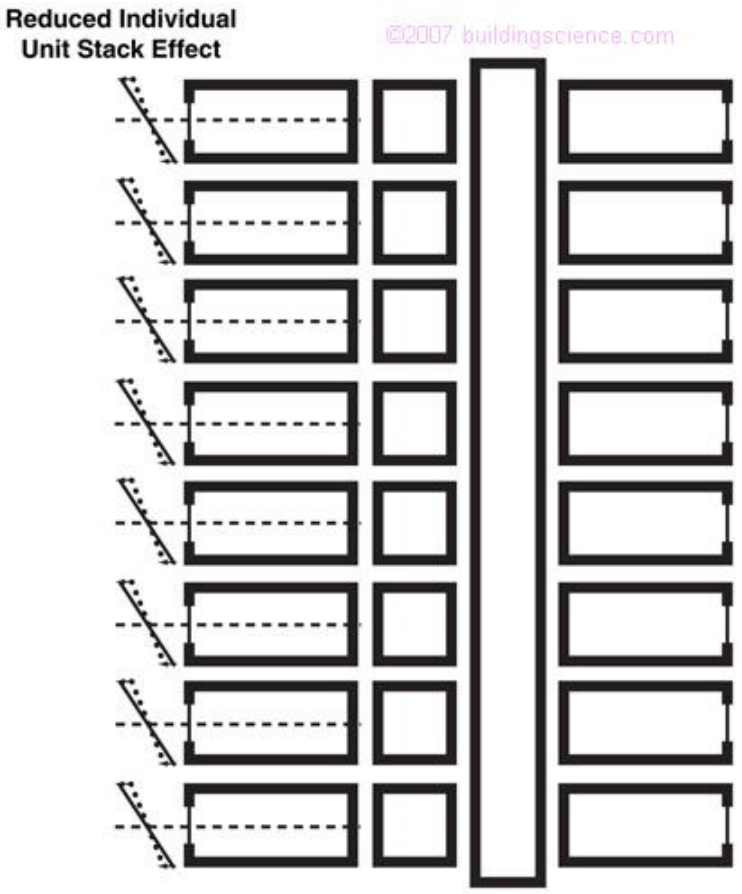
# WHY NOT NATURAL VENTILATION?

**Stack effect in the real world.**

Image courtesy Northwest ENERGY STAR Homes

# BUILD TIGHT AND VENTILATE RIGHT


Image courtesy Aeroseal




**Standard packages vs high value targets**

**Compartmentalized air sealing = top priority**

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# VENTILATION STRATEGIES & VALUE PROPOSITION

- Exhaust Ventilation
- Supply Ventilation
- Balanced Ventilation

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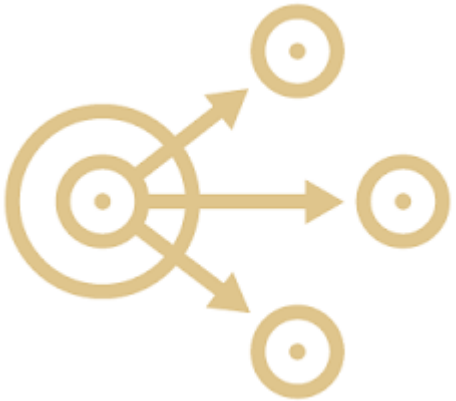
# GREAT VENTILATION PROVIDES…

## DISTRIBUTION



Distributed air into each living space.

## FILTRATION

Filtration of fresh air and/or room air.

## BALANCE

Balanced pressures that discourage strong pressures in rooms/units.

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# EXHAUST ONLY

- **Advantages**
  - Inexpensive
- **Disadvantages**
  - May not provide adequate ventilation
  - May add to energy consumption
  - May pull odors from neighbors
  - Not balanced
  - Not filtered
  - Not distributed
- **Best Application**
  - Exhaust fan efficiency is > 4.0 cfm/Watt, continuous run, paired with + pressure hallways

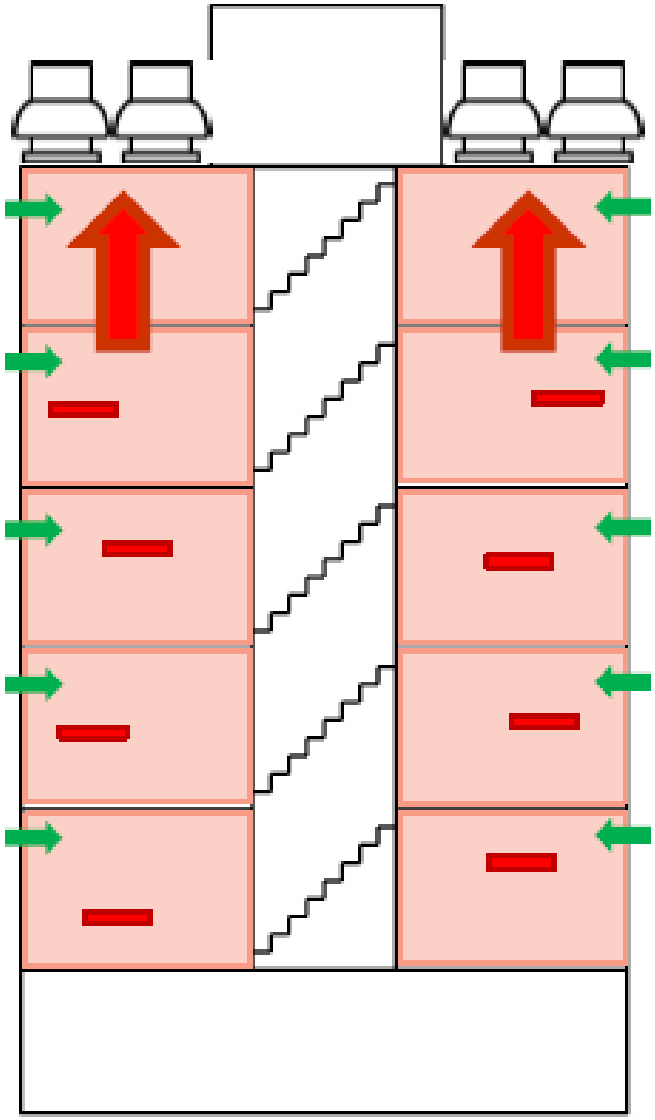
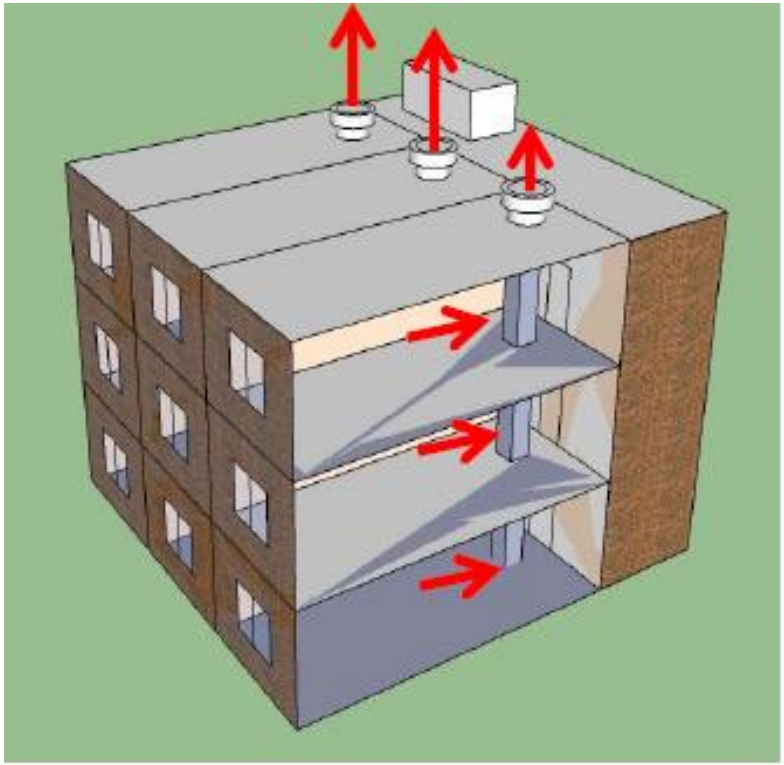


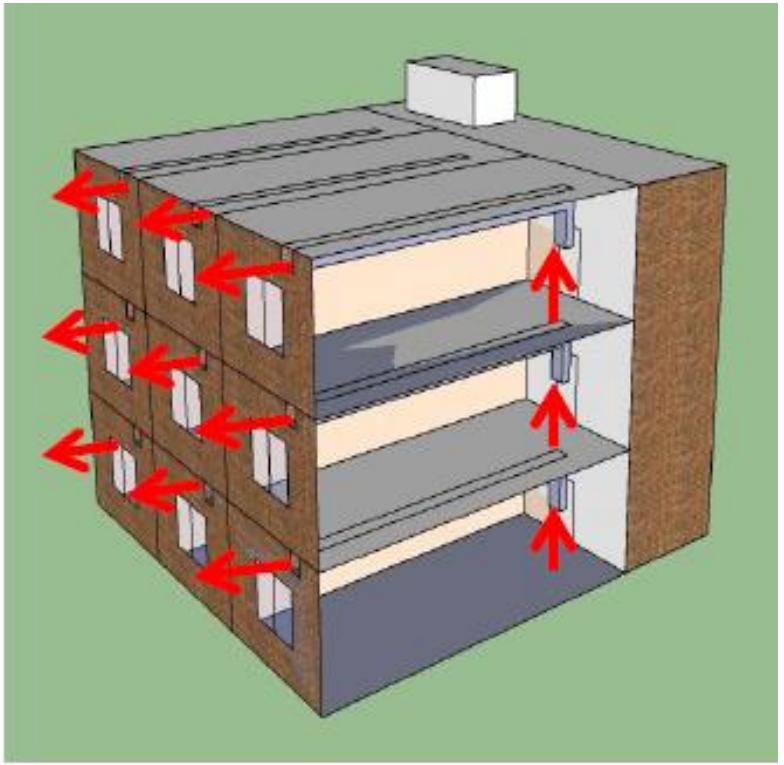
Image courtesy Building America

# EXHAUST VENTILATION

## Central Exhaust



## Unitized Exhaust



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Images courtesy Building America

# SUPPLY ONLY

- **Advantages**
  - Relatively inexpensive
  - Potentially good air distribution
  - Potential to add filtration
- **Disadvantages**
  - Not common on a per unit basis
  - May push pollutants/moisture into cavities/other units
  - Outside air reduces the heating and cooling capacity of the H/AC system(s)
  - May lead to comfort issues (outdoor temp, humidity)
- **Best Application**
  - Dry climates
  - When spot ventilation is well controlled
  - Set to run continuous with fan efficiency is > 4.0 cfm/Watt

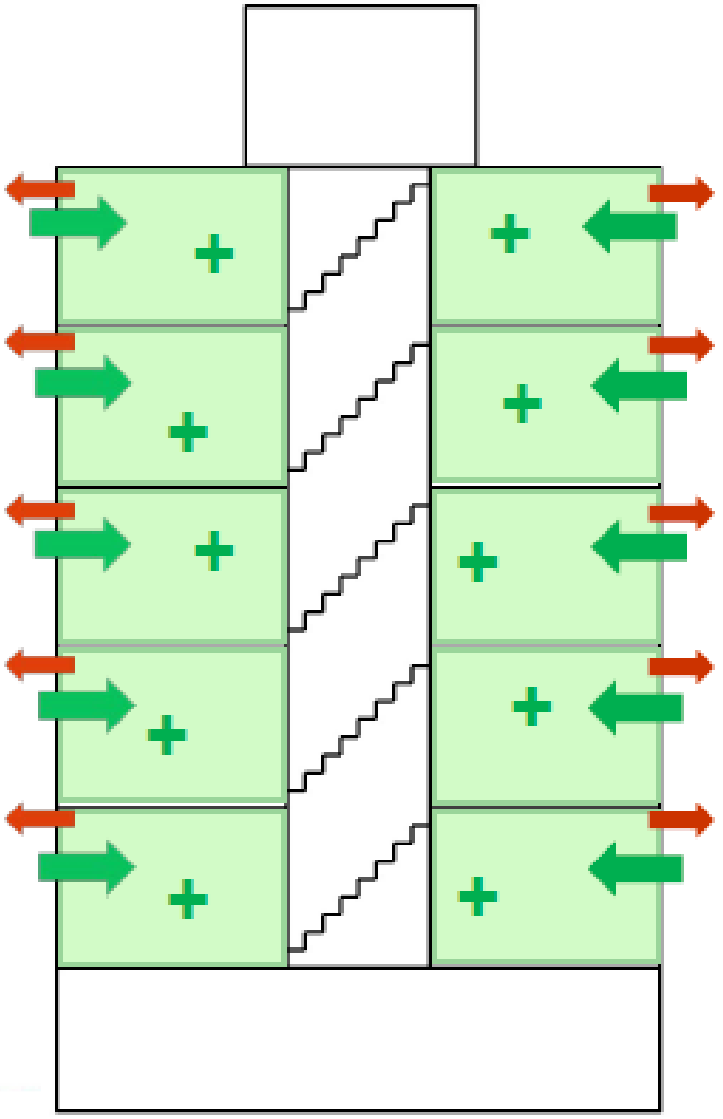


Image courtesy Building America

# BALANCED – UNIT HRV/ERV

- **Advantages**
  - Balanced ventilation
  - Good air distribution
  - Potentially saves energy (with good fan)
  - Good filtration options
- **Disadvantages**
  - Increased cost
  - Requires running independent ducting into rooms, or multiple units
  - Not all systems distribute into all rooms
  - Requires commissioning and balancing
- **Best Application**
  - Cost of operation and moisture control are main drivers

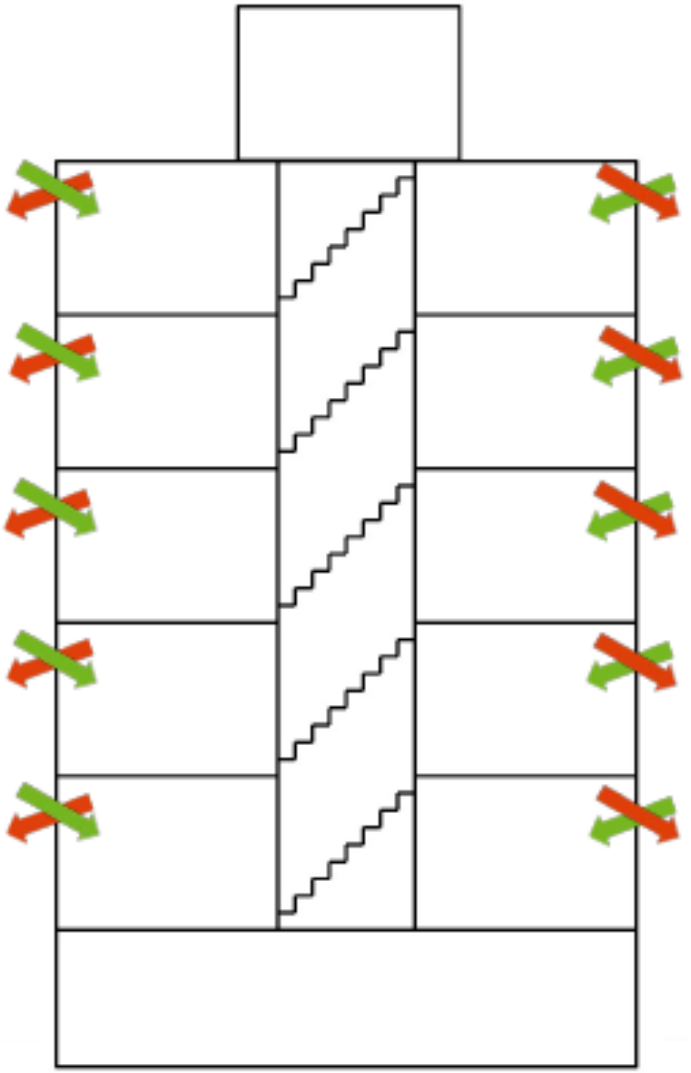
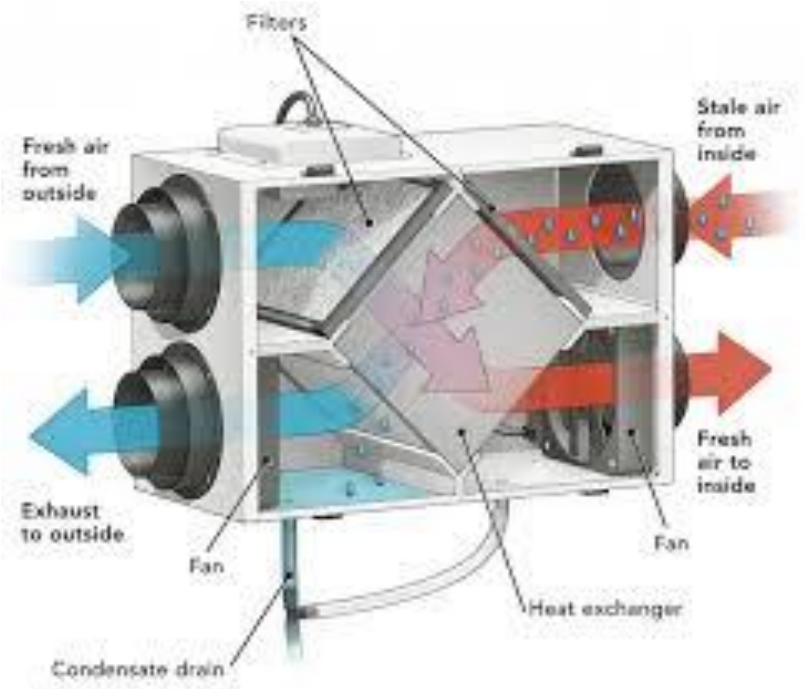
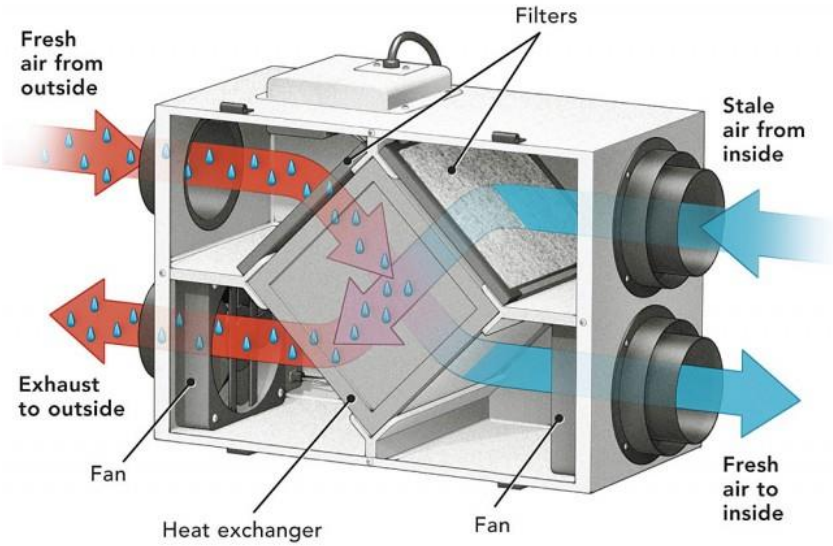


Image courtesy Building America

# BALANCED VENTILATION – WITH RECOVERY




Heat Recovery Ventilator




Energy Recovery Ventilator

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Images courtesy Building America

# IN-UNIT HRV/ERV

## Package ERV

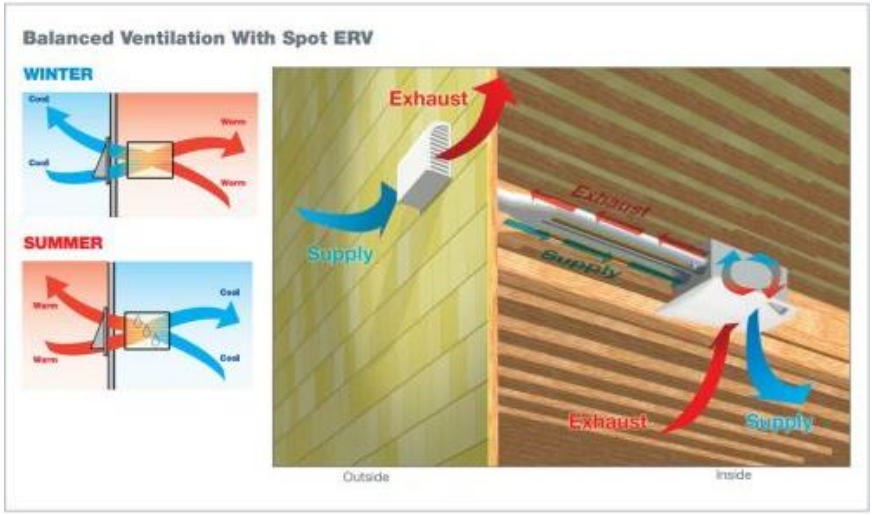


Image courtesy Building America

## Small Thru-wall Models

Image courtesy Lunos

# VENTILATION STANDARDS & GUIDES

- Oregon Code
- ASHRAE
- Building Science Corporation (BSC)
- International Code Council (ICC)

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# OREGON CODE

## 2014 OR Mech Specialty Code

Baseline for ventilation in new and existing multifamily buildings and to confirm compliance in regulatory and non-regulatory settings. **Based on the 2012 International Mechanical Code**


http://ecodes.biz/ecodes_support/free_resources/Oregon/14_Mechanical/14_ORMech_main.html

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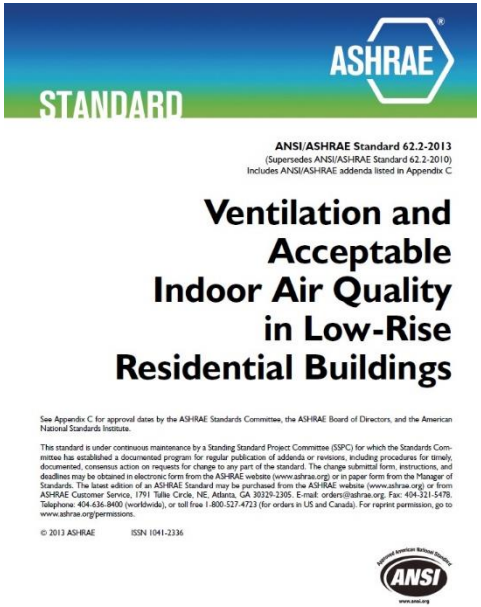
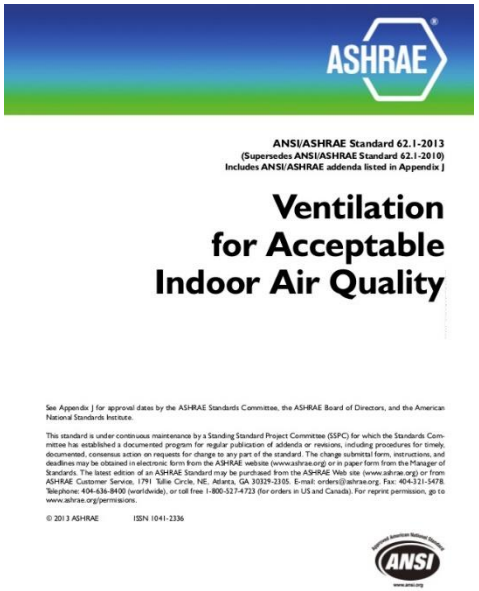
# ASHRAE



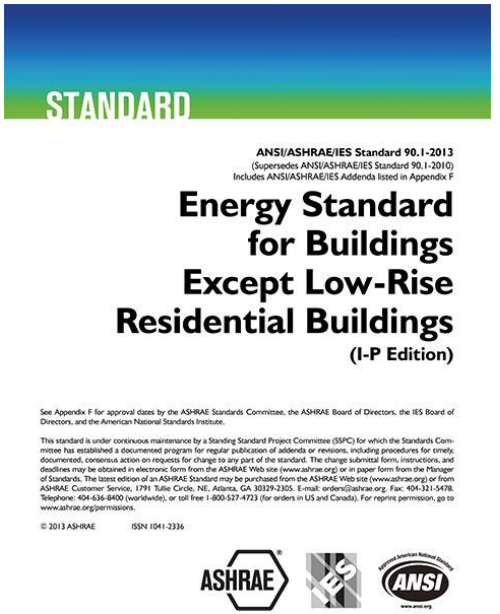

## ASHRAE 62.2

Used as a standard for **multifamily** building **dwelling units**




## ASHRAE 62.1

Used for low-rise **multifamily corridors** and common areas




## ASHRAE 90.1

Used as a standard for **high-rise** multifamily buildings

https://www.ashrae.org/technical-resources/standards-and-guidelines

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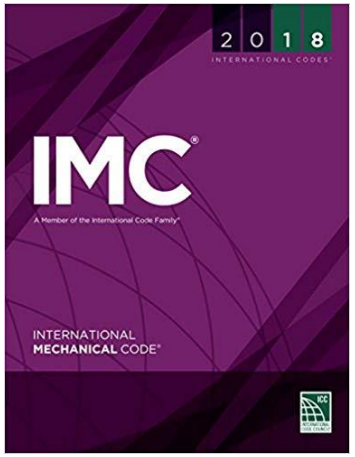
# BUILDING SCIENCE CORPORATION & INTERNATIONAL MECHANICAL CODE

Building Science Corporation




## BSC GM-1501 Ventilation Guide

Provides mechanical ventilation requirements of occupied spaces in new low-rise residential buildings

https://buildingscience.com/documents/special/ventilation-new-low-rise-residential-buildings

## ICC International Mechanical Code

Baseline for ventilation in new and existing multifamily buildings and to confirm compliance in regulatory and non-regulatory settings.

https://codes.iccsafe.org/public/document/yc7355qxk7/chapter-4-ventilation

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# DWELLING-UNIT VENTILATION

## Minimum Ventilation Rate for Dwelling Units

- OR MSC: Ventilation Rate (CFM) = 15 cfm x (Number of Bedrooms + 1)
- **ASHRAE: Ventilation Rate (CFM) = 0.03 X Unit Floor Area ($ft^2$) X (Number of Bedrooms + 1)**
- ICC & BSC: Ventilation Rate (CFM) = 0.01 X Floor Area ($ft^2$) + 7.5 X (Number of Bedrooms + 1)

## How to Supply Minimum Ventilation

- OR MSC: Occupied space ventilated by mechanical means, unless ACH is greater than 5
- **ASHRAE & BSC: Mechanical exhaust system, supply system, or combination thereof supplying outdoor air**
- ICC: Occupied space ventilated by mechanical means, unless ACH is greater than 5

## Controls and Operation

- ASHRAE, OR, ICC & BSC: Mechanical ventilation systems shall be provided with manual or automatic controls that will operate such systems whenever the spaces are occupied

# DWELLING-UNIT VENTILATION

## Airflow Testing

- ASHRAE: **Ventilation devices and equipment serving individual dwelling units shall be tested**[1]
- OR & ICC: Indoor air exhausted measured using a flow hood, flow grid, or other airflow measuring device

## Minimum Filtration

- ASHRAE: MERV 6 or better[2] or equivalent in effectiveness
- BSC: MERV 9 or better[3]

## Adjacent Spaces

- ASHRAE & BSC: Minimize air movement across envelope components to dwelling units from adjacent spaces

[1] ***in accordance with ANSI/ASHRAE Standard 51/AMCA 210, or ANSI/RESNET 380-2016***

[2] *when tested in accordance with ANSI/ASHRAE Standard 52.2*

[3] *when tested in accordance with ANSI/ASHRAE Criterion 52.2*

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# INTAKE & EXHAUST

## Intake Air

- **ASHRAE, ICC, & BSC: Inlets located a minimum of 10 ft. from contaminant sources**
- OR, ICC & BSC: When10 ft from intake, opening must be 3 ft below exiting contaminant sources
- ASHRAE & ICC: Openings not obstructed and protected with screen

## Exhaust Air

- **ASHRAE, OR, ICC, & BSC: Kitchen & bathrooms must be provided with a local exhaust**
- BSC: Kitchen hood and bathroom fan Energy Star compliant & supplied with back-draft damper

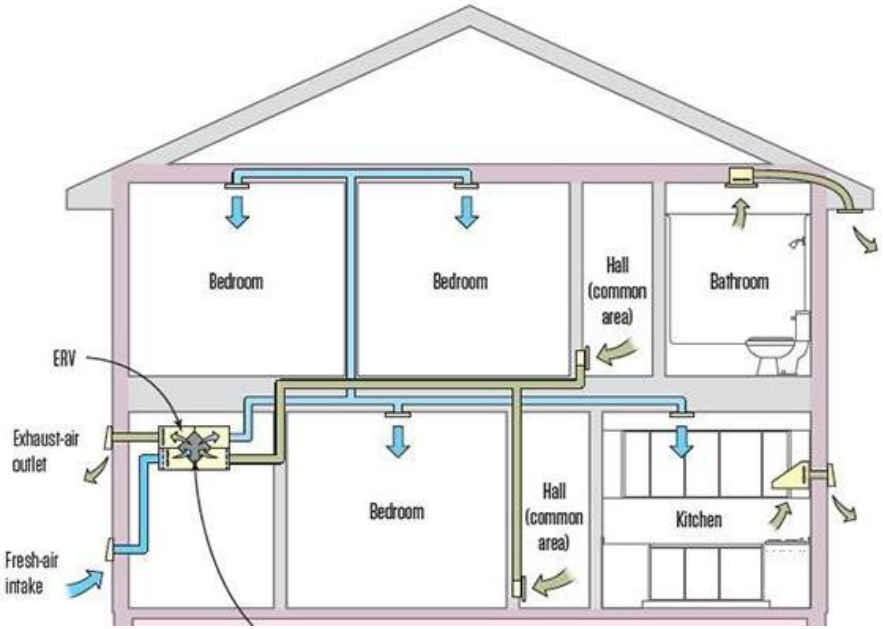


Image courtesy Building Science Corp

# INTAKE & EXHAUST

## Exhaust Air Rate

- ICC: Table 403.3.2.3
- OR: Table 403.3
- BSC: Similar to ICC
- **ASHRAE: 62.2 Tables 5.1 & 5.2**

**TABLE 403.3.2.3**
**MINIMUM REQUIRED LOCAL EXHAUST RATES FOR GROUP R-2, R-3, AND R-4 OCCUPANCIES**

| AREA TO BE EXHAUSTED | EXHAUST RATE CAPACITY |
|---|---|
| Kitchens | 100 cfm intermittent or<br>25 cfm continuous |
| Bathrooms and toilet rooms | 50 cfm intermittent or<br>20 cfm continuous |

For SI: 1 cubic foot per minute = 0.0004719 $m^3/s$.

**TABLE 5.1 Demand-Controlled Local Ventilation Exhaust Airflow Rates**

| Application | Airflow |
|---|---|
| Enclosed Kitchen | • Vented range hood (including appliance-range hood combinations): 100 cfm (50 L/s)<br>• Other kitchen exhaust fans, including downdraft: 300 cfm (150 L/s) or a capacity of 5 ach |
| Nonenclosed Kitchen | • Vented range hood (including appliance-range hood combinations): 100 cfm (50 L/s)<br>• Other kitchen exhaust fans, including downdraft: 300 cfm (150 L/s) |
| Bathroom | 50 cfm (25 L/s) |

**TABLE 5.2 Continuous Local Ventilation Exhaust Airflow Rates**

| Application | Airflow |
|---|---|
| Enclosed Kitchen | 5 ach, based on kitchen volume |
| Bathroom | 20 cfm (10 L/s) |

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# BUSINESS CASE FOR PRIORITIZING SYSTEMS

- Odor Control
- Moisture Control
- Cost to Operate
- Maintenance
- First Cost
- Winning Cases

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# ODOR CONTROL

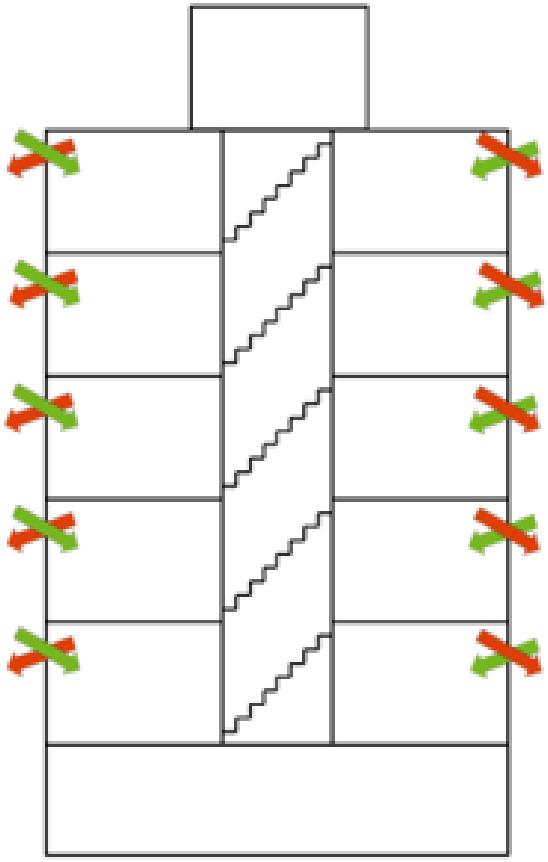
## Controlling Odors Generated In-Unit

- Meeting both spot and whole-unit ventilation

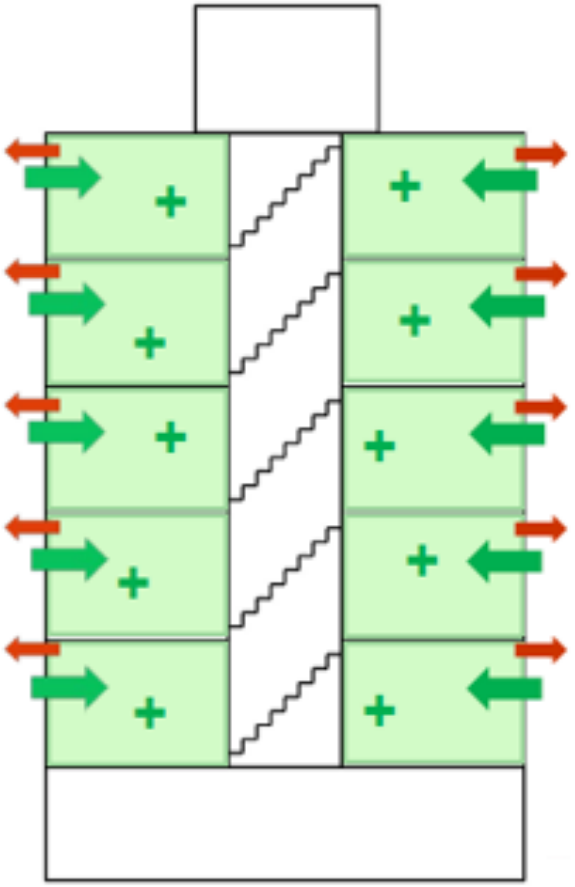
## Controlling Odors from Neighboring Units

- Compartmentalized air sealing PLUS
  - Balanced ventilation top option
  - Alternatively, + pressure ventilation, running continuous, with efficient fans

# ODOR CONTROL



**Balanced Ventilation**



**Supply Only Ventilation**

Images courtesy Building America

# MOISTURE CONTROL

## Controlling Relative Humidity

- Meet both spot and whole-unit ventilation
- Exhaust whole house and exhaust spot
- Balanced system
  - HRV/ERV
  - Separate supply fan and exhaust fans (range hood or bathroom fan)

Reduce comfort complaints

Reduce chances of building rot

Reduce instances of mold/mildew

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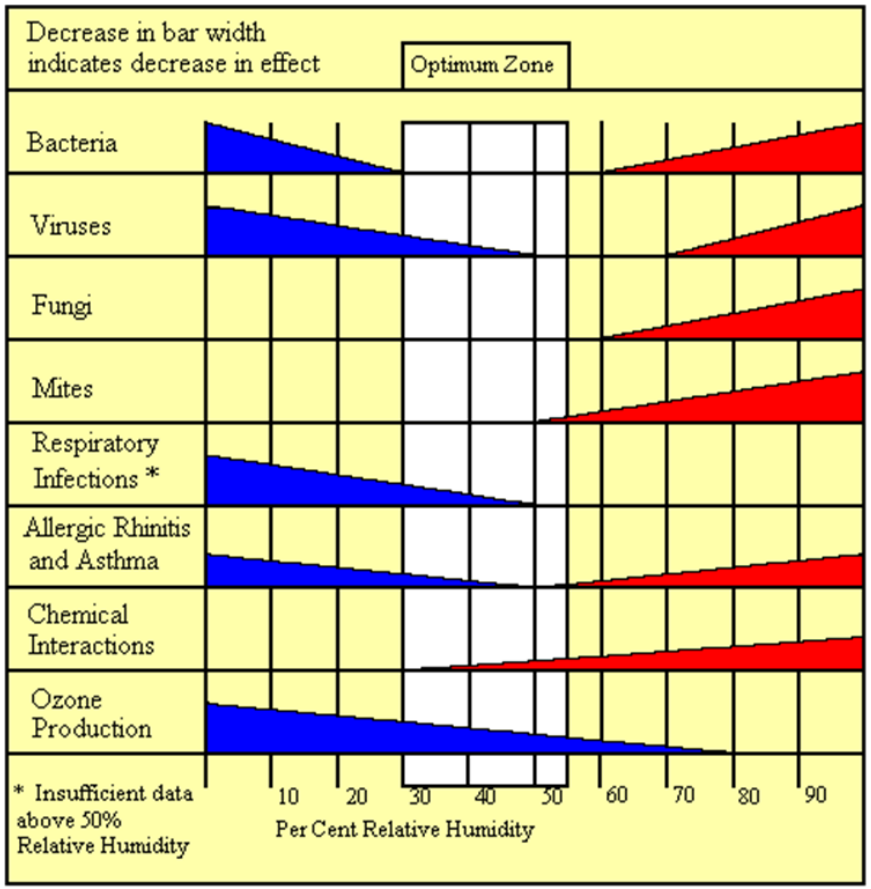
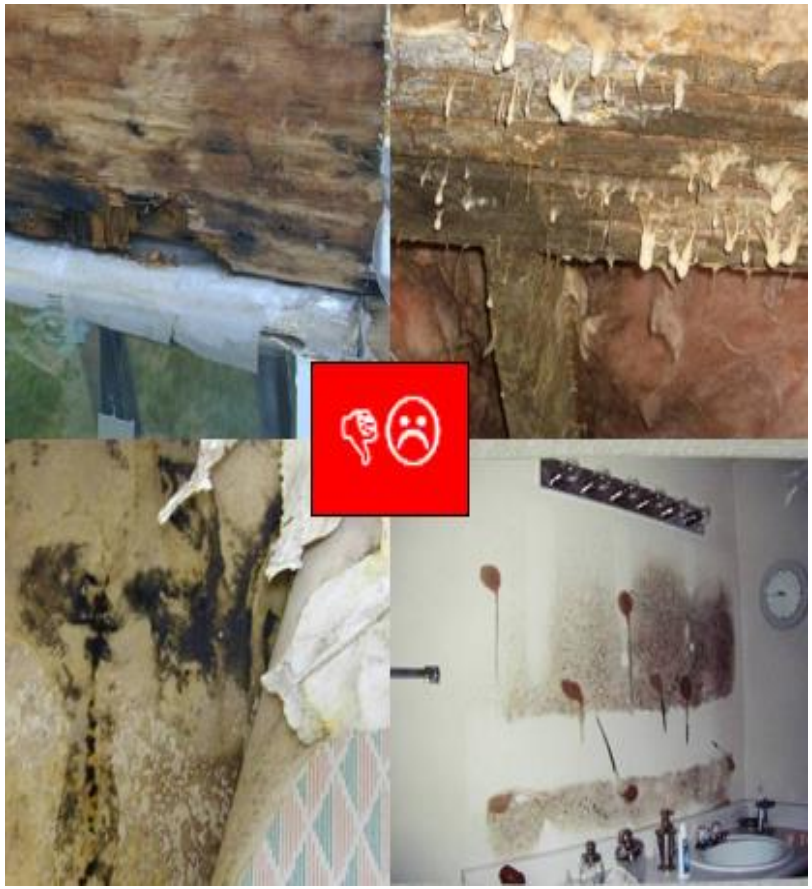
# MOISTURE CONTROL




**Unmanaged moisture can lead to poor Indoor Air Quality**



**Unmanaged moisture can lead to build durability issues**

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Image courtesy Northwest ENERGY STAR Homes

# COST TO OPERATE

## Cost to Heat/Cool or Dehumidify Fresh Air

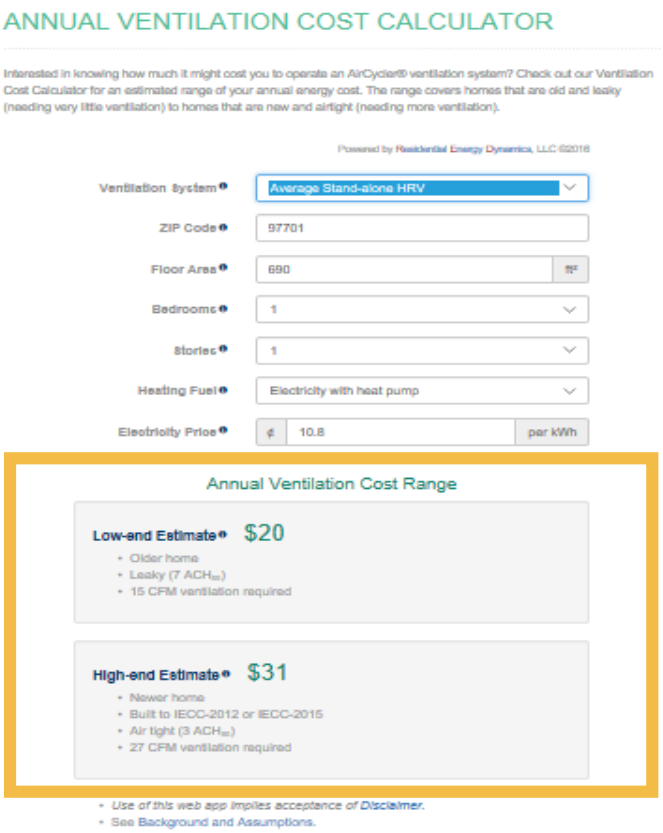
- Avoid direct supplied outdoor air

## Cost of Fan Energy Used

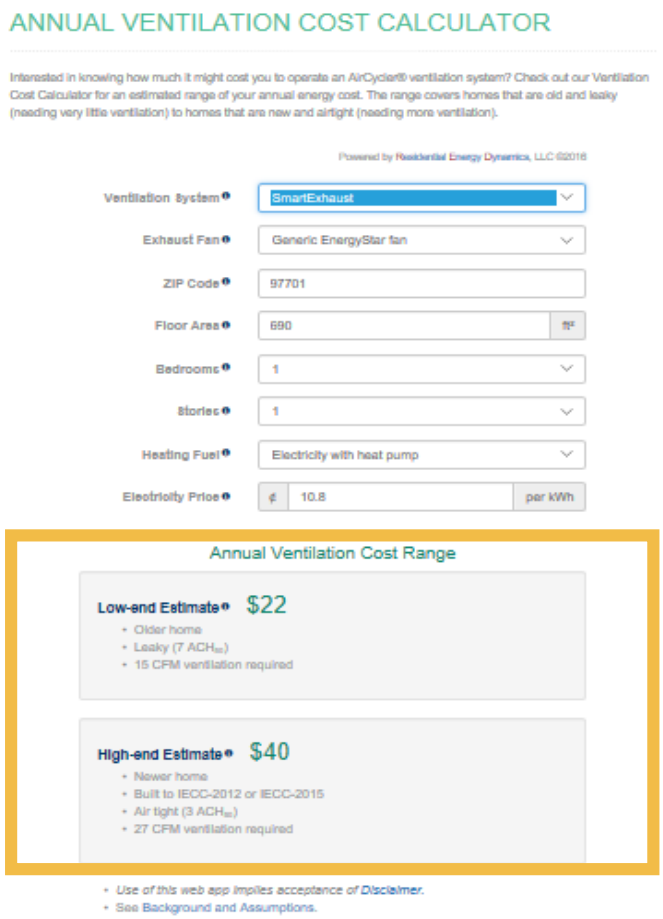
- Balanced with heat/energy recovery, preferably with low energy fan
- Exhaust strategy with efficient fan (moves >4 cfm/watt)

# COST TO OPERATE

## Balanced Ventilation with HRV




## Exhaust Ventilation




Source: https://www.aircycler.com/pages/calculator

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# MAINTENANCE

## Staffed Building

- Central exhaust systems
- Positive pressure central systems
  - Better access to filters that impact multiple units at once

## Un-Staffed Building

- In unit exhaust
- In unit HRV/ERVs
  - Will require tenant education

# FIRST COST

**Table 1. Overview of Whole-Building Ventilation Systems Evaluated and Considered in CCCRD Homes**

| System | Power | Approximate Installed Cost ($) | Advantages | Disadvantages |
|---|---|---|---|---|
| **Exhaust Fan Operating Continuously** | 6 W | 400 | • Low first cost<br>• Simplest installation<br>• Low operating cost<br>• Lowest maintenance | • May draw air in from garage*<br>• OA not actively distributed |
| **CFIS** ** | Depends on AHU, 250 W minimum | 650 | • Low first cost<br>• Simple installation<br>• Distributed OA | • High operating cost |
| **Distributed ERV/HRV** | Varies, at least 40 W | 1,450–3,300 | • Distributed OA<br>• Heat recovery<br>• Potential for low operating cost | • High first cost<br>• More complex installation<br>• Highest maintenance |
| **Local ERV** | 23 W | 750 | • Heat recovery<br>• Low operating cost | • OA not distributed |

**Could be neighboring unit or hallway*

***CFIS is a + pressure system integrated with a central air handler*

Image courtesy of US DOE Building Technologies Program

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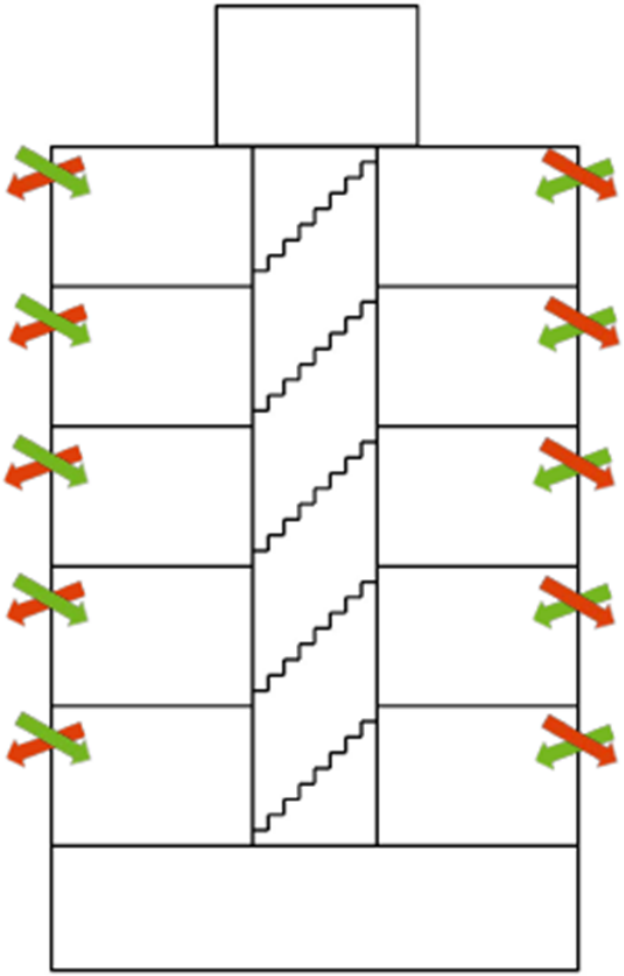
# OVERALL WINNERS



Balanced Ventilation

**1st**

**Balanced ducted systems with heat/energy recovery are a high choice for all but first cost.**

*First cost considerations can be met with Local ERV system*

**2nd**

**Other balanced systems, or exhaust with constant flow and energy efficient fans are second best.**

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# QUESTION BREAK

# THANK YOU FOR ATTENDING

## Oregon Housing and Community Services Multifamily Energy Program

www.oregonmultifamilyenergy.com


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