

_Improving Indoor Air Quality in Commercial Spaces: Technologies, Codes, and Best Practices



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ACHIEVING BEST INDOOR AIR QUALITY

Ernest Conrad



AGENDA


**BASICS – CODES &
STANDARDS**

**PHYSICAL
CHARACTERISTICS
of ORGANISMS**

**AIR CLEANING
DEVICES – DO'S &
DON'TS**



Codes and standards

- ASHRAE standard 62.1 - minimum outdoor ventilation
 - 5cfm/person minimum
 - or calculate “ventilation rate procedure”
- 

Codes and standards

- ASHRAE Standard 55 – theoretical human comfort chart

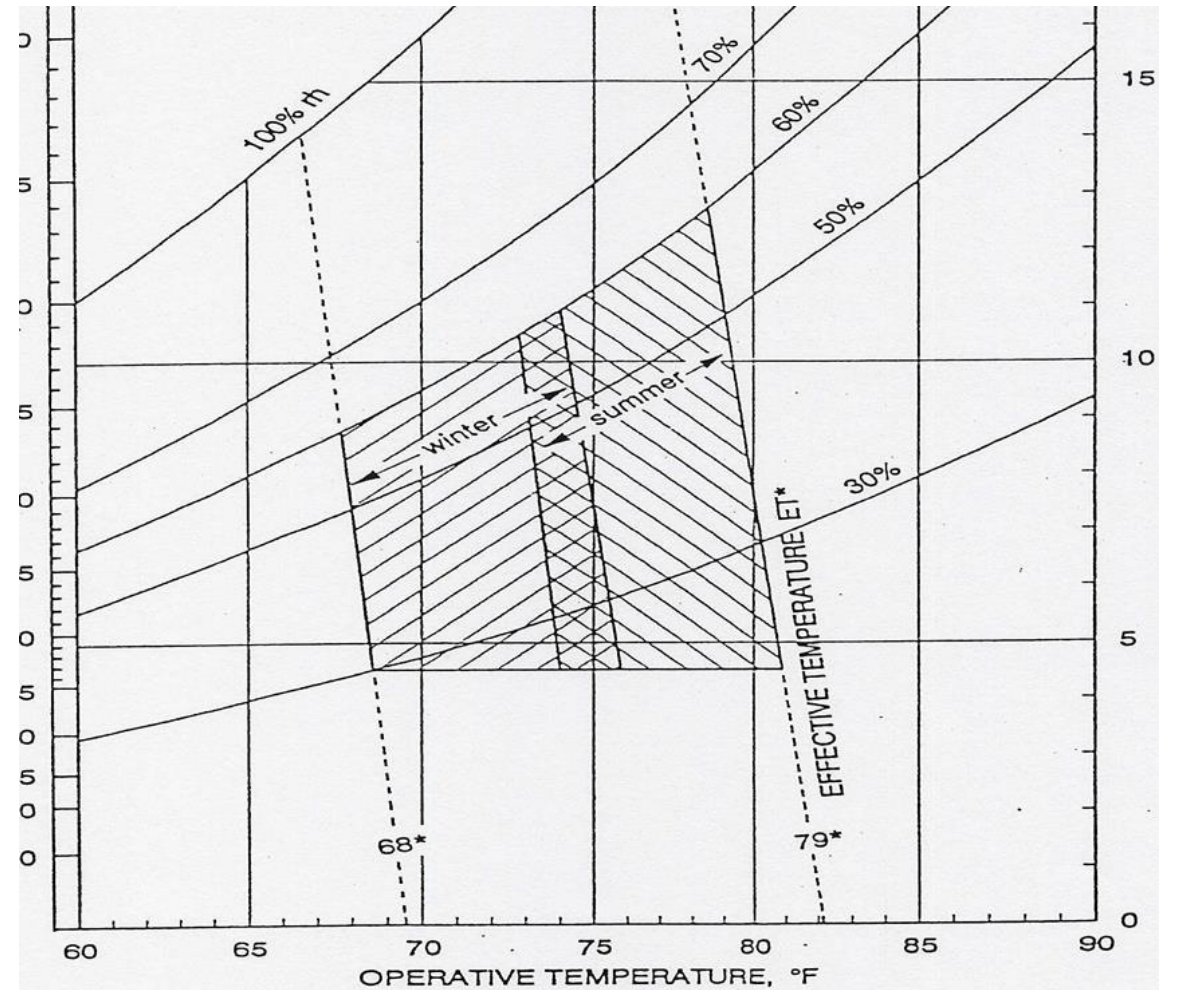


Fig. 5 Standard Effective Temperature and ASHRAE Comfort Zones

PHYSICAL CHARACTERISTICS of ORGANISMS

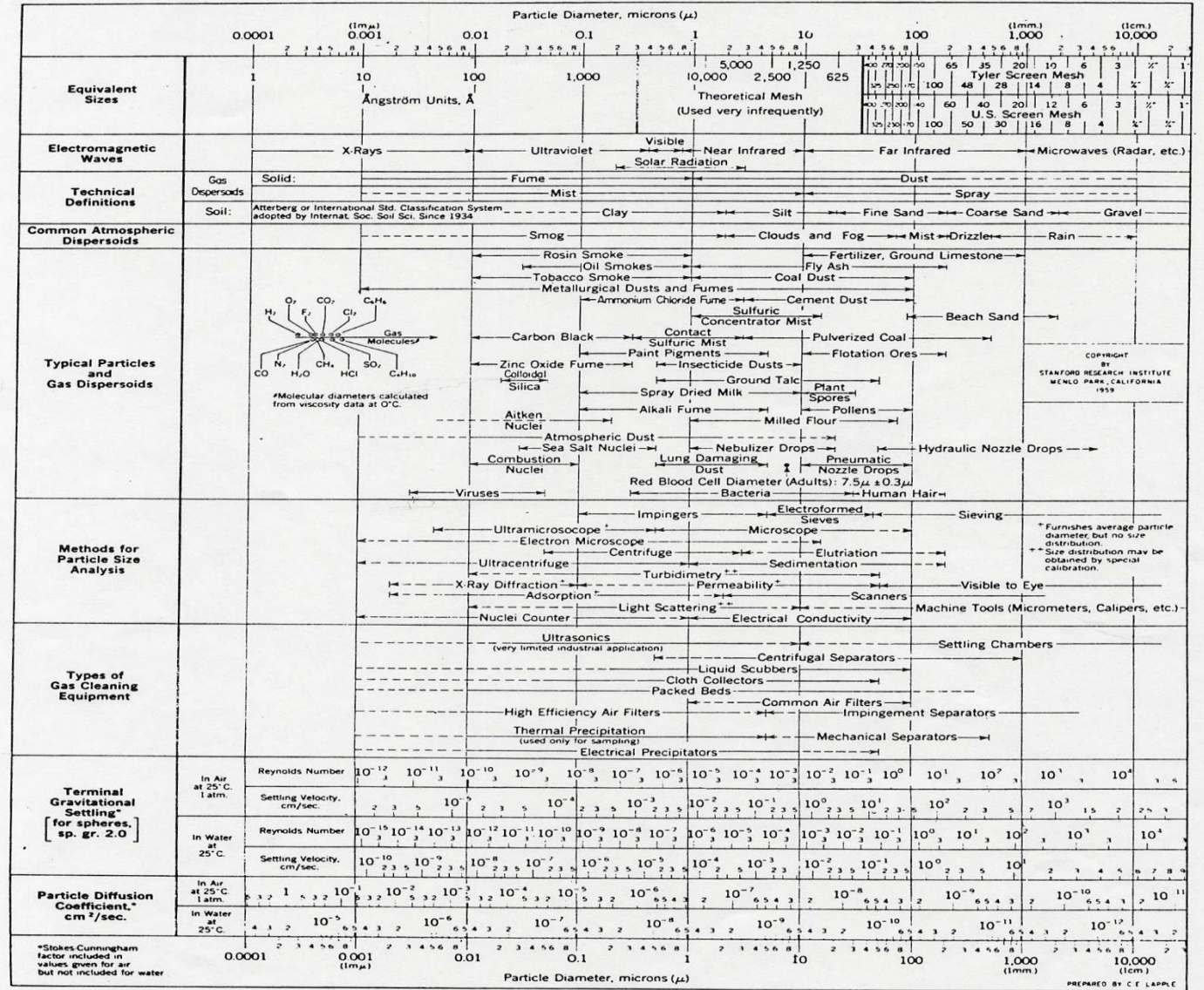


Figure 2-1. Characteristics of particles and particle dispersions. Courtesy Stanford Research Institute.



Typical particle sizes

- Human hair-----100 microns
- Tobacco smoke -----.01 - 1micron
- Virus-----.003 - .05 micron
- Plant spores-----10 – 30 microns
- Bacteria----- .3 – 30 microns
- Hepa filter-----.01 – 10 microns

Filtration Effectiveness

F I L T R A T I O N E F F E C T I V E N E S S

MERV level	Dust spot, percent	Typical particulate-filter type	Percent 0.3 to 1.0 μm	Percent 1.0 to 3.0 μm	Percent 3.0 to 10.0 μm
1	NA	Low-efficiency fiber-glass- and synthetic-media disposable panels, cleanable filters, and electrostatically charged media panels	Efficiency too low to be applicable to Standard 52.2 determination		
2	NA				
3	NA				
4	NA				
5	NA	Pleated filters, cartridge/cube filters, and disposable multidensity synthetic link panels			20 to 35
6*	NA				36 to 50
7	25 to 30				50 to 70
8	30 to 35				Greater than 70
9	40 to 45	Enhanced-media pleated filters, bag filters of either fiber-glass or synthetic media, and rigid box filters using <i>lofted or paper media</i>		Greater than 50	Greater than 85
10	50 to 55			50 to 65	Greater than 85
11	60 to 65			65 to 80	Greater than 85
12	70 to 75			Greater than 80	Greater than 90
13	80 to 85	Bag filters, rigid box filters, and minipleat cartridge filters	Greater than 75	Greater than 90	Greater than 90
14	90 to 95		75 to 85	Greater than 90	Greater than 90
15	Greater than 95		85 to 95	Greater than 90	Greater than 90
16	98		Greater than 95	Greater than 95	Greater than 95
The following classes are determined by a methodology different than that of ANSI/ASHRAE Standard 52.2-1999, <i>Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size</i>					
17	NA	High-efficiency-particulate-air/ultralow-penetration-air filters evaluated using Institute of Environmental Sciences and Technology (IEST) method of test. Types A through D yield efficiencies at 0.3 μm and Type F at 0.1 μm	99.97-percent IEST Type A		
18	NA		99.99-percent IEST Type C		
19	NA		99.999-percent IEST Type D		
20	NA		Greater than 99.999-percent IEST Type F		

*MERV 6 level prescribed by ANSI/ASHRAE Standard 62-2001, *Ventilation for Acceptable Indoor Air Quality*, for minimum protection of HVAC systems

TABLE 2. Comparison of MERV data, filter type, and prior designations.



Walk-off
mats reduce
particulates

Dedicated
Outside Air
SYSTEMS







Carbon-Impregnated HVAC Filter

Electrostatic
ionizers
ozone?





Guy Tomberlin

Vice President of Plumbing,
Mechanical and Gas Programs



The “New Normal” for Indoor Air Quality and the International Code Council (ICC)-Codes

Moving forward towards a Post-COVID environment

Presenter: Guy Tomberlin, Vice President
Plumbing Mechanical and Fuel Gas Programs
International Code Council



Objectives:

- Identify the importance of code applications pertaining to IAQ.
- Define the “new normal” in Indoor Air Quality (IAQ).
- Describe what the “new normal” in IAQ may mean in different applications.
- More clearly understand how to evaluate systems to better embrace the “new normal” in IAQ.
- Explain how to incorporate the “new normal” in IAQ into different type HVAC Systems.



What is the definition of the *New Normal* in IAQ?

- Truth-is there is not one generic “new normal” for all applications.
 - No one-size fits all
 - No silver bullet
- IAQ is based on individual specific applications, including things like:
 - The type of structure
 - The type of occupancy
 - The existing equipment
 - The needs of the occupants
 - The ability to alter equipment and practices



Drive-through
cafes



Multi-Purpose Facilities



Fire Houses

What is the *New Normal* for IAQ?

- It may be different for everyone.
- Some may want to replace, upgrade and or retrofit systems.
- Some may already have state of the art equipment.
- Some may learn that changing system components is more challenging than expected.

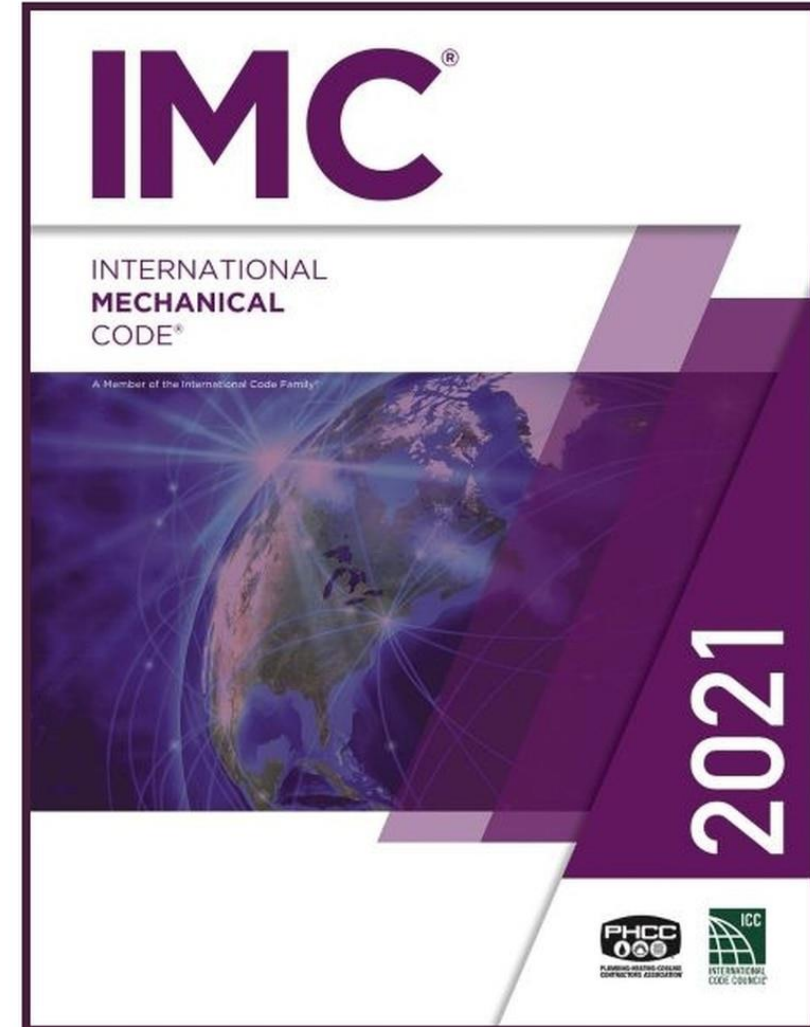


What do the codes have to do with IAQ anyway?

- **International Mechanical Code**
 - New HVAC/OA/IAQ system design and installation, includes the duct systems.
- **International Existing Building Code**
 - Alterations of existing HVAC/OA/IAQ systems.
- **International Property Maintenance Code**
 - Continued maintenance and operation of HVAC/OA/IAQ systems.

International Mechanical Code

- Encompasses new construction design, engineering, and installation details for HVAC mechanical systems.
 - Air balance required for new systems.
- Original permitting information should be obtainable through permitting records.
- Identify the code used at the time of construction.



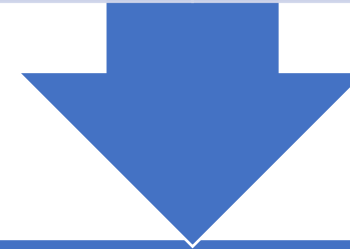
Why is the original design important?



Some have the expectation that all systems meet current code requirements....not realistic.

HVAC systems shall be maintained as they were permitted, designed and installed.

Some buildings may have been designed using codes that are decades old.

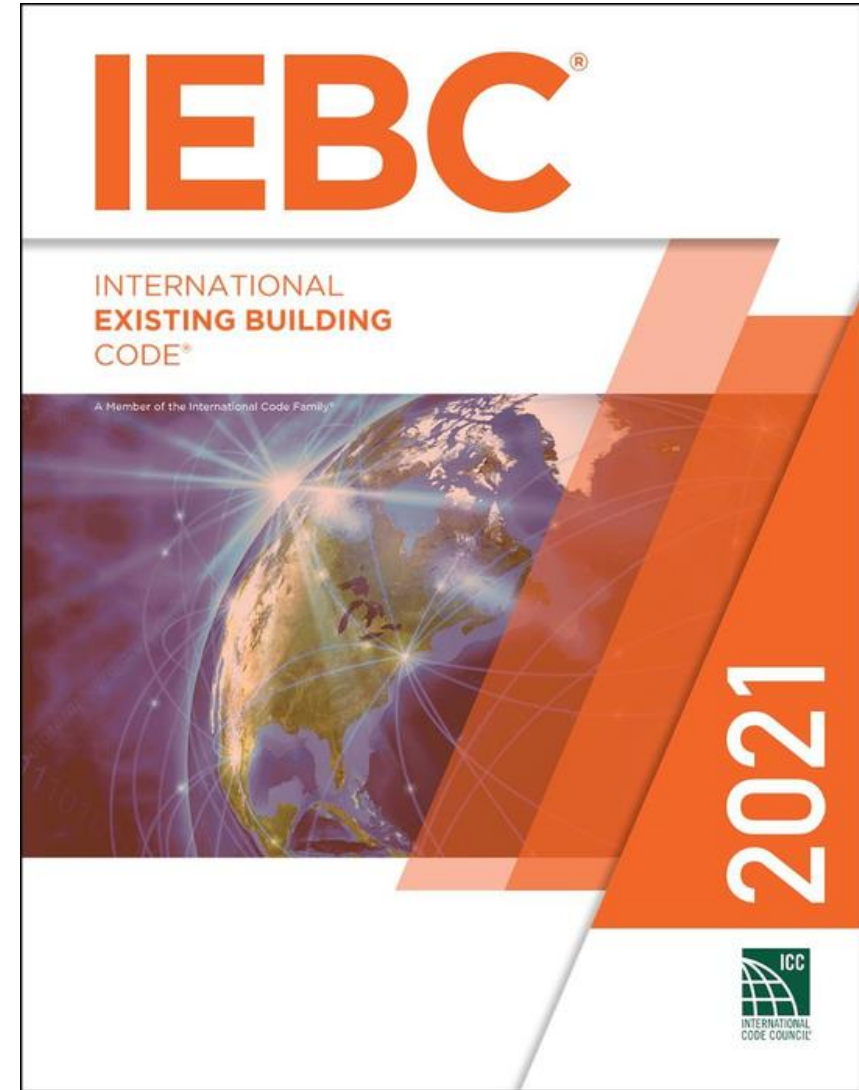


As uses and occupancies change, so do the ventilation requirements.

Sometimes Air-Balancing gets overlooked as tenants' transition in, out and around.

International Existing Building Code

- Used when remodeling and retrofitting existing structures.
- Provides construction guidance based on the 3 levels level of activity from replacement operations (Level 1) to complete renovation alterations (Level 3).
- Check for permitting requirements!



International Property Maintenance Code

- Requires that all mechanical equipment is maintained in a safe working condition and shall be capable of performing the intended function.
- Duct systems shall be maintained free of obstructions and capable of performing the required function.



Are permits required?

- Yes-well....maybe
 - Alterations to any required HVAC appliances and equipment.
 - Additional permanent equipment.
 - Fans (exhaust, make-up, circulation)
 - Electronic filtration
 - Humidifiers
 - Installation of new permanent appliances and equipment.
 - May require plans as well.



Consult with the Authority Having Jurisdiction (AHJ)!

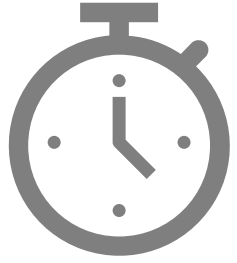
Are permits required?

- No-well...maybe
 - Portable cord and plug (re)movable type equipment.
 - Room air purifiers.
 - Room humidifiers.
 - Room fans.



Keep in mind some types of portable units may impact existing system performance and efficiency. For example, room humidifiers.

Consult with the Authority Having Jurisdiction (AHJ)!



In Summary



- Fully evaluate your specific IAQ needs as a holistic system working together within a structure or space.
- Determine what actions you intend to undertake.
- Determine which codes and standards are applicable.
- Check with AHJ to determine permitting and plan submission needs.
- Commission and air balance final product.

Thank You!

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Ron Cosby

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Your Building's IAQ Future

Taking a holistic view

A building's interconnected systems and the interactions between those systems result in an occupant experience that is influenced by IAQ.



ASSESS

- Analyzing current state/determining needs
- Projecting the future of the space

MITIGATE

- Developing occupant-centric strategies
- Implementing the solutions
- Improving energy efficiency and sustainability

MANAGE

- Ongoing optimization
- Continuous managing and monitoring

Regaining Trust In *Your* Building Begins With Assessing Its Current Capabilities



Indoor Air Quality Assessment

- Fact based, data-driven analysis of your building's indoor air quality
- Aligned to latest CDC/ASHRAE® guidelines for operating HVAC systems
- Recommend ways to improve IAQ today
- Highlight opportunities for future upgrades



The Four Key Pillars of IAQ



Dilute



Exhaust



Contain



Clean



Why an IAQ Assessment?



Confidence

Staff and public want to know leaders are addressing their concerns



Resilience

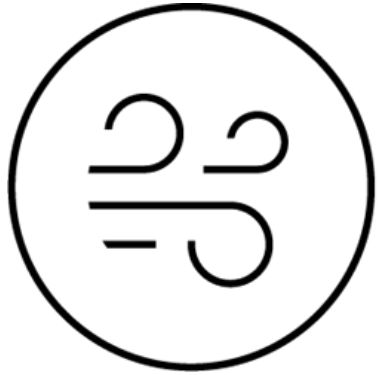
Today it's a global pandemic; what's next? IAQ will be an ongoing focus



Sustainability

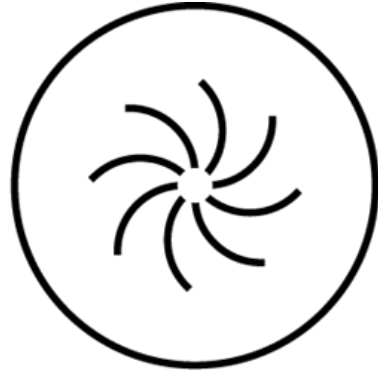
Ensure clean indoor air efforts are in tune with community values

The Four Key Pillars of IAQ



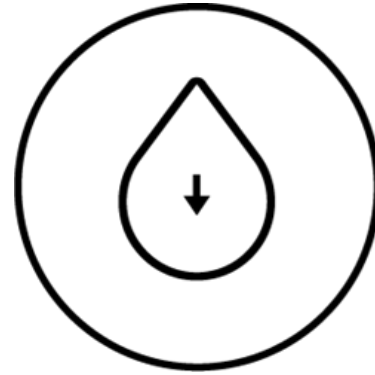
Dilute

Making sure plenty of fresh outdoor air dilutes the buildup of indoor contaminants through proper ventilation



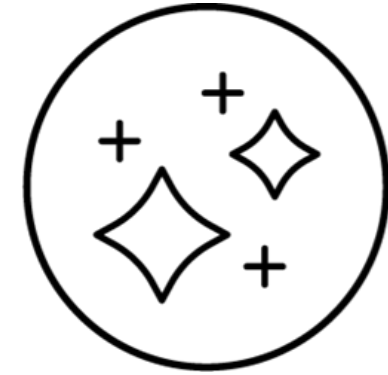
Exhaust

Getting exhaust air out is equally important, especially air from kitchens, restrooms, and combustion systems



Contain

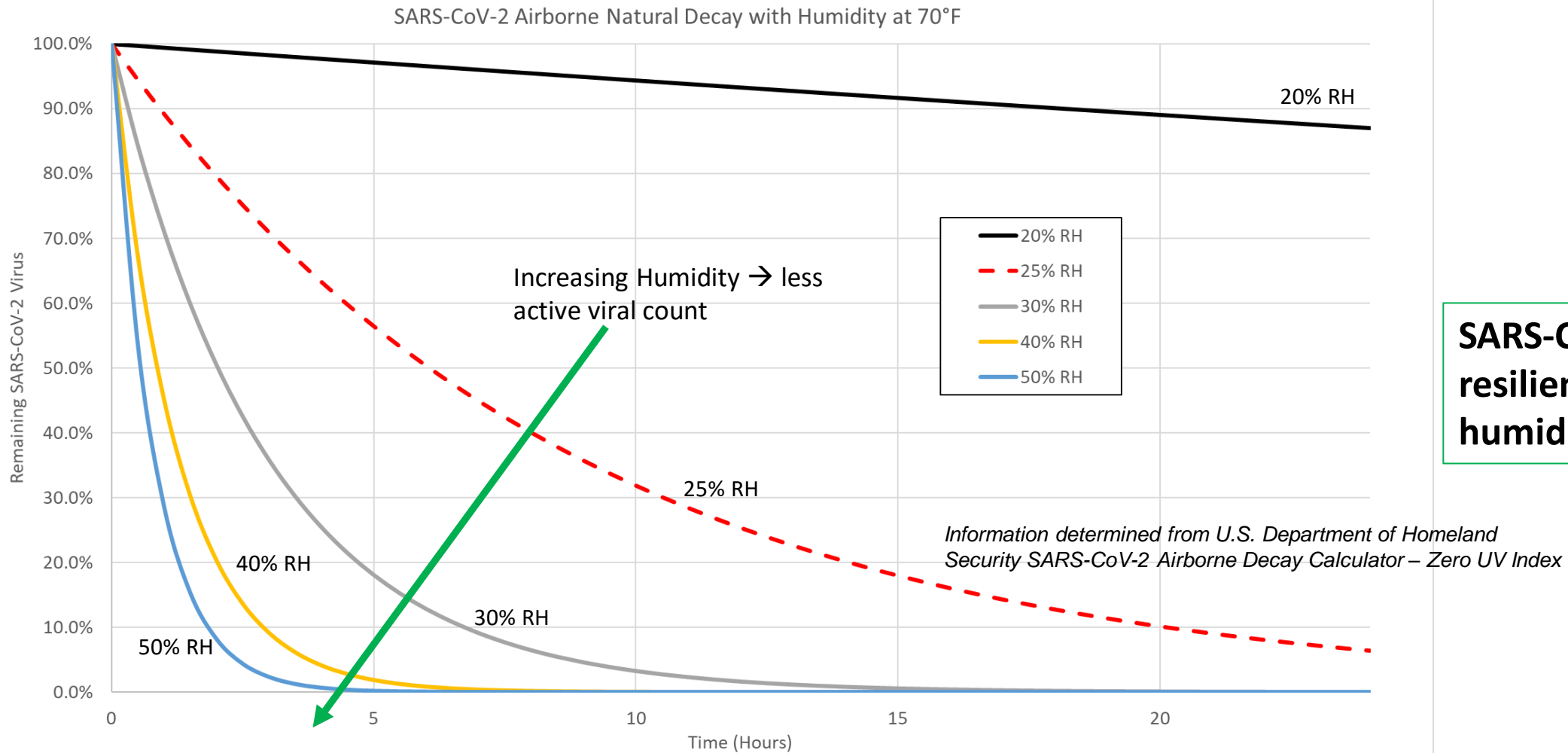
Keeping indoor humidity levels within the ASHRAE® - recommended range maximizes occupant comfort and reduces the risk of microbial growth



Clean

Humidity Control - Increase Humidity → Reduce Risk

Mitigate

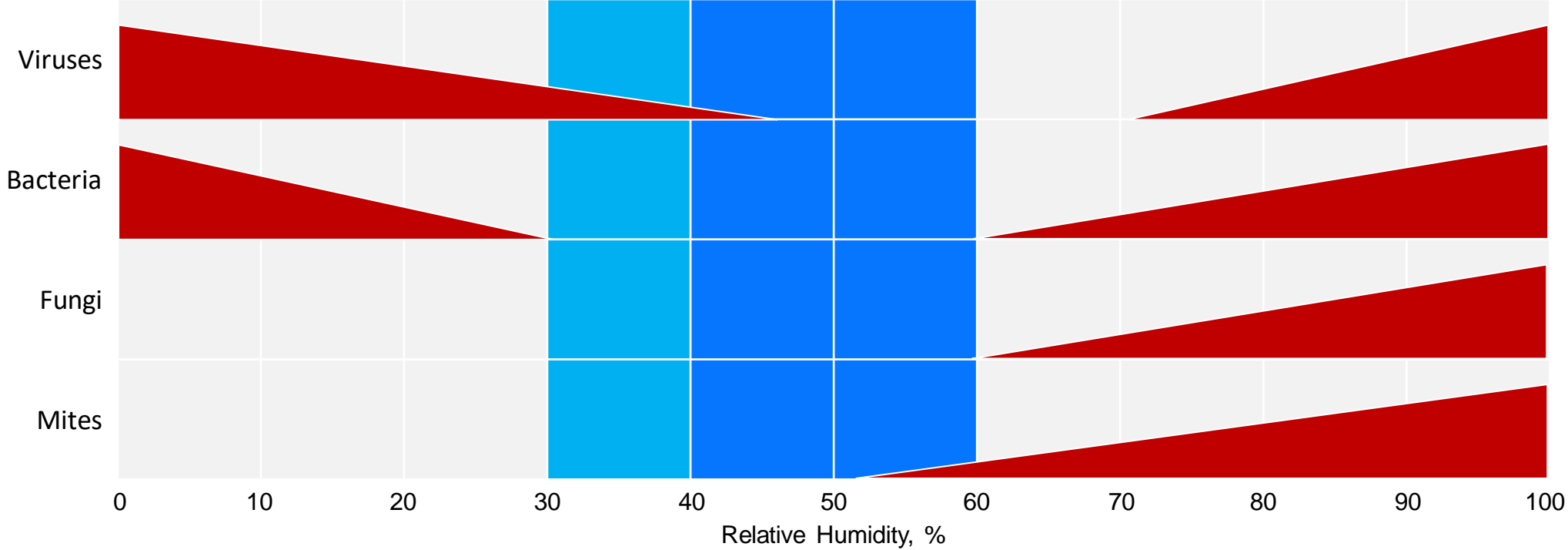


SARS-CoV-2 is more resilient at lower humidity levels

SARS-CoV-2 will naturally deactivate at higher humidities → Helps reduce need for other abatements

Contain: Humidity Control – Helps Reduce Viral Load and Lessen Impact

Viruses are typically less stable between RH of 40-60%

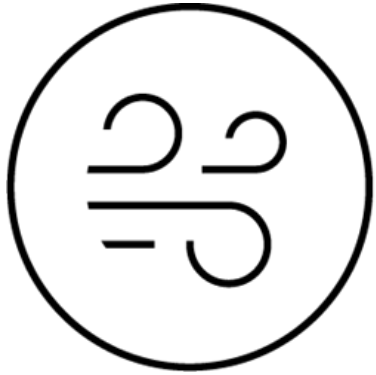


Sweet spot 40-60% relative humidity for viruses

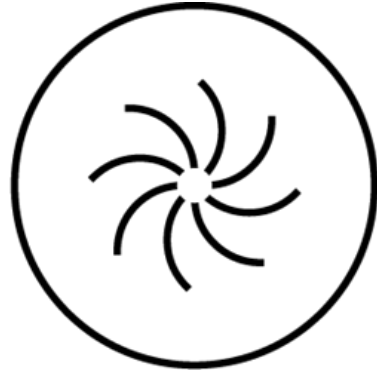
Information from 2016 ASHRAE® Handbook, HVAC Systems and Equipment



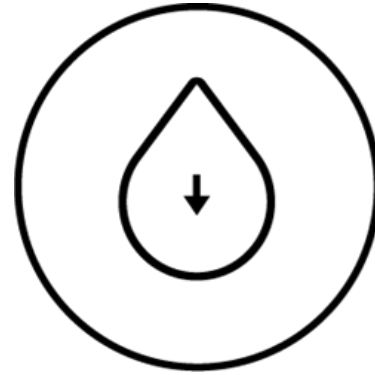
The Four Key Pillars of IAQ



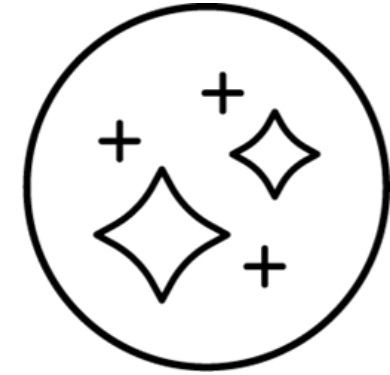
Dilute



Exhaust



Contain



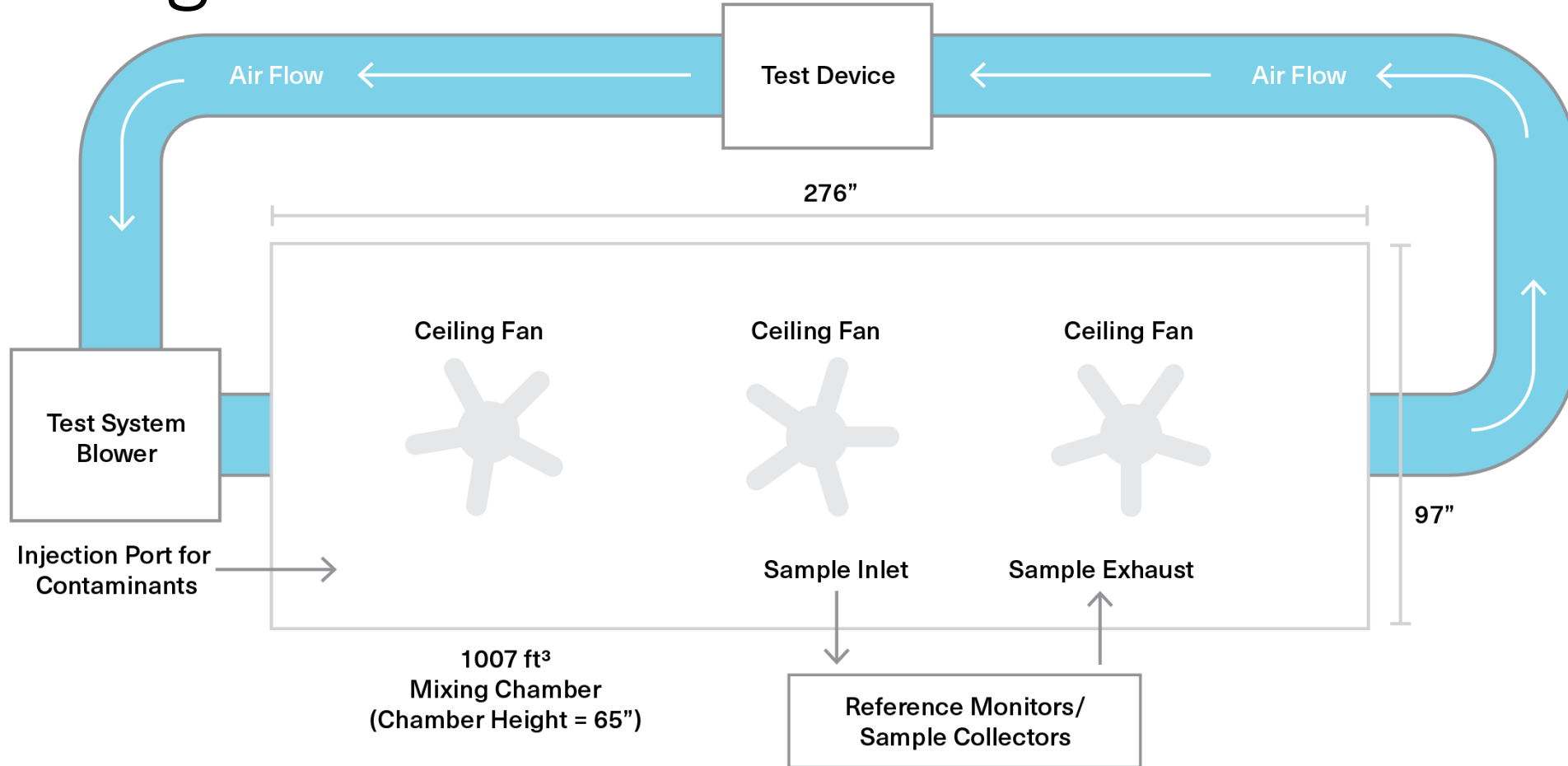
Clean
Reducing particles,
odors, or
micro-organisms
(such as mold,
bacteria, and viruses)

Cleaning Technology Efficacy

- In order to better describe our IAQ Cleaning Technology portfolio, efficacy testing on multiple technologies was conducted at a third-party lab
- Technologies were examined for two scenarios which define potential customer scenarios
 - In-duct – In-equipment capability and/or in-duct
 - In-room – Devices located within the room – standalone
- Consistent testing methodology to compare technologies against each other and provide industry-wide testing of IAQ cleaning devices
 - Virus reduction capability – aerosolized and surface test with MS2 virus
 - Bacteria reduction capability – aerosolized only with Staphylococcus aureus
 - VOC reduction capability – Formaldehyde and toluene
 - Ozone generation

No silver bullet to a building's IAQ problems – no singular technology addresses everything

Testing Chamber – In-Room and In-Duct



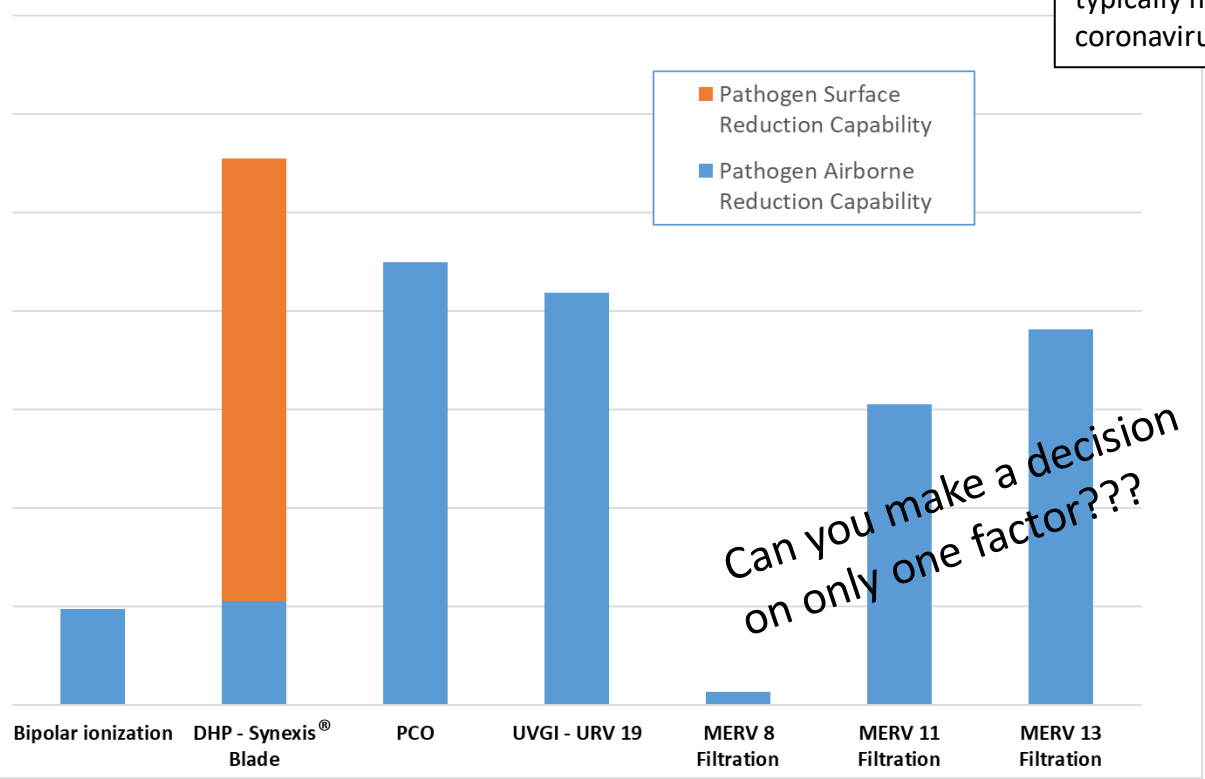
Consistent testing methodology and process in a large chamber – not a breadbox

IAQ Cleaning Technology Comparison:

All devices tested were found to have low ozone levels (< 7 ppb)

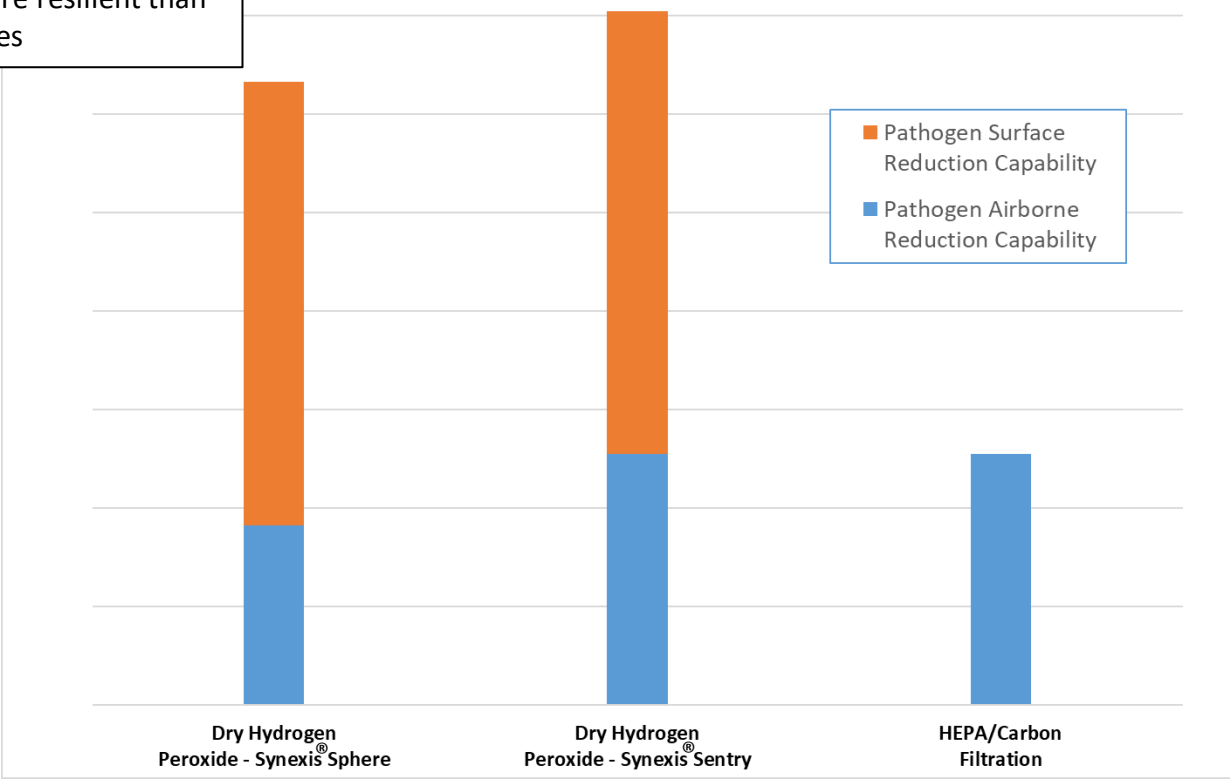
Results shown are for **6 air changes per hour** for reduction efficacy of MS2 viral substitute, a non-encapsulated virus that is typically more resilient than coronaviruses

In-Duct/In-Equipment Pathogen Cleaning Efficacy



Can you make a decision on only one factor???

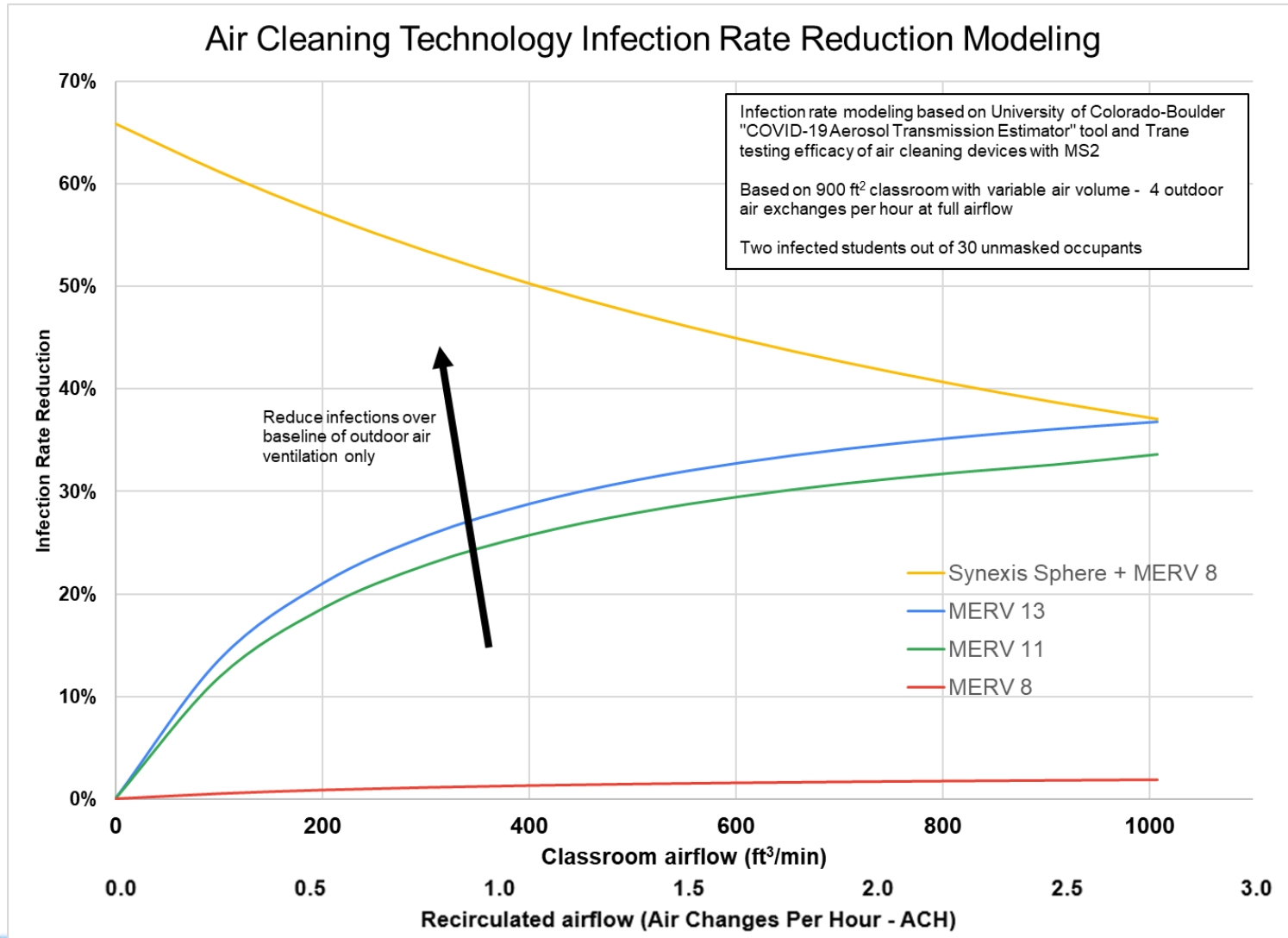
In-Room Air Cleaning Efficacy



All devices tested worked to reduce viral count on airborne MS2
 Only dry hydrogen peroxide generation devices reduced viral count on surfaces



IAQ Cleaning Technology Comparison:



- Each building is different!
- Variable Air Volume (VAV) systems require different mitigations
- If there's less recirculated airflow then filters and other air cleaning devices may not work as effectively → if the air doesn't go through the filter then it won't work on virus reduction
- System makeup matters for which technology may be most effective for your building use

Results shown based on equivalent Outdoor Air Exchanges (subtracting natural decay)



Manage – The Future of IAQ

Controls Platforms are Evolving for the IAQ Future

- Standalone, in-room or building-wide control and communication/dashboard options
- Analyze air quality trends and source potential problems
- Track improvements over time
- Meet measuring performance requirements set by WELL, RESET or your own team
- Engage stakeholders with visual demonstration of results
- Optimize comfort and IAQ for balancing risk mitigation with energy consumption



Confirm impact, build and maintain confidence of the people in your building

The Future of Building IAQ Starts NOW!



- Each building is different → Work with a professional to provide a systematic approach for assessment for your building
- Develop a mitigation plan that involves all four pillars of IAQ – Dilute, Exhaust, Contain, and Clean
- Manage your building through active controls and service to ensure that your building IAQ and function is optimized for both use and its occupants



Questions?