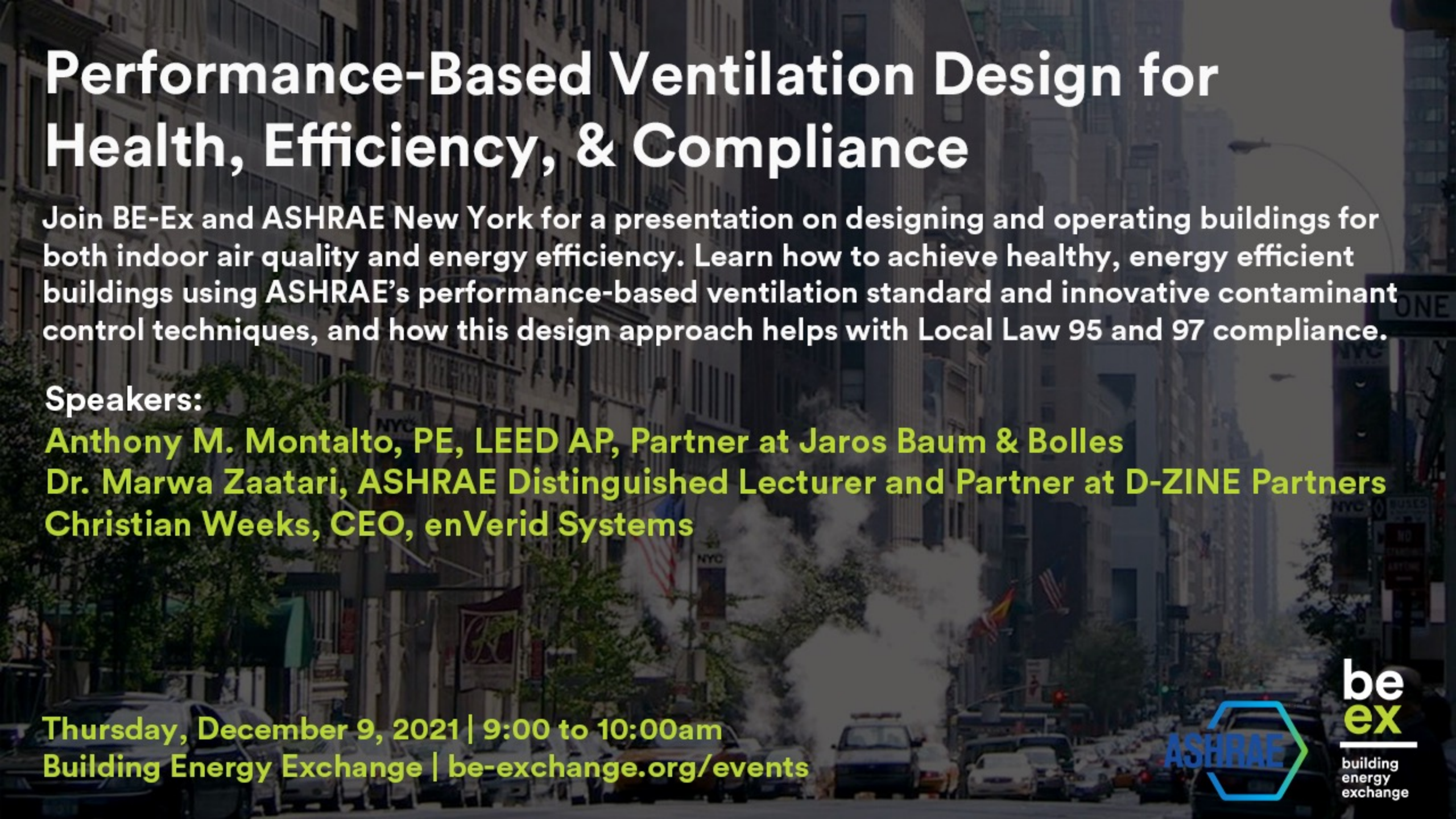


Performance-Based Ventilation Design for Health, Efficiency, & Compliance

Join BE-Ex and ASHRAE New York for a presentation on designing and operating buildings for both indoor air quality and energy efficiency. Learn how to achieve healthy, energy efficient buildings using ASHRAE's performance-based ventilation standard and innovative contaminant control techniques, and how this design approach helps with Local Law 95 and 97 compliance.

Speakers:

Anthony M. Montalto, PE, LEED AP, Partner at Jaros Baum & Bolles
Dr. Marwa Zaatari, ASHRAE Distinguished Lecturer and Partner at D-ZINE Partners
Christian Weeks, CEO, enVerid Systems

Thursday, December 9, 2021 | 9:00 to 10:00am
Building Energy Exchange | be-exchange.org/events

ASHRAE

be ex
building energy exchange

BE-EX AND ASHRAE NEW YORK PRESENT...

PERFORMANCE-BASED VENTILATION DESIGN FOR HEALTH, EFFICIENCY, & COMPLIANCE

Speakers

Anthony M. Montalto, PE, LEED AP, Partner at JB&B
Dr. Marwa Zaatari, ASHRAE Distinguished Lecturer and Partner at D-ZINE Partners
Christian Weeks, CEO, enVerid Systems

Event Details

Thursday, December 9th, 2021 from 9 AM - 10 AM

LEARNING OBJECTIVES

- Assess how performance-based ventilation design can improve indoor air quality and save energy
- Describe how the use of air cleaning technologies can make ventilation systems more efficient
- Clarify how the proposed design approaches help with LL95 and LL97 compliance
- Identify projects where the proposed design approach is appropriate

JBB enVerid Energy savings. Air quality. D=ZINE

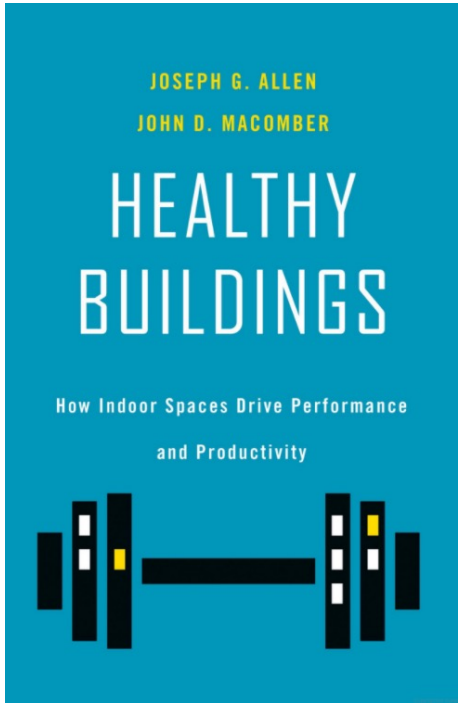
AGENDA

- Market Trends & Challenges
- Smart Ventilation Design Strategies
- Compliance with NYC Local Laws
- Air Cleaning & COVID-19 Mitigation
- Target Applications for Air Cleaning
- Case Study: NYC Office Building

JB&B enVerid Energy savings. Air quality. D=ZINE

TWO ACCELERATING MARKET TRENDS

Indoor Air Quality



The New York Times

Experts Urge Strict Workplace Air Quality Standards, in Wake of Pandemic

FACILITY EXECUTIVE
Creating Intelligent Buildings

Indoor Air Quality A Top Concern Among People Returning To Work

THE FUTURE OF EVERYTHING | HOME

CLEAN AIR: THE NEXT LUXURY APARTMENT PERK

Decarbonization

THE CLEAN FIGHT
NEW YORK
POWERED BY
NEW ENERGY NEXUS

BlackRock

Net zero: a fiduciary approach

GatesNotes THE BLOG OF BILL GATES

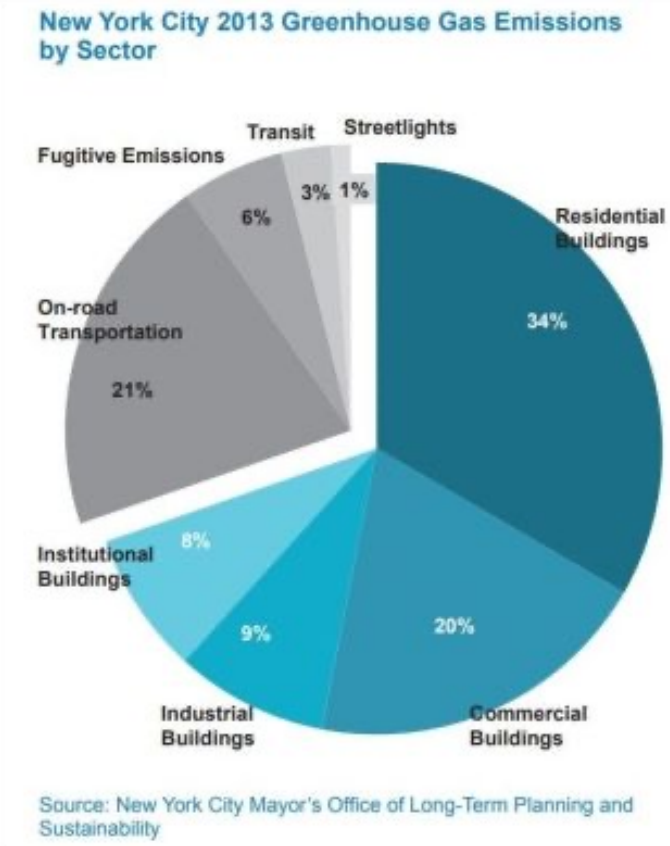
COVID-19 is awful. Climate change could be worse.

THE CHALLENGE FOR OWNERS

“How to enhance indoor air quality without so much energy impact?”

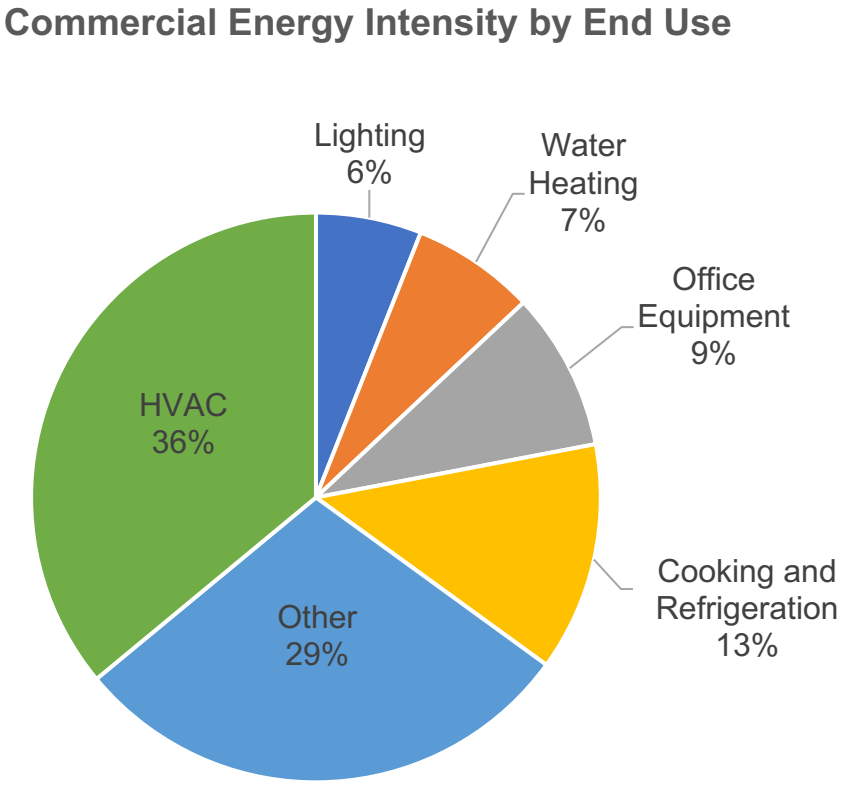
VENTILATING BUILDINGS IS ENERY INTENSIVE

71% of NYC GHG emissions are from buildings



Source: New York City Mayor's Office of Long-Term Planning and Sustainability

HVAC is 36% of commercial building energy intensity



Source: U.S. Energy Information Agency. Annual Energy Outlook 2021.

CLIMATE CHANGE DISPROPORTIONALLY IMPACT "FRONTLINE" COMMUNITIES

The New York Times

Biden Opens New Federal Office for Climate Change, Health and Equity

"Climate change is fundamentally a health threat"

Gina McCarthy, the White House national climate change adviser

OUTSIDE AIR IS NOT ALWAYS “FRESH AIR”

Smoke from Western wildfires is harming air quality on the East Coast

PUBLISHED WED, JUL 21 2021•2:05 PM EDT | UPDATED WED, JUL 21 2021•2:28 PM EDT

Emma Newburger
@EMMA_NEWBURGER

SHARE

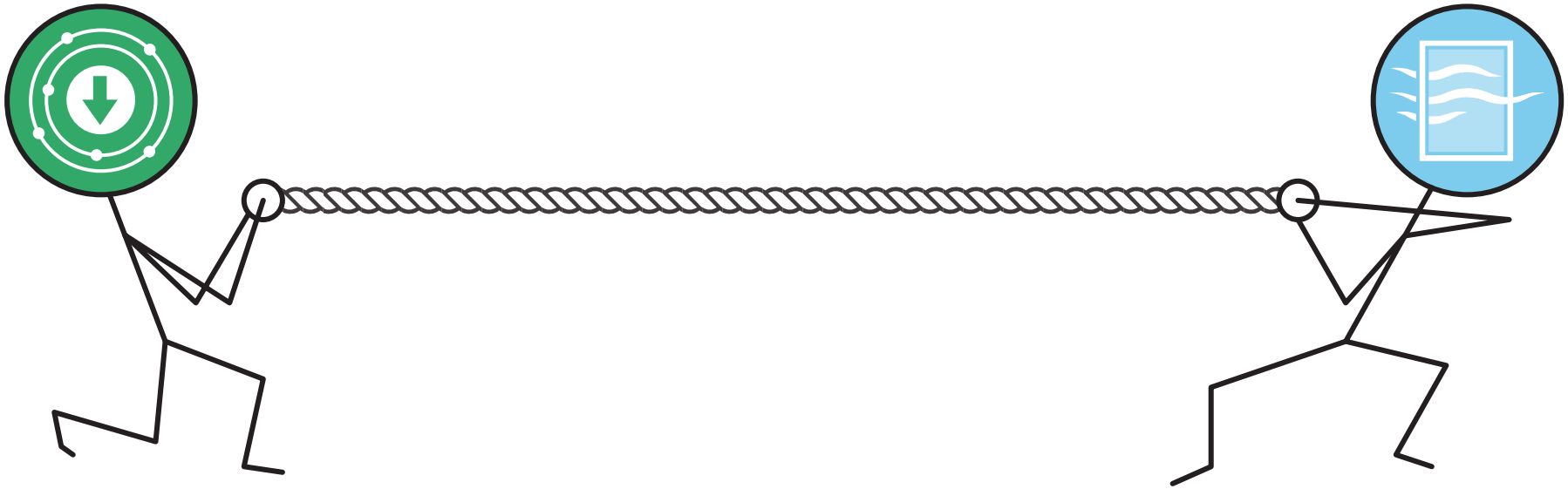
The Statue of Liberty sits behind a cloud of haze on July 20, 2021 in New York City.
Spencer Platt | Getty Images

Over 54 million Americans live in counties with F grades for spikes in daily particle pollution

HOW DO WE DELIVER GOOD IAQ ENERGY EFFICIENTLY?

Energy/Carbon

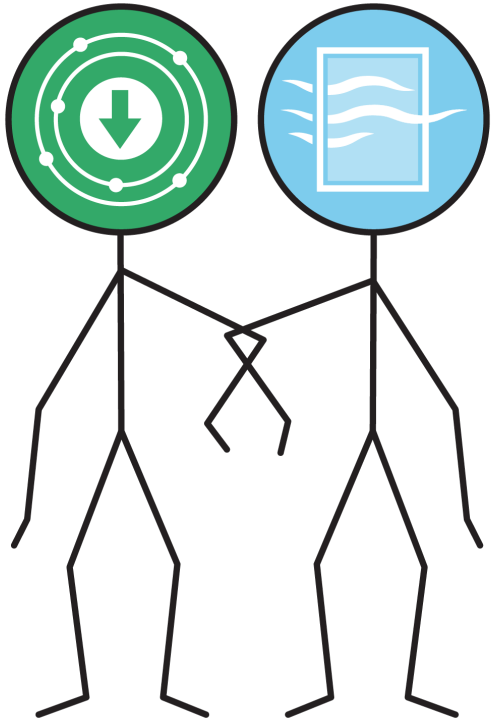
Indoor Air Quality/Healthy Building



THE MOST EFFICIENT SOLUTION: CLEAN INDOOR AIR

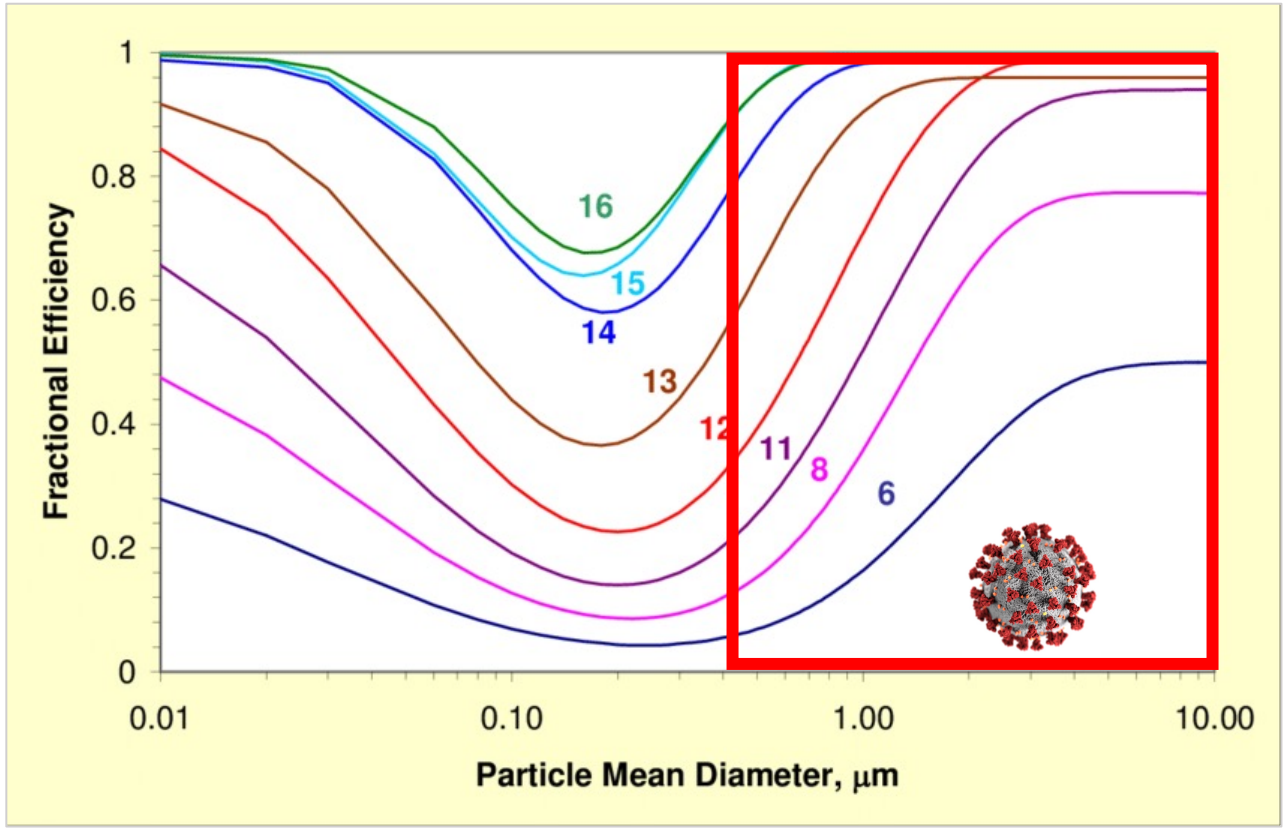
"The future of really good indoor air quality is going to be alternatives to ventilation, so we don't have to rely on outside air for everything."

Prof. William Bahnfleth, Past ASHRAE President



AIR CLEANING FOR PARTICLES & VIRUSES

MERV Filter Efficiency



Filter Droplet Nuclei Efficiency

MERV Rating (Based on 52.2-2017)	Filter Droplet Nuclei Efficiency
4	16.80%
5	26.55%
6	32.45%
7	41.13%
8	55.57%
9	62.00%
10	64.65%
11	72.86%
12	83.39%
13	89.93%
14	94.94%
15	96.18%
16	97.40%

Source: https://www.ashrae.org/file%20library/technical%20resources/covid-19/ashrae-building-readiness.pdf

AIR CLEANING FOR GASEOUS CONTAMINANTS

"The [air cleaning] technology was shown to control contaminants of concern below exposure limits with lower ventilation rates, which leads to energy savings."

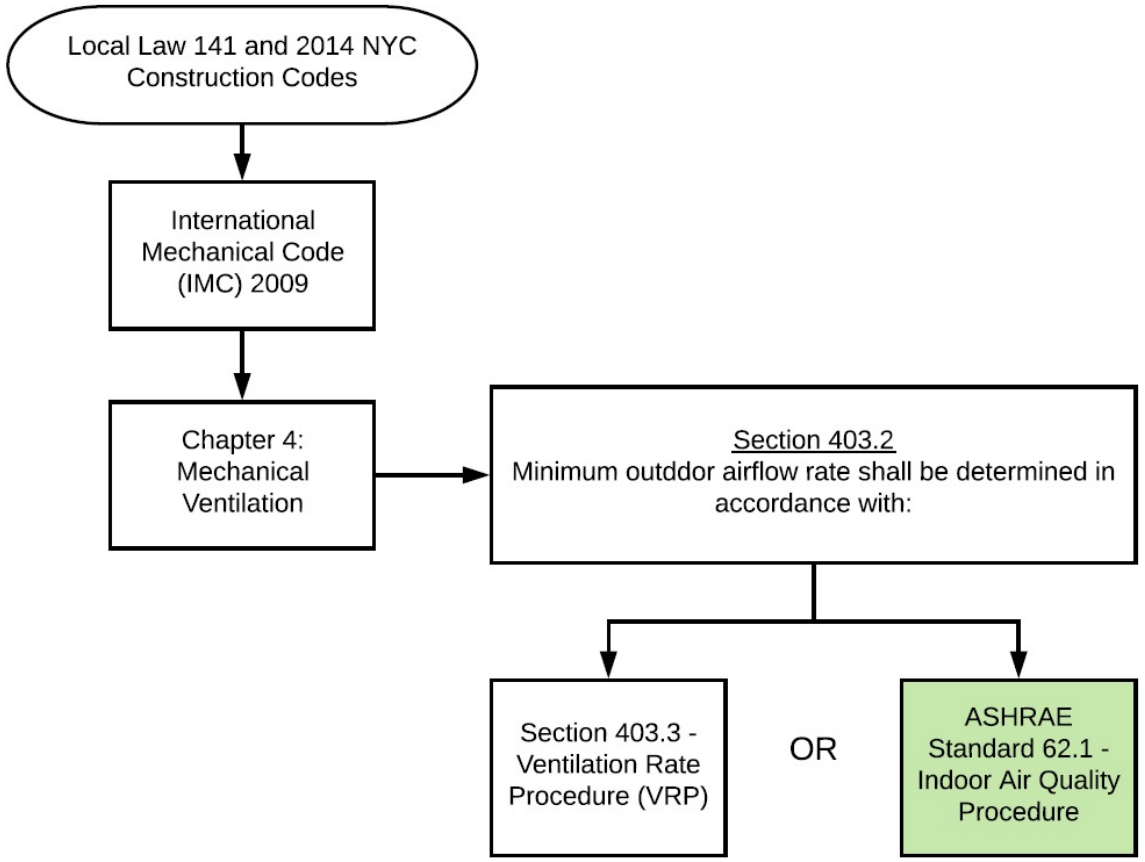
"Air cleaning can substitute for outdoor air ventilation, leading to energy savings."

ASHRAE: TWO WAYS TO CALCULATE MINIMUM VENTILATION RATES

	Ventilation Rate Procedure (VRP)	Indoor Air Quality Procedure (IAQP)
Calculation Approach	**Prescriptive:** Minimum outside air based on area and occupancy without accounting for source-control and removal measures.	**Performance-based:** Minimum outside air based on contaminant emission rates and source-control and removal measures.
Energy Intensity	High in many climate zones because IAQ is achieved using only outside air.	Often lower because a portion of outside air is offset with source-control and removal measures such as air cleaning.
Indoor Air Quality	Depends on quality of outside air and any unusual indoor air contaminates and their emission rates.	Equivalent or better than VRP, especially when outside air is polluted or unusual contaminant or emissions rates exist.

"Although the intake airflow determined using each of these approaches may differ significantly…any of these approaches is a valid basis for design." (62.1-2019 Section 6.1)

THE IAQP IS ALLOWED BY THE NYC BUILDING CODE



From IMC Section 403.2

"Where a registered design professional demonstrates that an ***engineered ventilation system design*** will prevent the maximum concentration of containments from exceeding the obtainable by the rate of outdoor air ventilation determined in accordance with Section 403.3, the ***minimum required rate of outdoor air shall be reduced*** in accordance with such engineered system design."

"An engineered ventilation system is more of a direct method of controlling air quality and would be classified as an **"Indoor Air Quality Procedure"** in ASHRAE 62.1."

HOW THE IAQP WORKS: 4 SIMPLE STEPS

Step 1: Identify Contaminants of Concern & Design Targets	**Step 2:** Determine Indoor Emission Rates & Outdoor Concentrations	**Step 3:** Identify Air Cleaning Efficiency for Capturing Contaminants	**Step 4:** Perform Mass Balance Analysis
Provided in table (new User's Manual)	Provided in table (new User's Manual)	Standard tests: e.g., 145.2, 52.2, UL 2998	Use proven IAQP calculators

SAMPLE CALCULATIONS: IAQP WITH AIR CLEANING

Ventilation Rate Calculations

Floor Area (sq.ft.)	1,880,000	Gross sq.ft. AHU S-1 thru 12
Baseline Supply Airflow (cfm)	1,904,380	HVAC schedule
Baseline Outside Air (cfm)	571,014	30% total supply airflow
IAQP Outside Air (cfm)	341,972	18% total supply airflow
Outside Air Reduced (cfm)	**229,042**	**Baseline OA - IAQP OA**
Outside Air Reduced (%)	**40%**	

The IAQP + air cleaning enables a 40% reduction in outside air while maintaining peak CO_2 at 1,000 ppm

SAMPLE CALCULATIONS: IAQP WITH AIR CLEANING (CONT.)

Ventilation Rate Calculations

Outside Air Reduced (cfm)	**229,042**	**Baseline OA - IAQP OA**
Outside Air Reduced (%)	**40%**	

MTCO2e Reduction	578
Annual Energy and Water Savings	**$432,456**
2024 LL97 Penalty Avoided	**$154,904**
Energy Star Points Earned	**5-10 points**

VENTILATION RATES & COVID-19: A BRIEF HISTORY OF ASHRAE GUIDANCE

Spring 2020 → Early 2021 → Spring 2021

Initial ASHRAE COVID-19 Guidance

- ASHRAE ETF formed in March
- Initial guidance based on perceived risk and possible effectiveness
- “ASHRAE recommendations were initially very conservative”

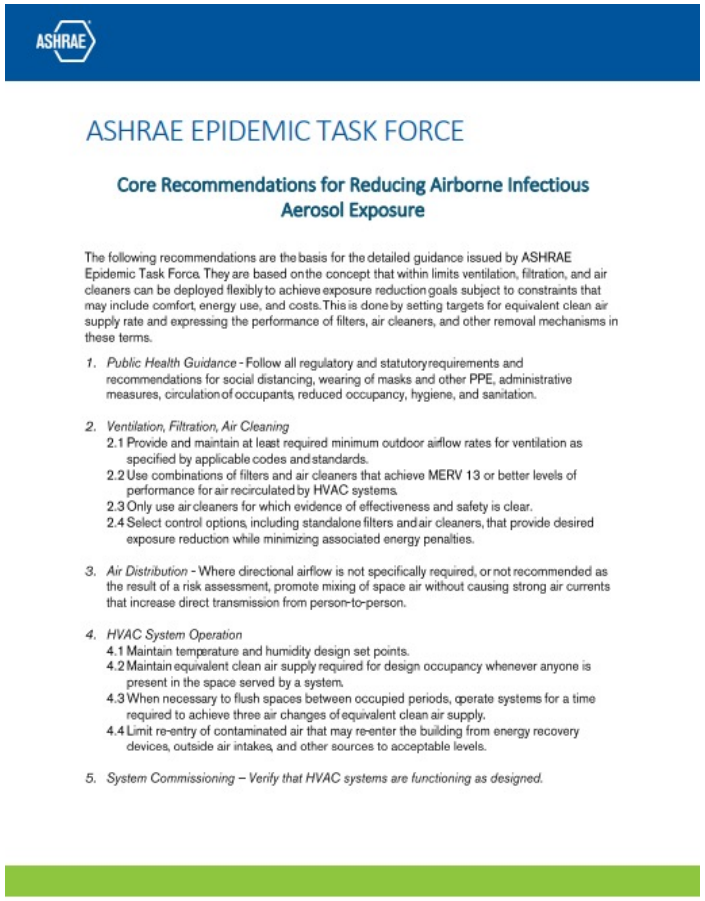
Updated Core Recommendations

- Updated guidance to achieve similar levels of protection with lower cost and energy impact
- “Based on the concept that ventilation, filtration and air cleaners can be combined flexibly”

Building Decarbonization Task Force

- Established to address climate change through responsible building decarbonization strategies
- Focused on actionable guidance to improve design and operation

ASHRAE CORE RECOMMENDATIONS (JAN 2021)



ASHRAE EPIDEMIC TASK FORCE

Core Recommendations for Reducing Airborne Infectious Aerosol Exposure

The following recommendations are the basis for the detailed guidance issued by ASHRAE Epidemic Task Force. They are based on the concept that within limits ventilation, filtration, and air cleaners can be deployed flexibly to achieve exposure reduction goals subject to constraints that may include comfort, energy use, and costs. This is done by setting targets for equivalent clean air supply rate and expressing the performance of filters, air cleaners, and other removal mechanisms in these terms.

1. *Public Health Guidance* - Follow all regulatory and statutory requirements and recommendations for social distancing, wearing of masks and other PPE, administrative measures, circulation of occupants, reduced occupancy, hygiene, and sanitation.

2. *Ventilation, Filtration, Air Cleaning*
   - 2.1 Provide and maintain at least required minimum outdoor airflow rates for ventilation as specified by applicable codes and standards.
   - 2.2 Use combinations of filters and air cleaners that achieve MERV 13 or better levels of performance for air recirculated by HVAC systems.
   - 2.3 Only use air cleaners for which evidence of effectiveness and safety is clear.
   - 2.4 Select control options, including standalone filters and air cleaners, that provide desired exposure reduction while minimizing associated energy penalties.

3. *Air Distribution* - Where directional airflow is not specifically required, or not recommended as the result of a risk assessment, promote mixing of space air without causing strong air currents that increase direct transmission from person-to-person.

4. *HVAC System Operation*
   - 4.1 Maintain temperature and humidity design set points.
   - 4.2 Maintain equivalent clean air supply required for design occupancy whenever anyone is present in the space served by a system.
   - 4.3 When necessary to flush spaces between occupied periods, operate systems for a time required to achieve three air changes of equivalent clean air supply.
   - 4.4 Limit re-entry of contaminated air that may re-enter the building from energy recovery devices, outside air intakes, and other sources to acceptable levels.

5. *System Commissioning – Verify that HVAC systems are functioning as designed.*

"…based on the concept that **ventilation, filtration and air cleaners** can be combined flexibly to achieve exposure reduction goals…"

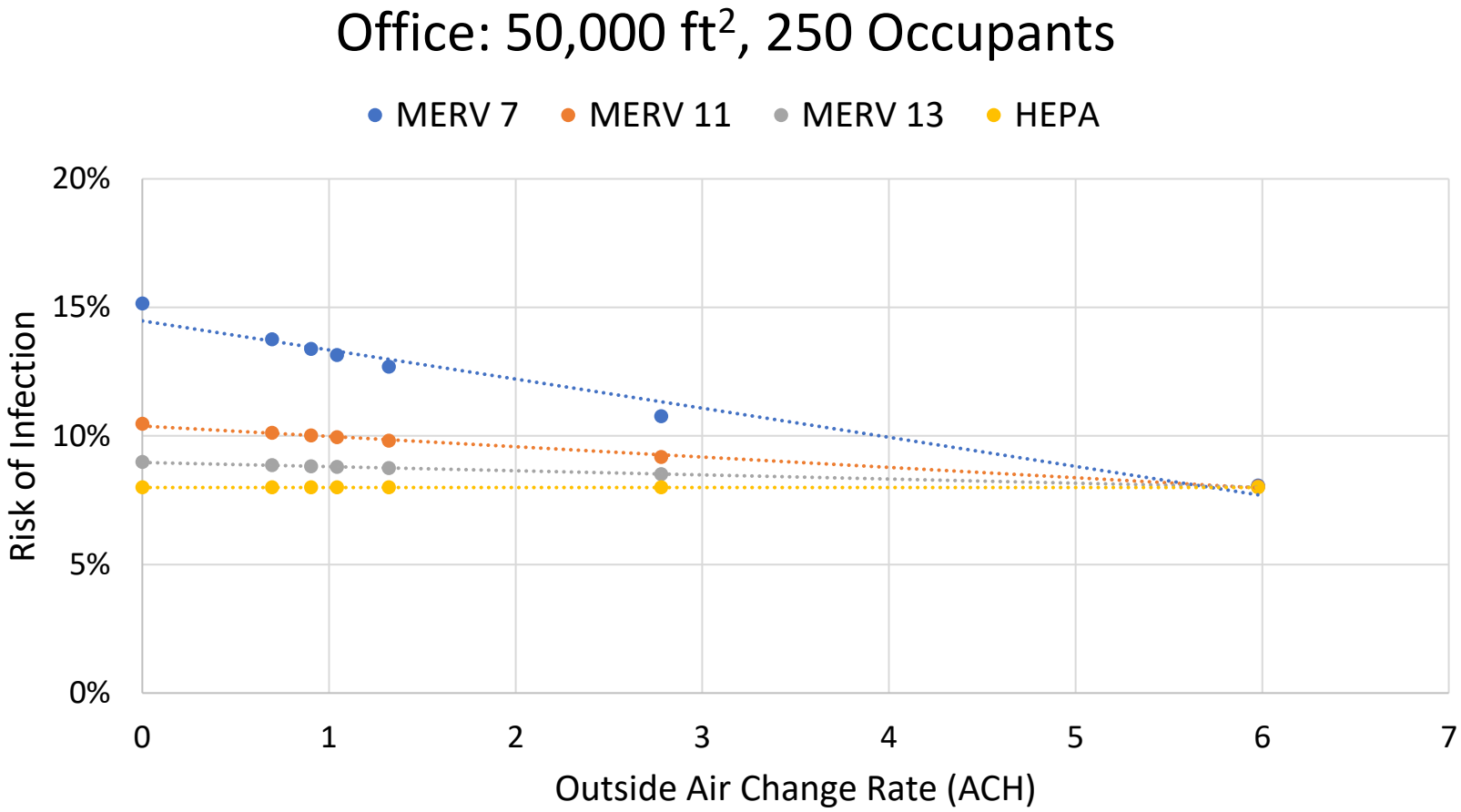
Core Recommendations for Ventilation, Filtration, and Air Cleaning

- At least required minimum outdoor airflow rates
- Combinations of filters and air cleaners to achieve MERV 13 or better
- Only use safe, proven air cleaners
- Select control options from the above that provide desired exposure reduction while minimizing energy penalties

The Core Recommendations can be accessed from https://www.ashrae.org/technical-resources/resources

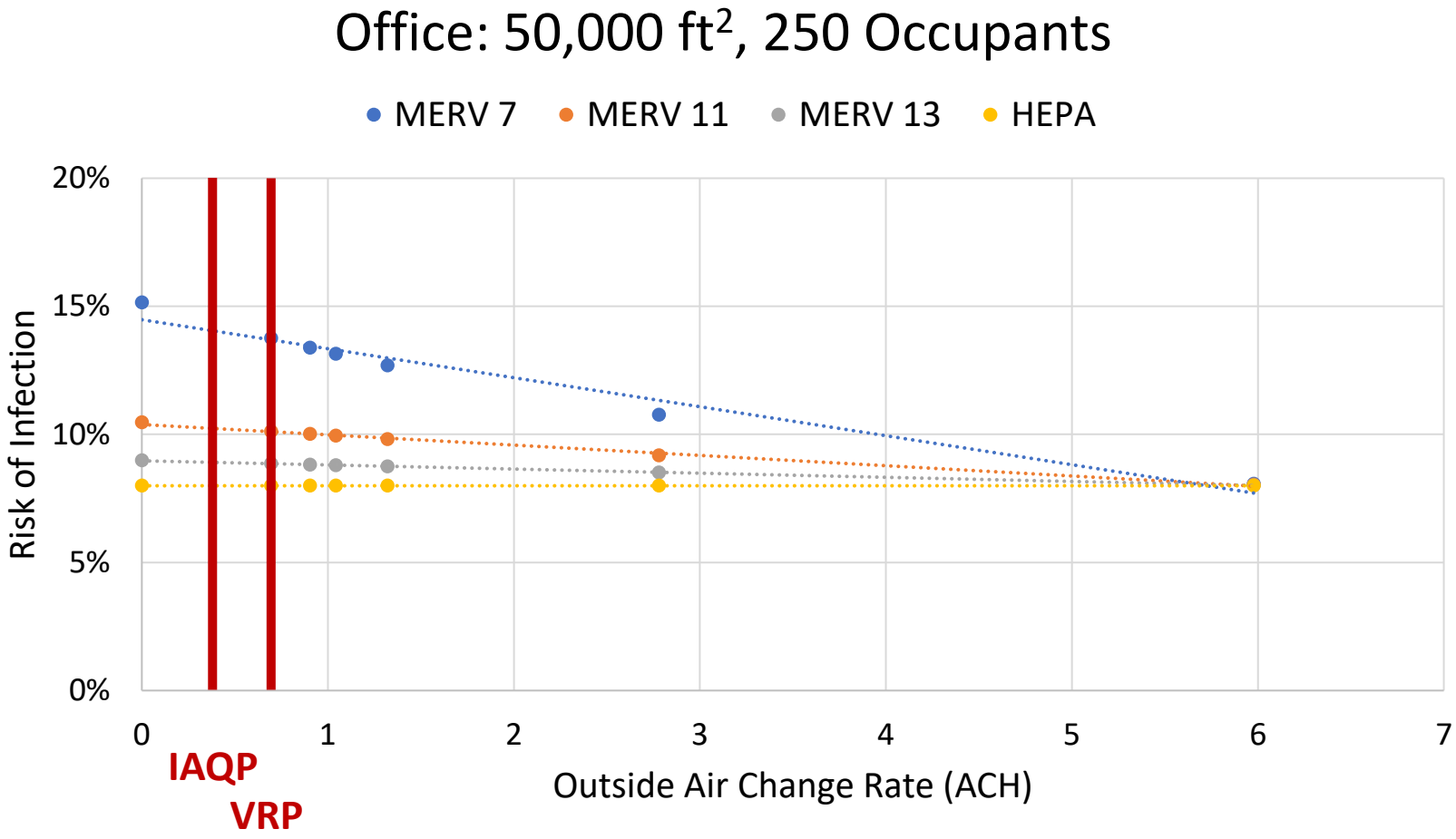
THE SCIENCE BEHIND ASHRAE'S CORE RECOMMENDATIONS

As filter efficiency goes up, the relative risk reduction benefits of increasing outside air go down.



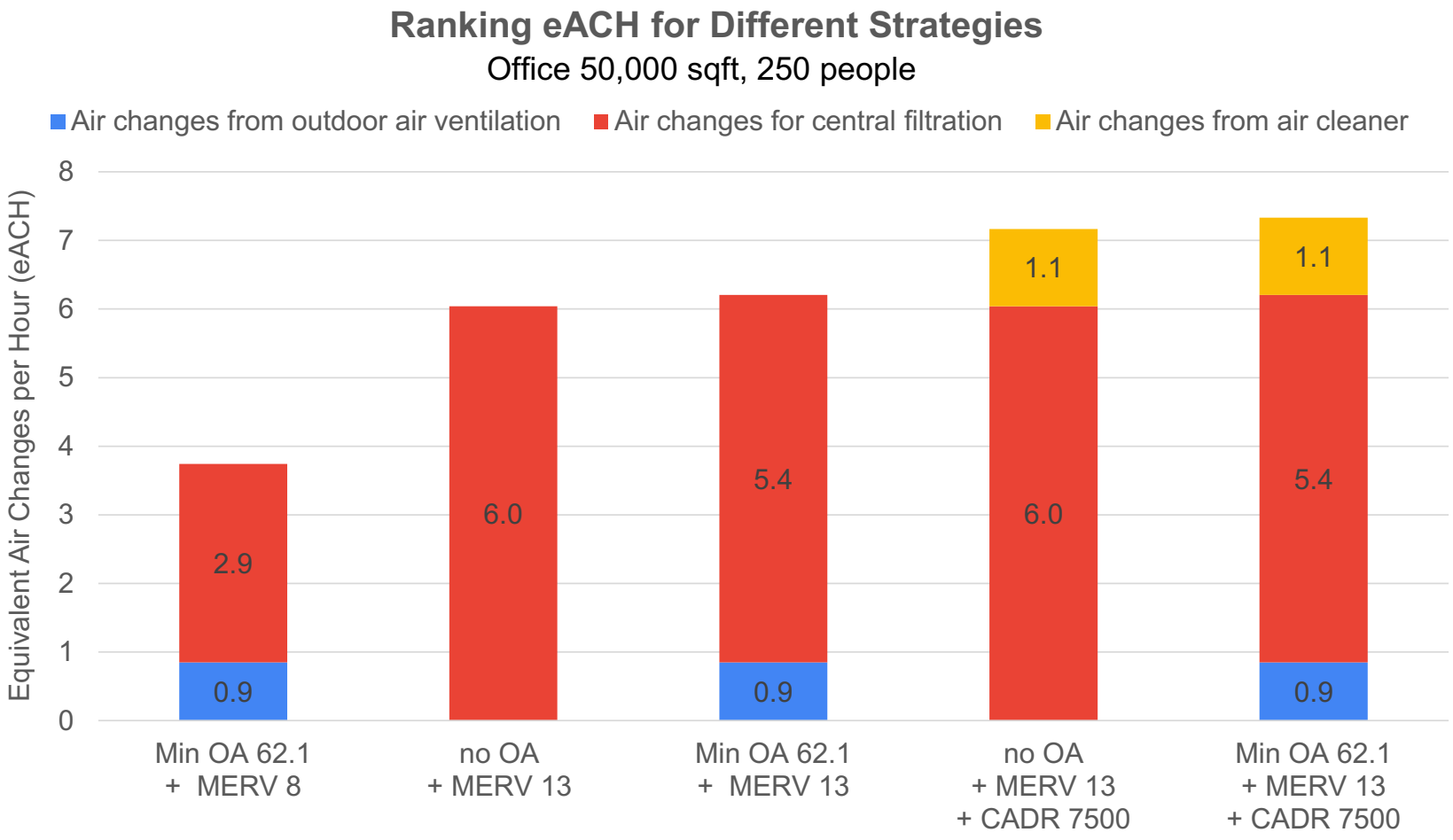
THE SCIENCE BEHIND ASHRAE'S CORE RECOMMENDATIONS

With MERV 13 filters, using the more efficient IAQP ventilation rate has a similar relative risk as the VRP rate.



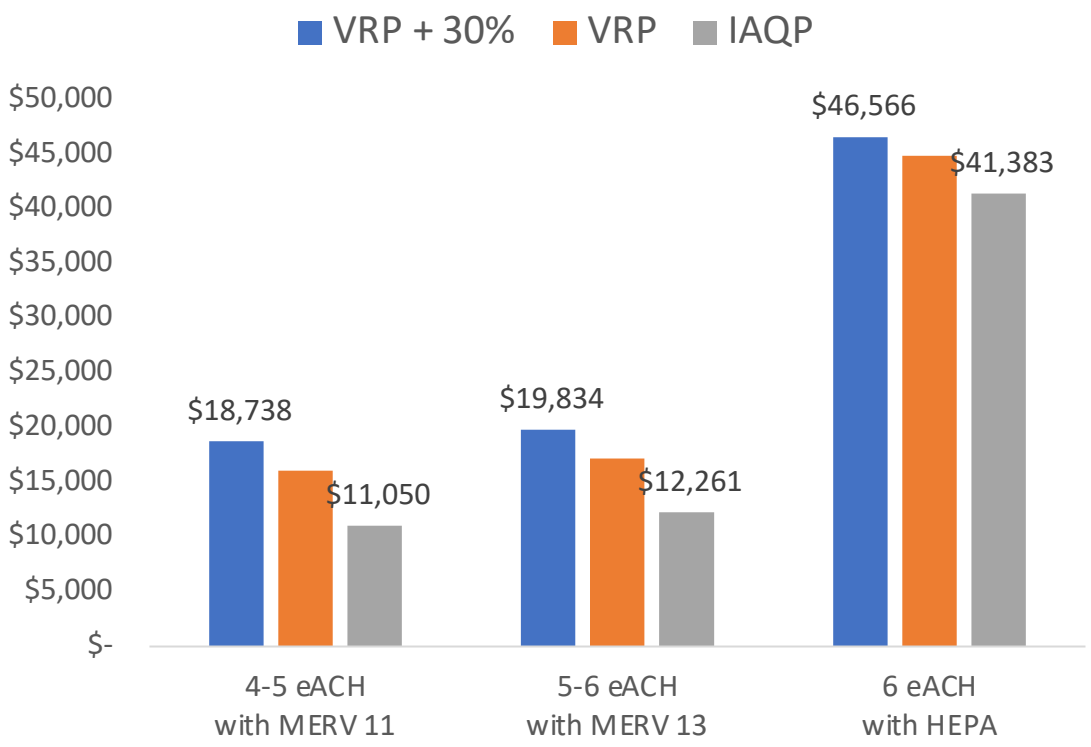
THE SCIENCE BEHIND ASHRAE'S CORE RECOMMENDATIONS

Achieving 4-6 Equivalent Air Changes per Hour (eACH) is possible with MERV 13 filters + minimum outdoor air.

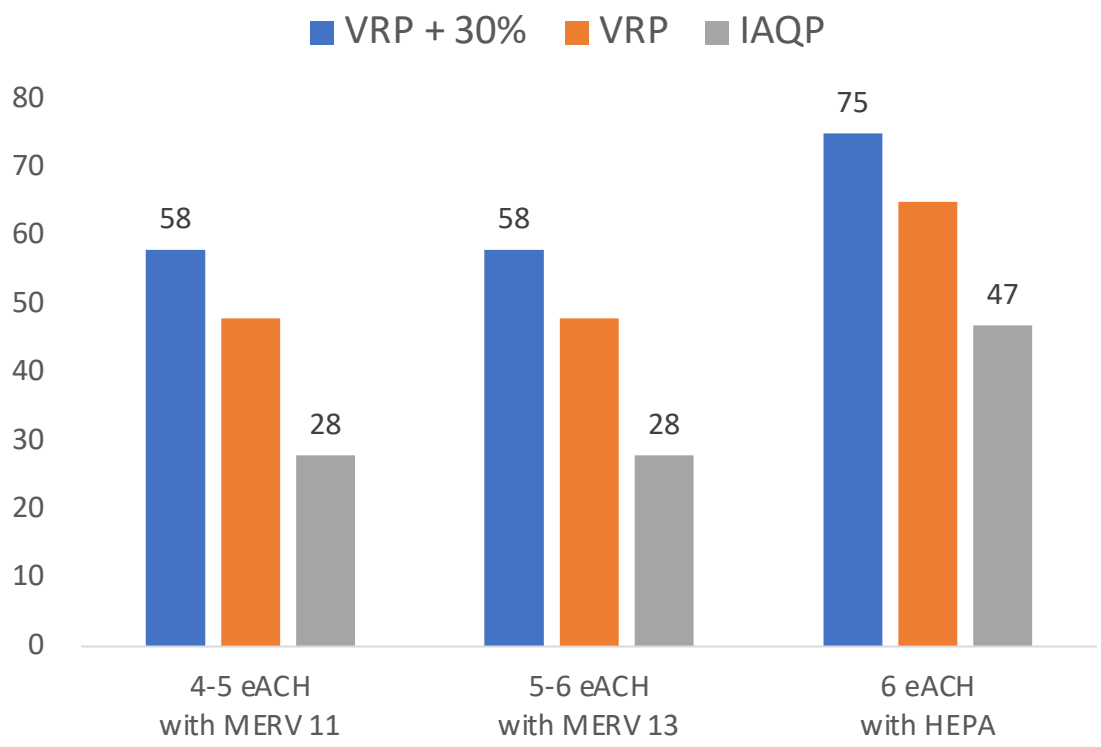


THE MOST EFFICIENT SOLUTION: CLEAN INDOOR AIR

Annual Operating Cost vs. Mitigation Strategy
(Office: 50,000 ft², 250 Occupants)



Metric Tons of CO_2/year vs. Mitigation Strategy
(Office: 50,000 ft², 250 Occupants)



Use the IAQP with air cleaners for particles and gases for the most efficient and safe IAQ solution.

CASE STUDY: HIGH RISE OFFICE BUILDING – OVERVIEW

Project Overview

- 44-floor Class A office, 1.35M square feet
- 40 sorbent-based air cleaners installed on the mechanical floors and integrated with 16 air handling units in June 2017
- New minimum ventilation rate set based on ASHRAE's Indoor Air Quality Procedure
- Wide range of IAQ metrics were measured before and after installation

Project Goals

- Reduce energy and water consumption and carbon emissions
- Improve indoor air quality by reducing the intake of polluted outside air

CASE STUDY: HIGH RISE OFFICE BUILDING – IAQP CALCULATIONS

Ventilation Rate Calculations

Baseline Supply Airflow (cfm)	750,000	HVAC schedule
Baseline Outside Air (cfm)	217,742	~30% total supply airflow
IAQP Outside Air (cfm)	85,244	~10% total supply airflow
Outside Air Reduced (cfm)	**133,871**	**Baseline OA - IAQP OA**
Outside Air Reduced (%)	**61%**	

IAQP + air cleaning enabled a 61% reduction in outside air

CASE STUDY: HIGH RISE OFFICE BUILDING – PROJECT DESIGN

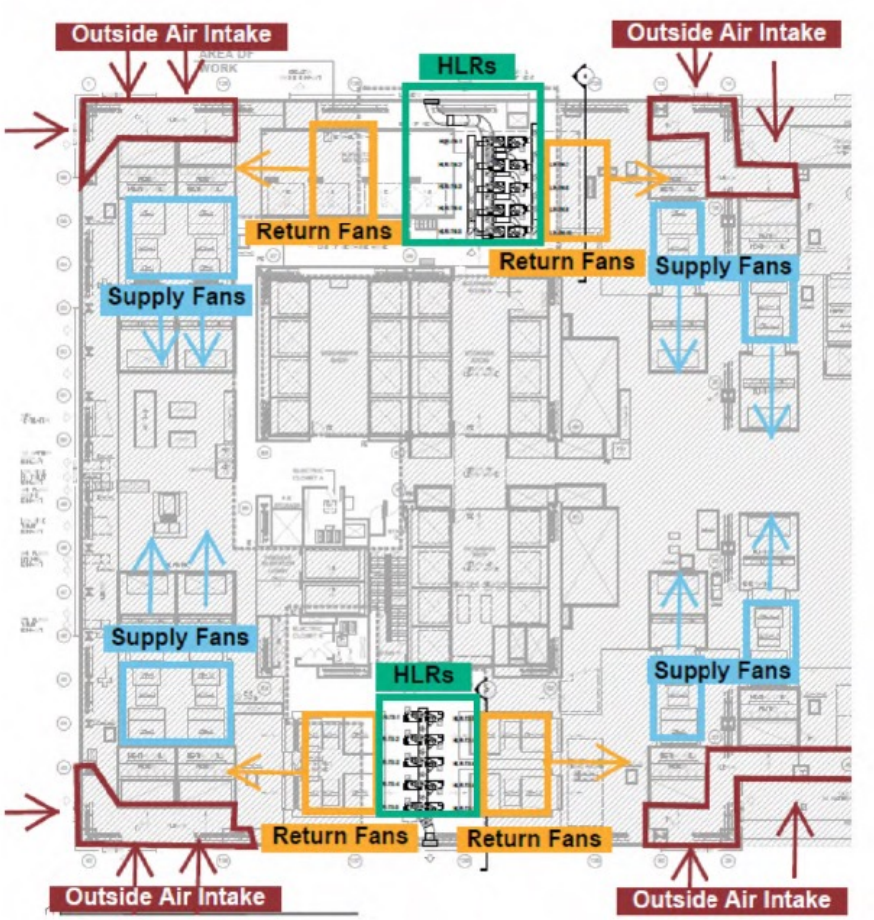


Figure 4: 7th floor mechanical room layout with two sets of 10 HLR modules installed near the AHUs' intake of plenum return air

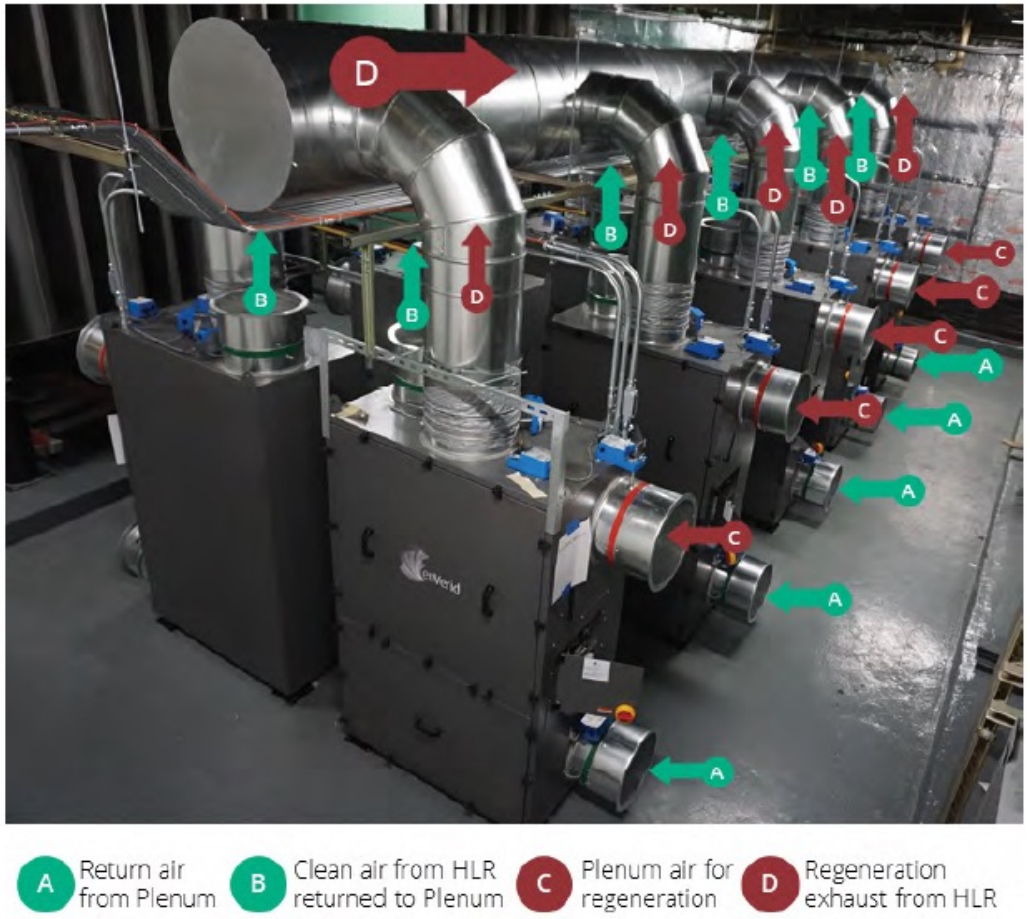
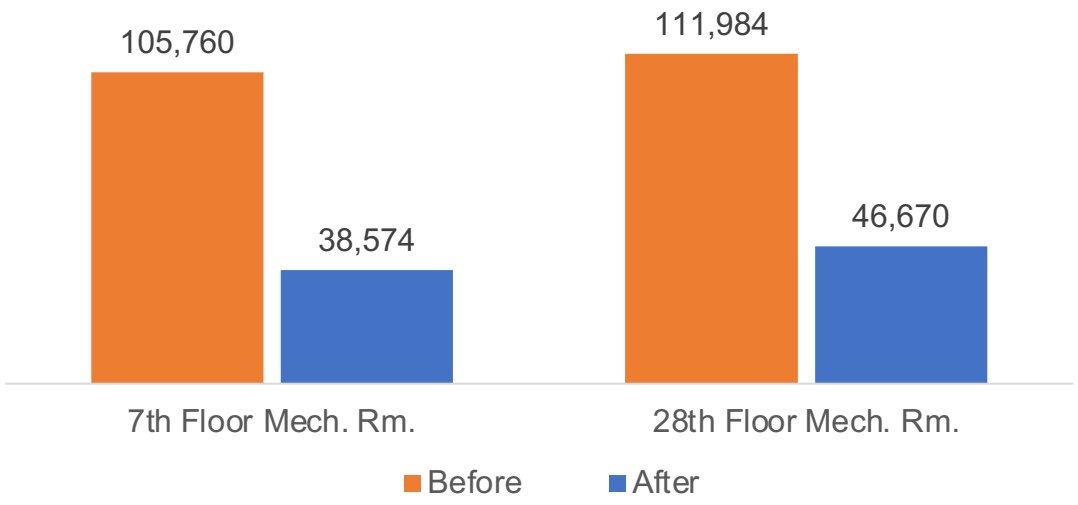


Figure 8: HLR modules were grouped in clusters of 10 each, with a shared exhaust duct.

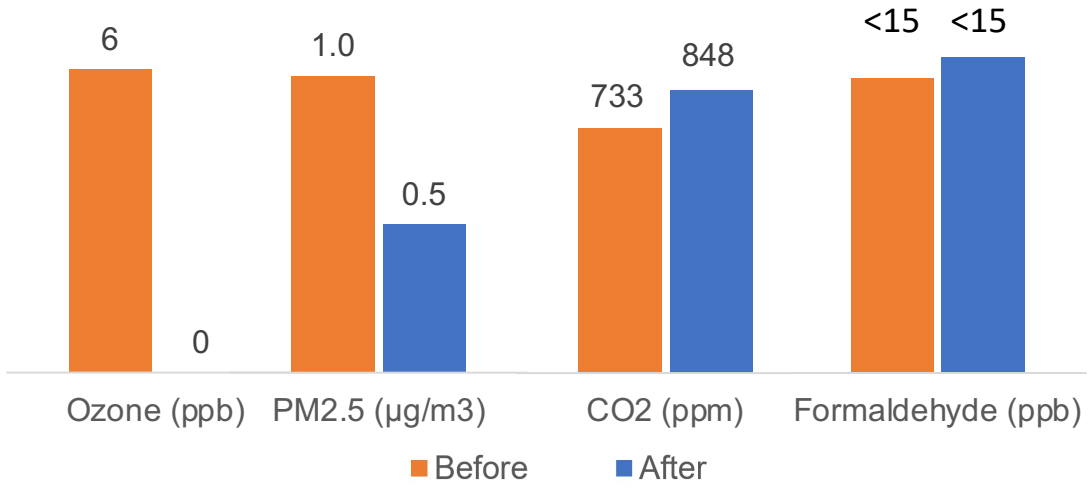
CASE STUDY: HIGH RISE OFFICE BUILDING – OUTSIDE AIR AND IAQ RESULTS

Measured OA Pre- and Post-Installation of Air Cleaners



61% reduction in outside air

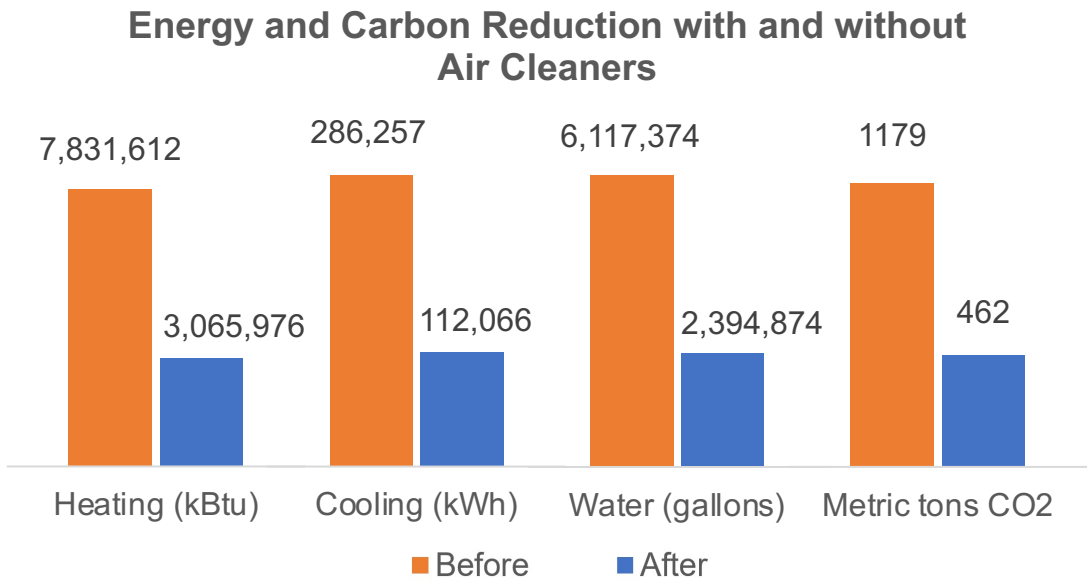
Measured IAQ Pre- and Post-Installation of Air Cleaners



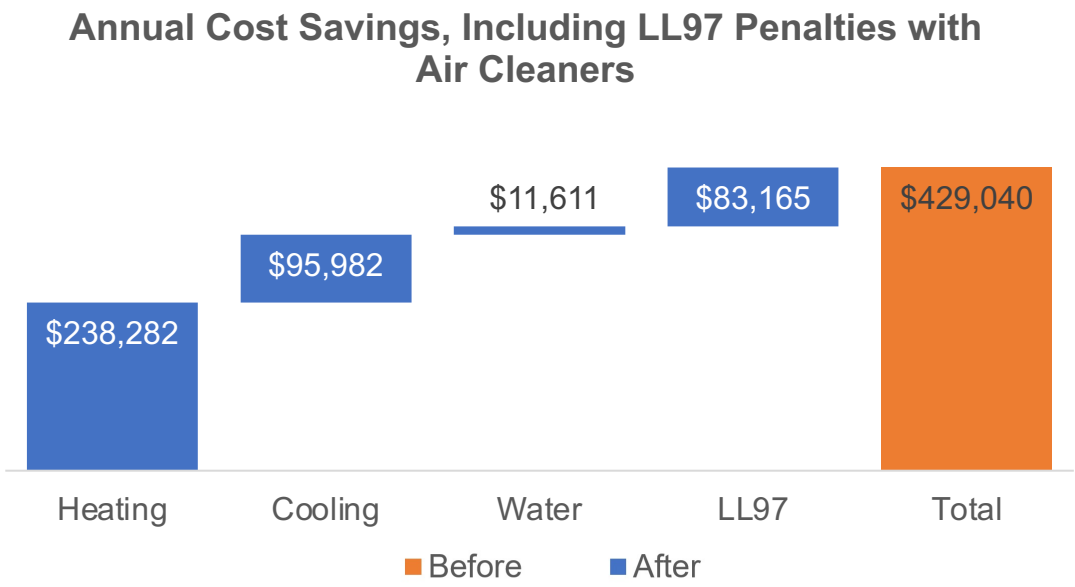
Similar or better indoor air quality

"This project demonstrated both energy savings and an improvement in IAQ immediately upon completion."
Marc Hourican, PE, Syska Hennessy

CASE STUDY: HIGH RISE OFFICE BUILDING – ENERGY AND FINANCIAL RESULTS



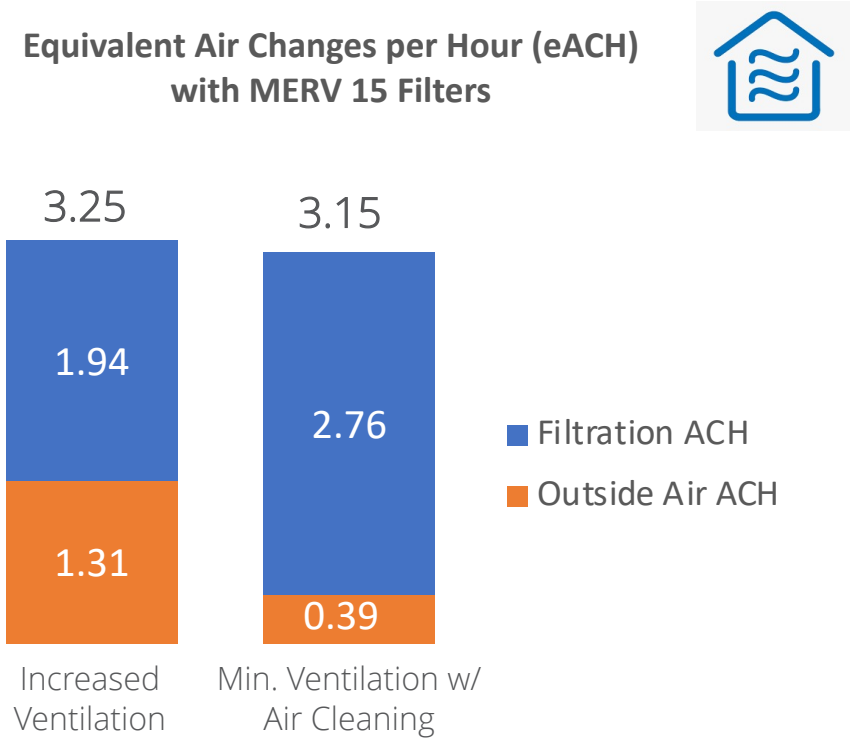
~60% reduction in HVAC energy, water, and carbon

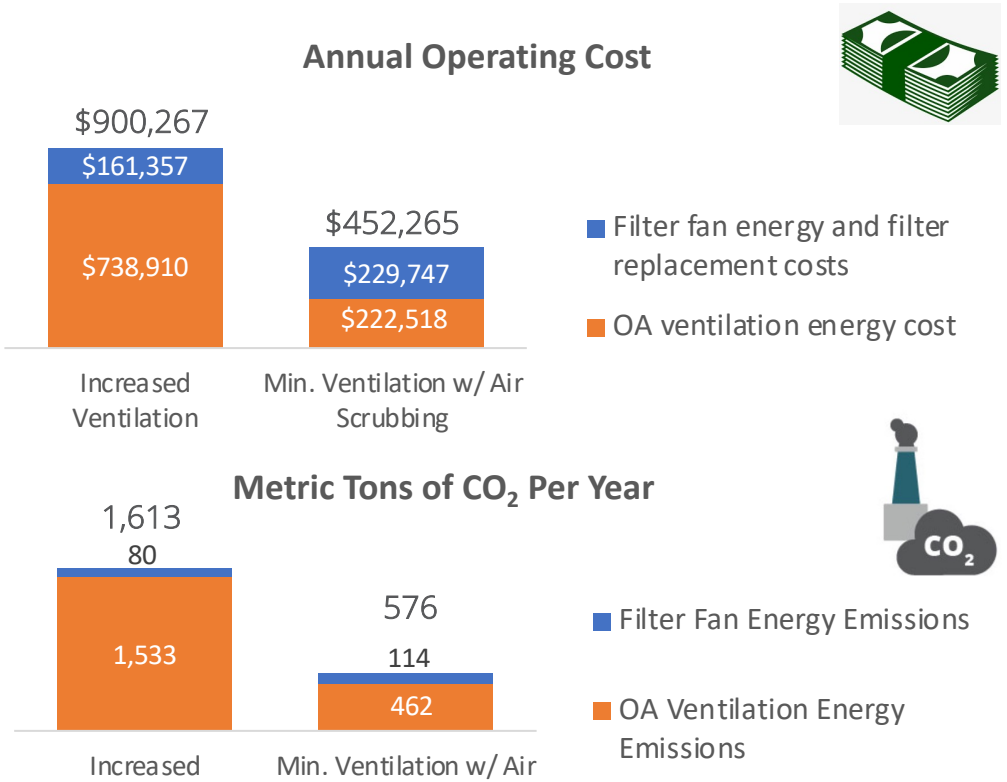


Over $425,000 in annual savings

The project delivered on key sustainability goals with a 2-year payback (before factoring in any LL97 penalties).

CASE STUDY: HIGH RISE OFFICE BUILDING – COVID-19 MITIGATION



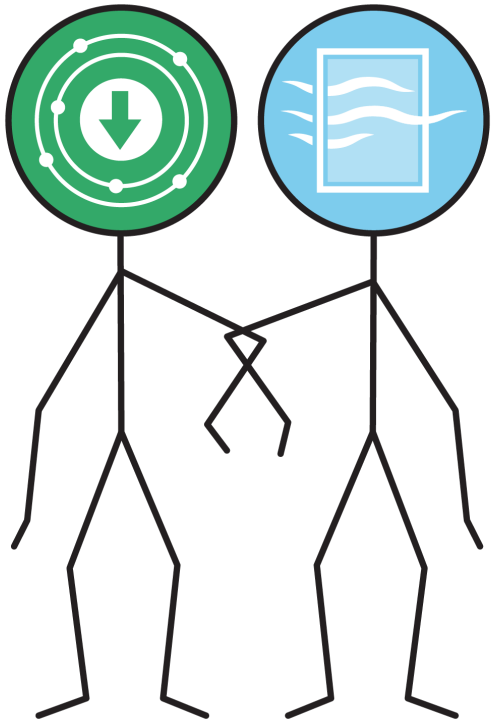


Combining sorbent air cleaners with high-efficiency MERV filters or local HEPA filters delivers nearly equivalent air changes with much lower energy use and carbon intensity.

SUMMARY: HOW TO DELIVER GOOD IAQ ENERGY EFFICIENTLY

Benefits of the IAQP method + air cleaning:

- Reduce HVAC energy consumption
- Improve indoor air quality
- Lower capital costs
- Comply with Local Laws and COVID-19 guidance



IDEAL APPLICATIONS FOR THE IAQP WITH AIR CLEANING

Target Applications

- Office buildings
- Non-critical care healthcare
- Schools, universities, libraries
- Public assembly, conference space, indoor arenas
- Malls and big-box stores
- Green / LEED buildings

Highest ROI Use Cases

- HVAC replacement / upgrade
- New construction – downsize new HVAC systems
- Retrofit applications with existing HVAC systems
- Hot/humid and cold climate zones
- High utility rate markets with rebates

THANK YOU

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