
IDEA2021
Powering the Future: District Energy/CHP/Microgrids
Sept. 27-29 | Austin Convention Center | Austin, Texas

# Clean Air Strategies for Mitigating Airborne Infection in Buildings

**Jon Douglas,** Director Healthy Buildings Services and Solutions

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# Presentation Outline

- Science of aerosol transmission
- Clean air tools for reducing risk
- ASHARE Equivalent outdoor air calculations
- Data supporting the science
- Practical considerations for large facilities

# Our HVAC clean air strategies primarily address transmission through aerosols

**Aerosols**
"Smoke filled room"

**HVAC Clean Air Strategies**
- Ventilation
- Filtration
- Disinfection
- Isolation

**Fomite Transmission**
Touching infected surfaces

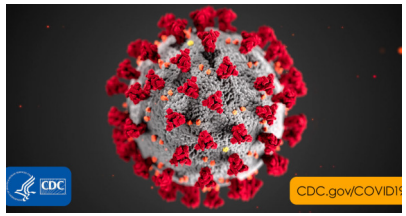
**Strategies**
- Handwashing
- "Touchless" solutions

**Large Droplets**
Quickly fall to surfaces/ ground

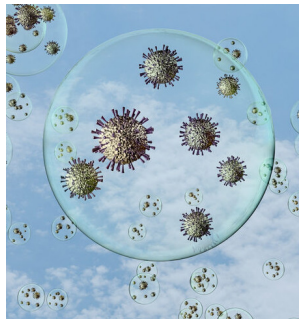
**Strategies**
- Masks
- Shields
- Physical Distancing

# You don’t need a HEPA filter

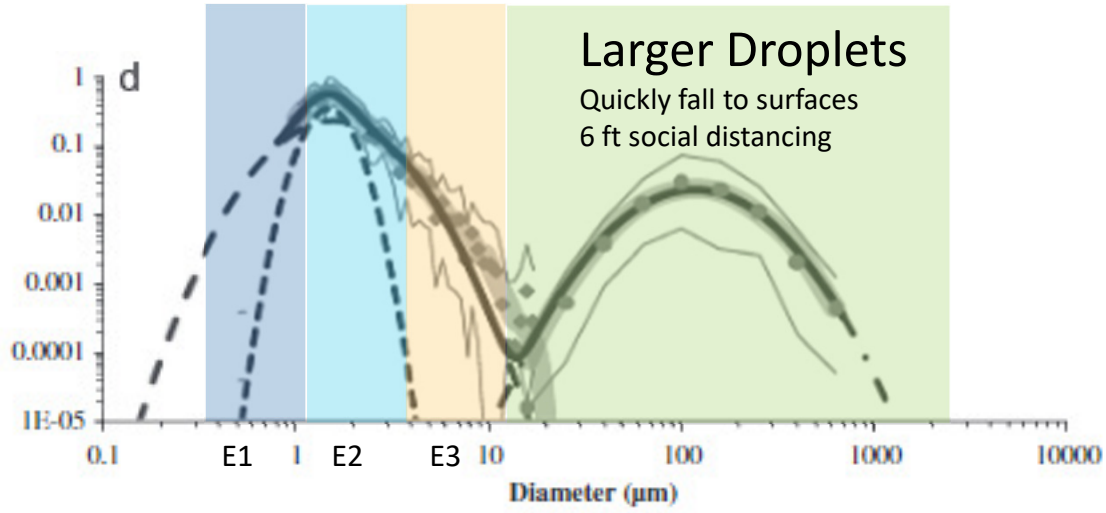
Airborne viruses are transmitted via droplets expelled by people




Size of SARS-CoV-2 is 0.1µm



https://news.umich.edu/should-we-worry-about-airborne-coronavirus/




20% 28% 51%

G.R. Johnson, et al, Modality of human expired aerosol size distributions
doi:10.1016/j.jaerosci.2011.07.009

**MERV 13 Filter is 89.9% Efficient at removing human droplets**

**Applies to most airborne transmitted diseases; Influenza, Measles, TB, etc.**

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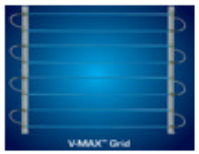
# Three Basic Air Cleaning Methods

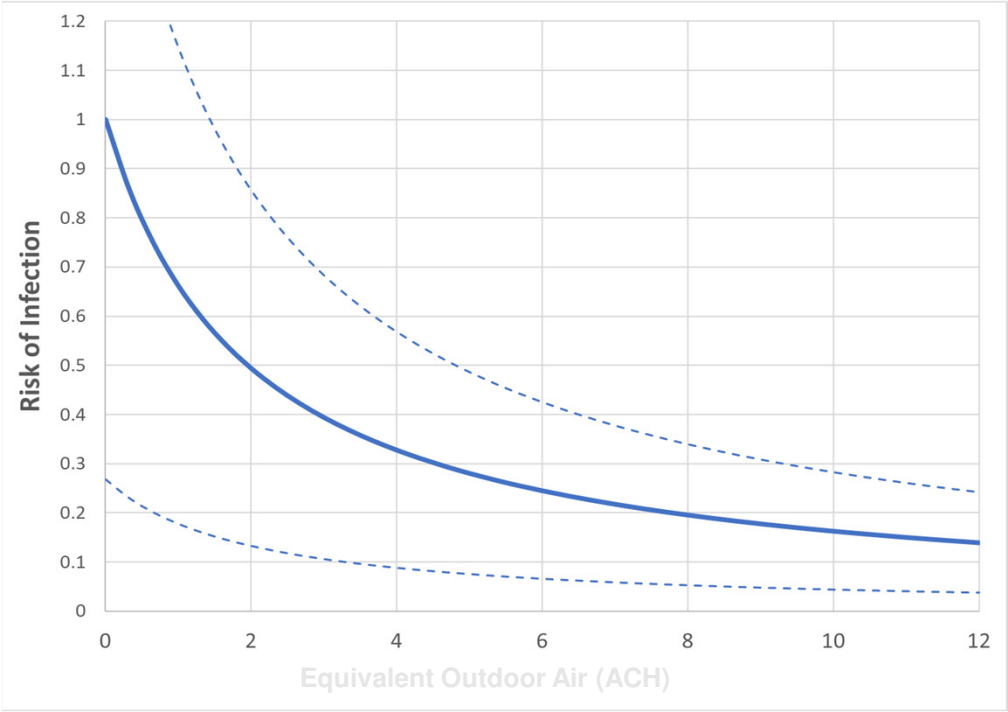
| | Dirt, Dust, & Allergens | Chemicals (cleaning agents, building materials, etc) | Biological gases | Viruses & Bacteria |
|---|---|---|---|---|
| Ventilation  | ✓ | ✓ | ✓ | ✓ |
| Filtration  | ✓ | | | ✓ |
| Disinfection  | | | | ✓ |

Why ASHRAE Standards focus on ventilation

Good news! Viruses can be removed by all 3

*Note: In most cases outdoor air is cleaner than indoor air. There are some locations, which this is not the case. There are also temporary events (i.e. wild fires) in which this is not the case*

# Dilution is the Solution




Wells-Riley Equation

$$P = 1 - exp\left(-\frac{(1-\eta_{mask})Iqpt}{CADR + kV}\right)$$

Key parameter groups

- COVID Science
- Building Operation
- Clean Air Delivered

Reducing Infectious Particles Reduces Risk

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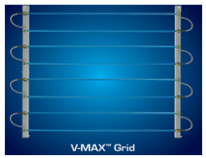
# ASHRAE Equivalent Outdoor Air

New metric coined by ASHRAE in 2/1/2021 Building Readiness Guidelines

**Equivalent Outdoor Air = Airflow Rate X Removal Efficiency**


Ventilation

Filtration



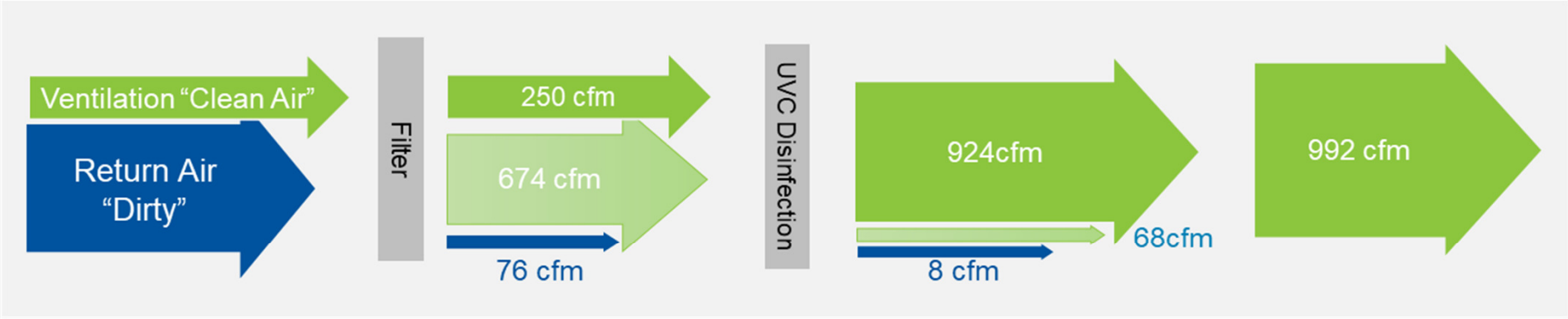

Disinfection

Common means to quantify the benefit of different air cleaning methods **for COVID risk reduction**

Similar concept to the AHAM Clean Air Delivery Rating (CADR) applied to small filters


*https://www.ashrae.org/technical-resources/building-readiness#eoa*

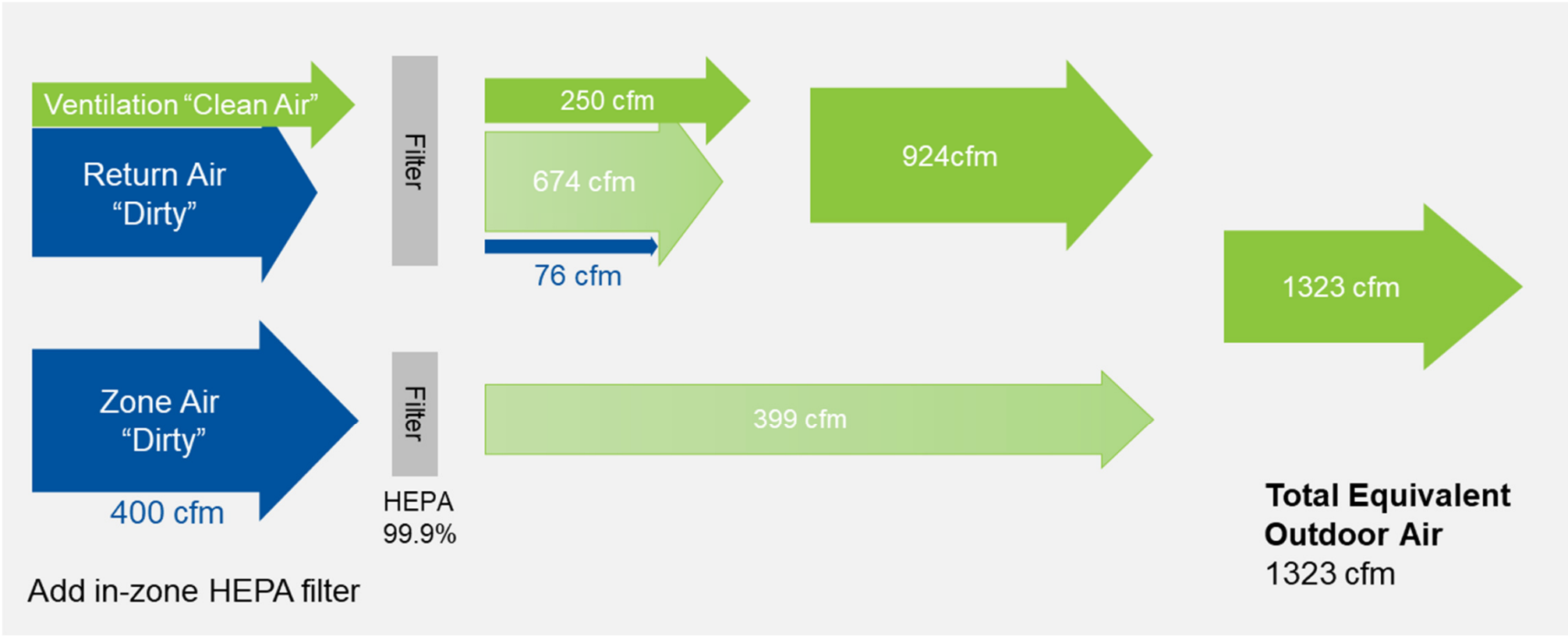
# Impact of Multiple Devices in One System




| | | |
|---|---|---|
| Ventilation 250 cfm | Filter = MERV 13<br>Efficiency = 89.9% | Equivalent Outdoor Air<br>992 cfm |
| Return Air 750 cfm | Equivalent Outdoor Air<br>89.9% x 750 = 674<br><br>Remaining Dirty Air<br>750 – 674 = 76 | |

*https://www.ashrae.org/technical-resources/building-readiness#eoa*

# Benefit of Added Clean Air Streams




*https://www.ashrae.org/technical-resources/building-readiness#eoa*

# Cost-optimized strategies based on the science of clean air

01 Ensure ventilation meets ASHRAE 62.1 standards for your space type

02 Increase air handler or packaged unit filtration to MERV 13 or higher

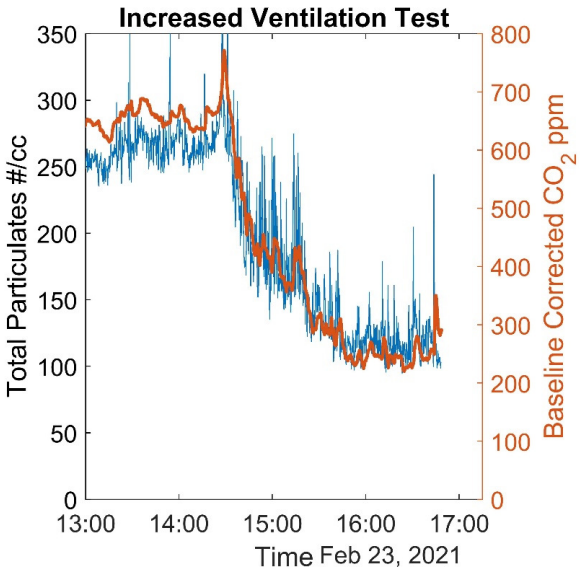
03 Update control sequences to increase supply airflow

04 Add zone level filtration/disinfection

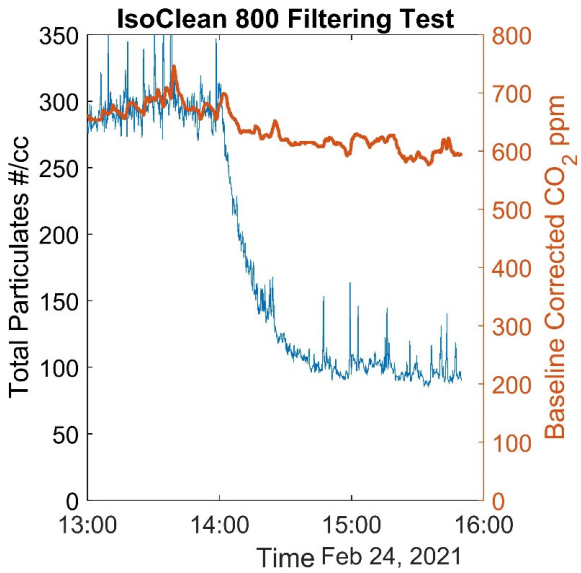
05 Add AHU disinfection technologies


Data supporting the science
Johnson Controls

# UW Research Verifies Benefits of Ventilation and Filtration

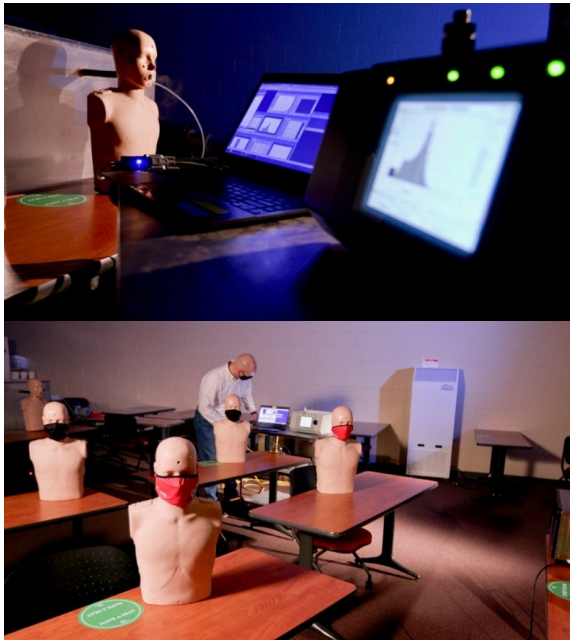



+3.6 ACH = 58% reduction




+3.7 ACH = 62% reduction

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON



ASHRAE Equivalent Outdoor Air Calculations Work!

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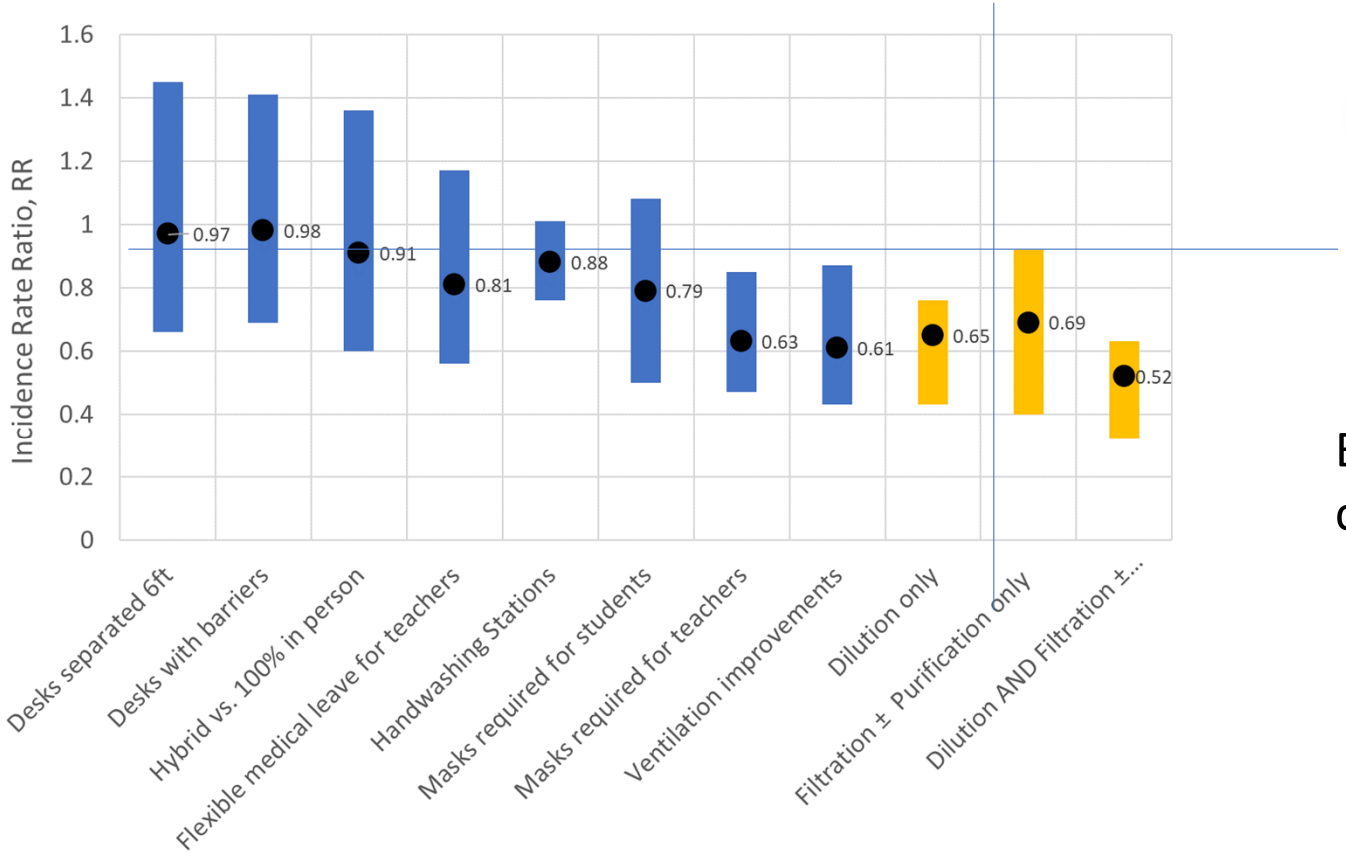
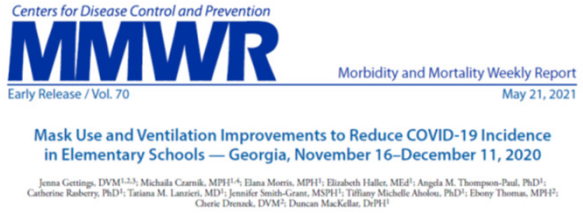
# CDC Study Verifies Outcomes of Clean Air




Below 1 = Reduction in cases

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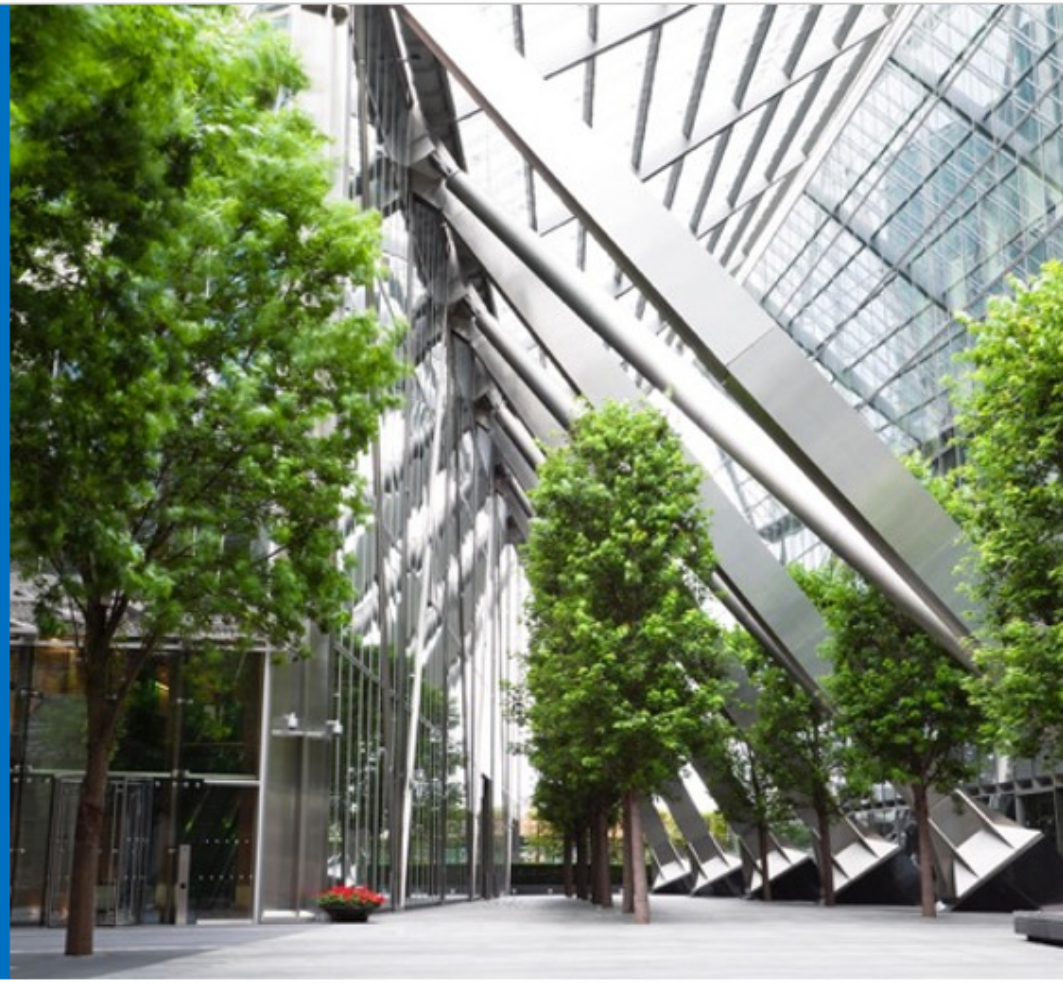
OpenBlue

# Impact on Central Plants



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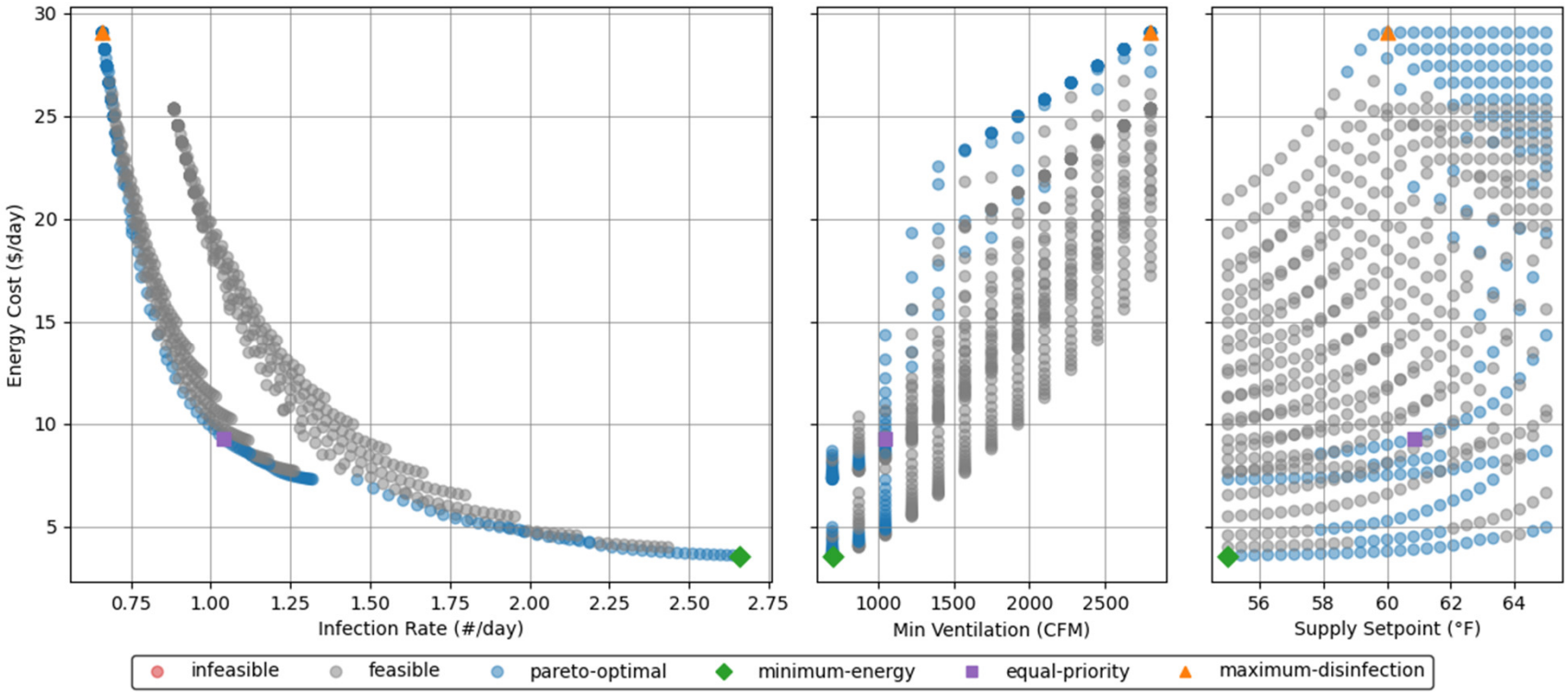
# Trade off Between Energy and Infection Risk



# Clean air impact to central plants

**01** Ensure ventilation meets ASHRAE 62.1 standards for your space type

- Central plant likely originally designed to handle ASHRAE ventilation rates
- Buildings are typically under ventilated
  - May see increased cooling in Summer
  - May see increased heating in Winter
- There are benefits to increasing ventilation beyond ASHRAE. Plan for future load increases.

**02** Increase air handler or packaged unit filtration to MERV 13 or higher

**03** Update control sequences to increase supply airflow

**04** Add zone level filtration/disinfection

**05** Add AHU disinfection technologies

- Slight increase in electrical consumption in the building.
- Small increase in cooling load

# Q&A

## Clean Air Strategies for Mitigating Airborne Infections in Buildings

# Thank You!

**Jon Douglas, Director Healthy Building Solutions**