Measuring and Maintaining Healthy Indoor Air Quality

Presented to BOMA Chicago
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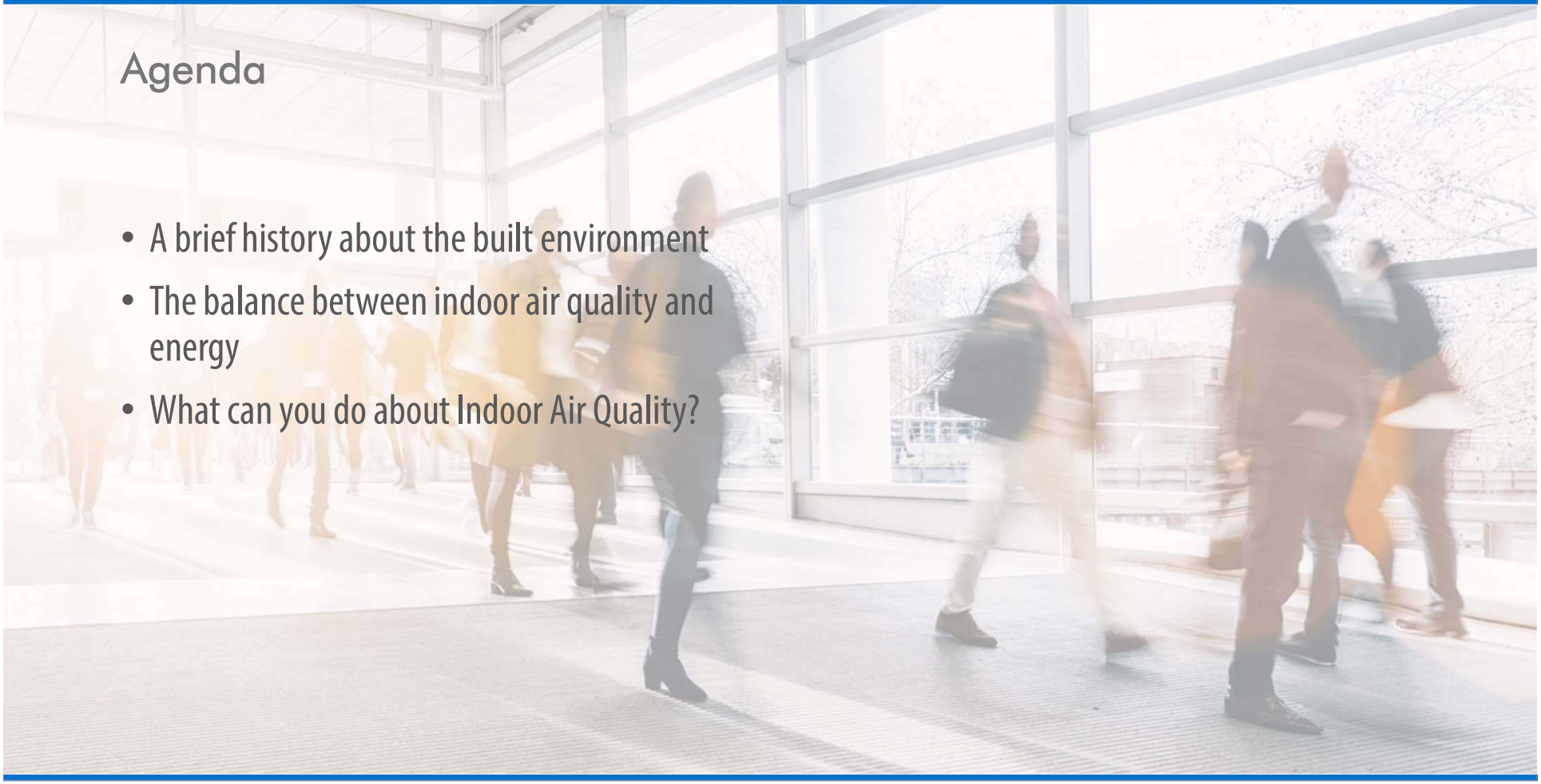
cycloneENERGYgroup

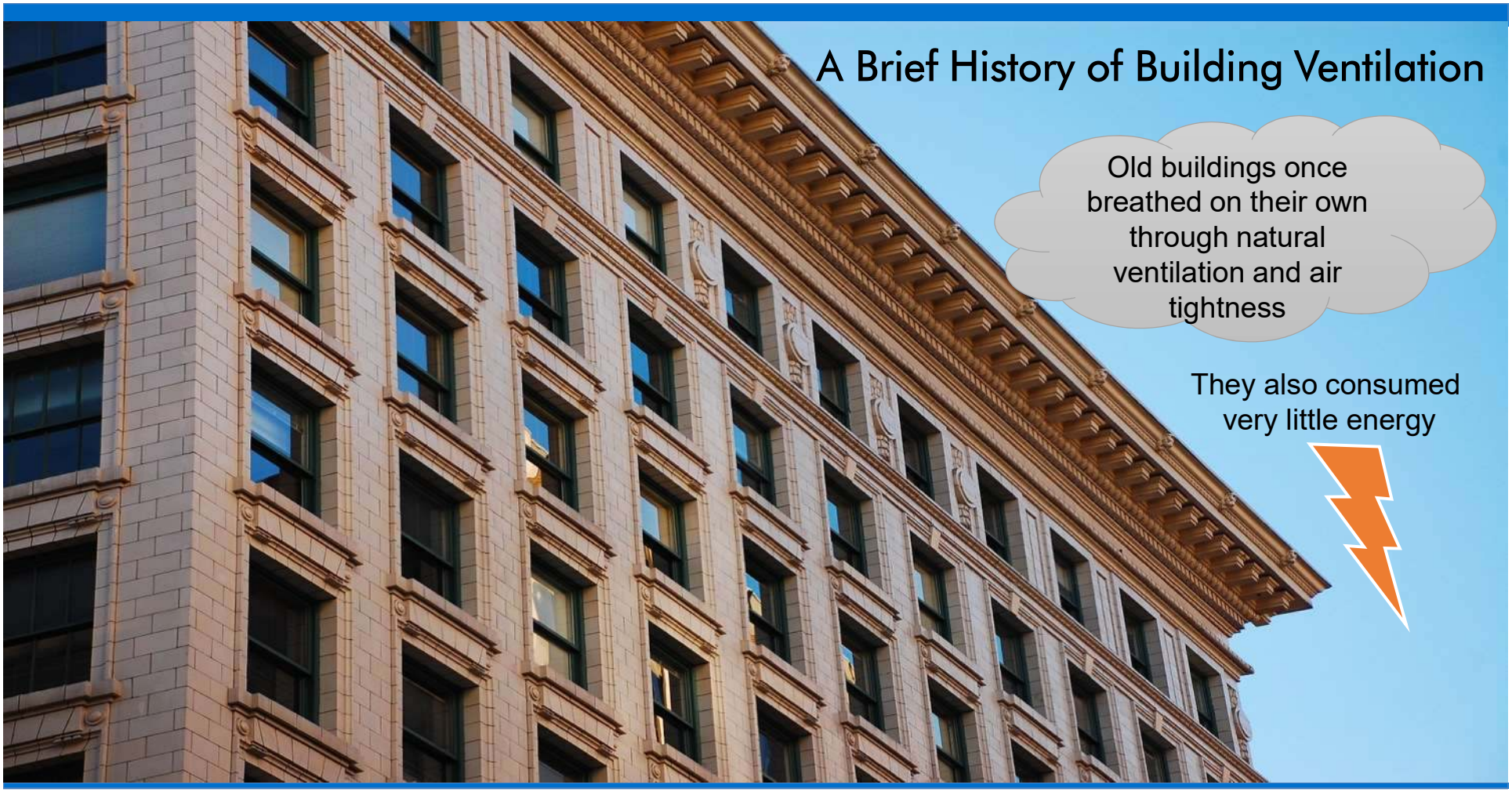
GLENSTAR

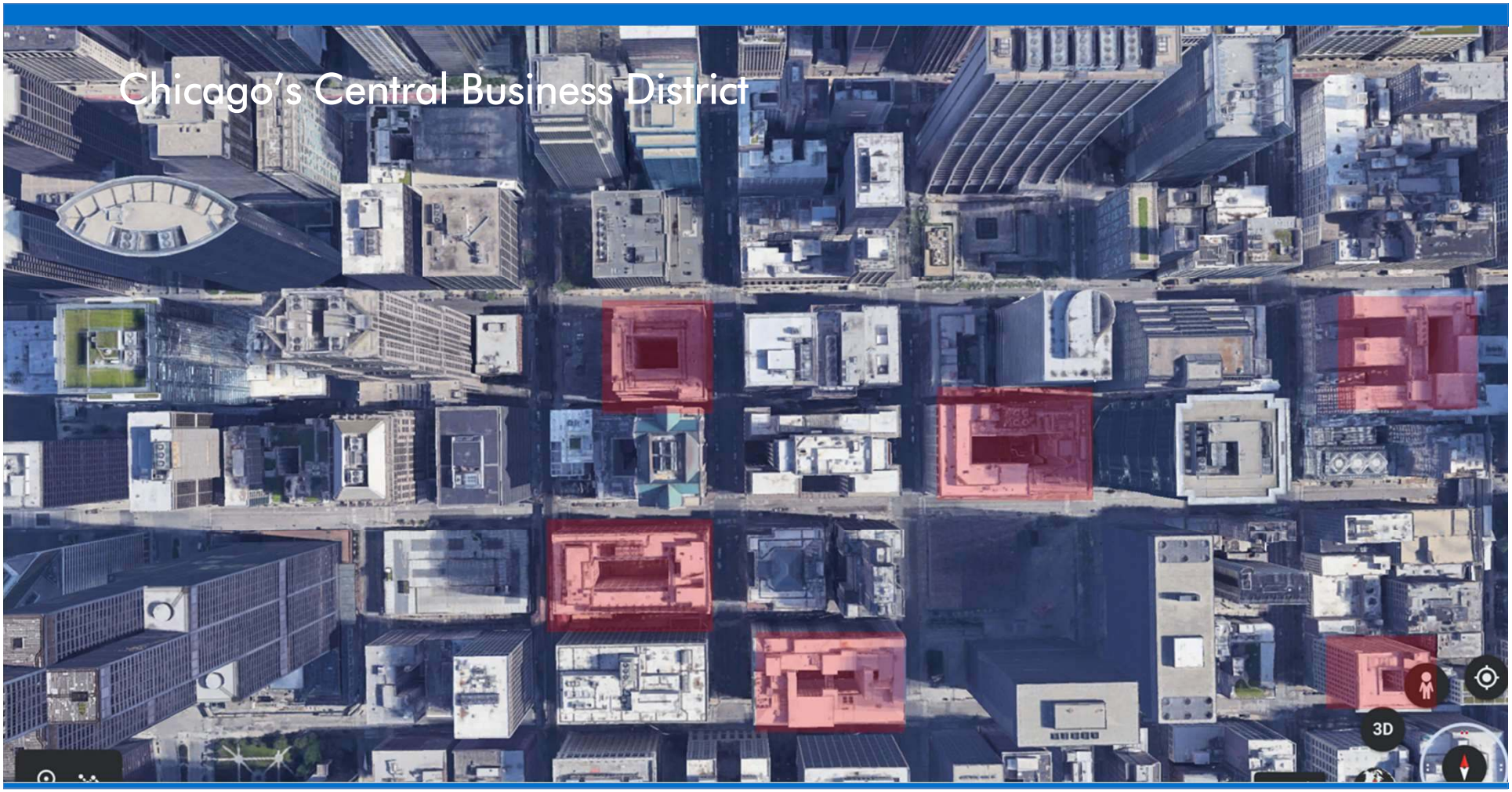
July 14, 2021

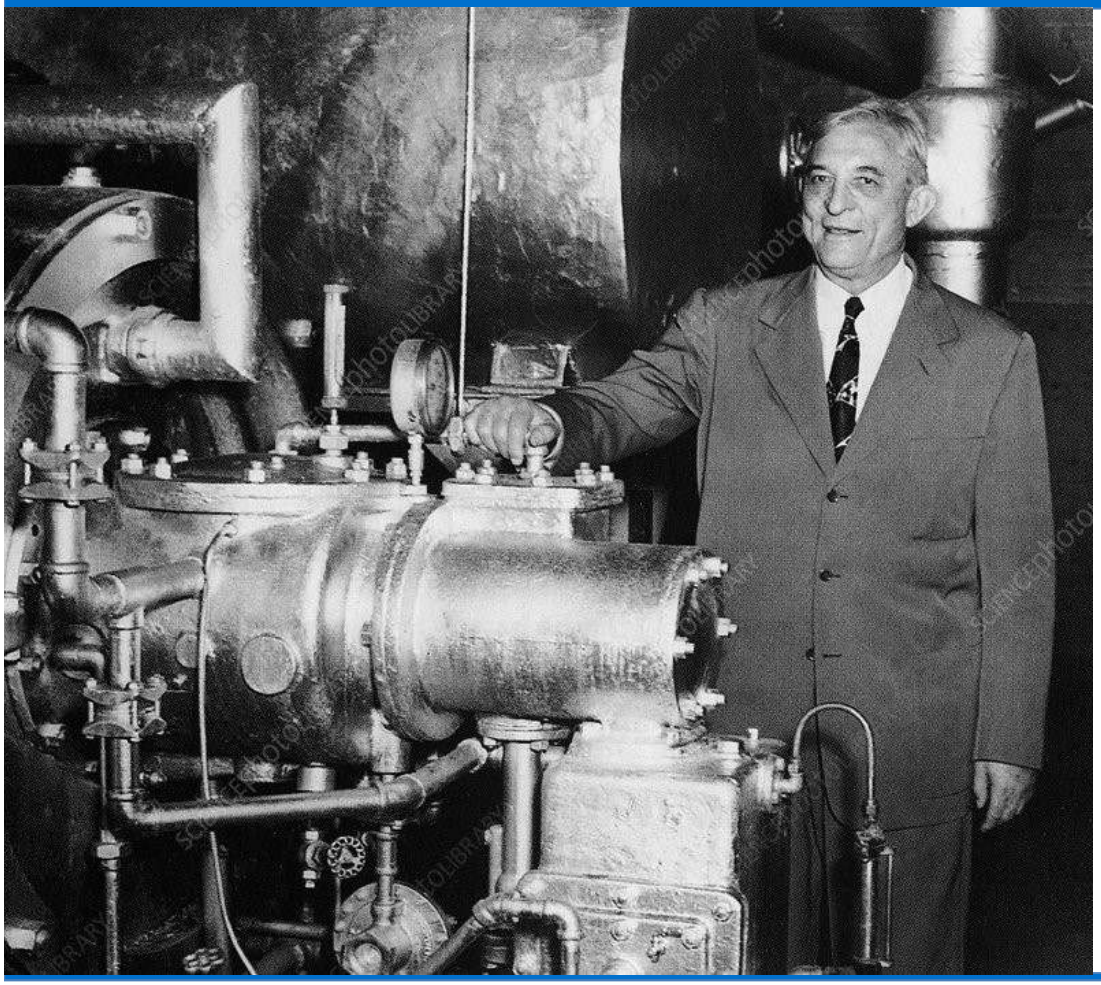
Agenda



- A brief history about the built environment
- The balance between indoor air quality and energy
- What can you do about Indoor Air Quality?


A Brief History of Building Ventilation
Old buildings once breathed on their own through natural ventilation and air tightness
They also consumed very little energy


Chicago's Central Business District
3D



Willis Carrier

The invention of "Manufactured Weather" in the 1920's was the beginning of a lot of consequences to both indoor and outdoor environments.

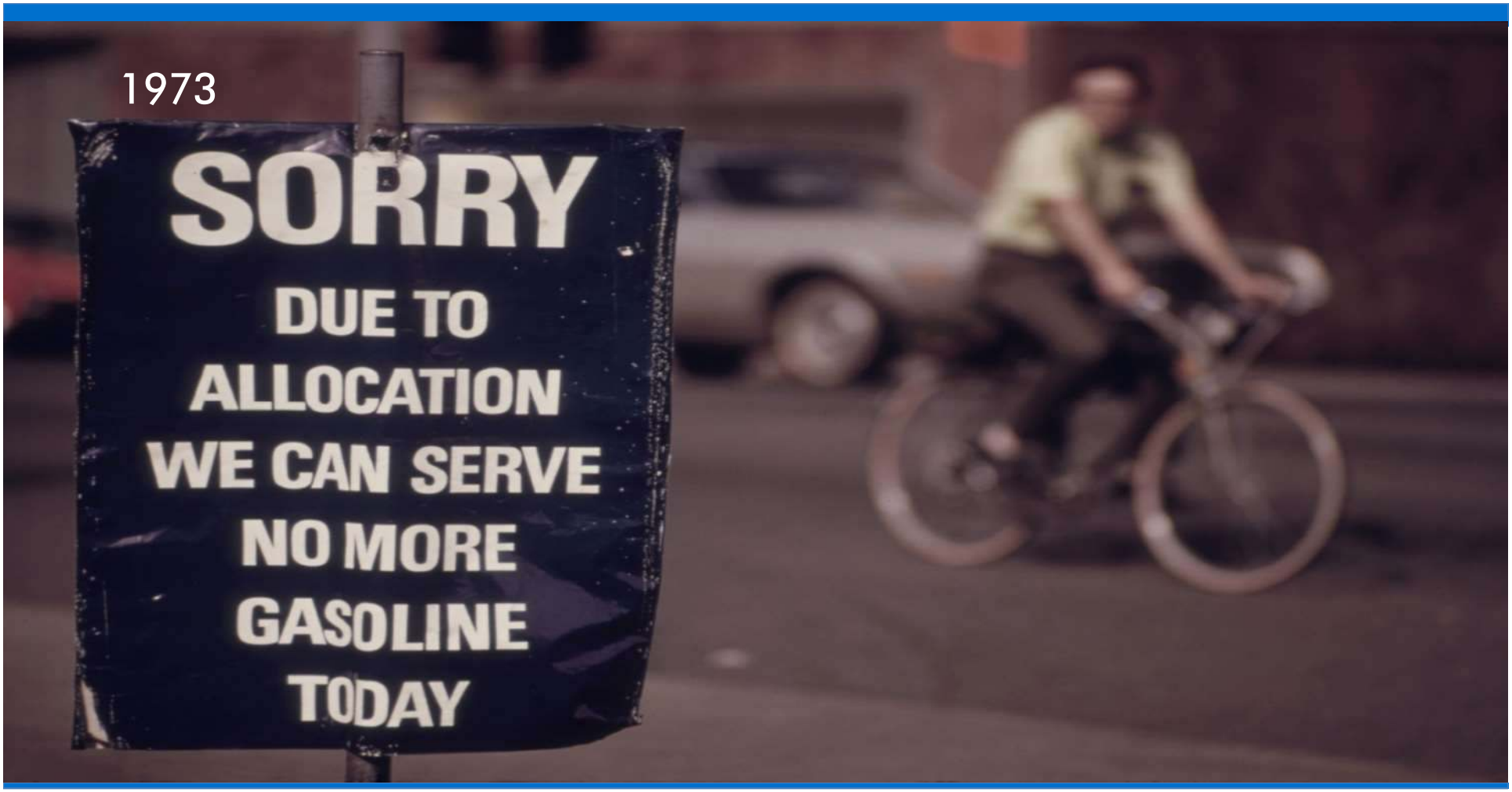
Ludwig Mies van der Rohe

The visionary architect proposed an all glass sealed building in the 1920's.

In the 1950's this become the new modernist style.

Features:

- Single-pane glass curtainwall systems
- Mechanically air conditioned, heated and ventilated
  - Some office buildings used heat from lights rather than install heating capacity in HVAC equipment
- Constant volume air handling equipment
- Often uncomfortable solar loads
- Expensive energy consumption


1973
SORRY
DUE TO
ALLOCATION
WE CAN SERVE
NO MORE
GASOLINE
TODAY


ASBESTOS
VOCs
TOBACCO SMOKE
MOLD
NITROGEN OXIDE
INDOOR AIR QUALITY
CARBO MONOX
STALE AIR
PARTICULATE MATTER
FORMALDEHYDE
RADON
CONDENSATION
BACTERIA

How To Find The Balance?

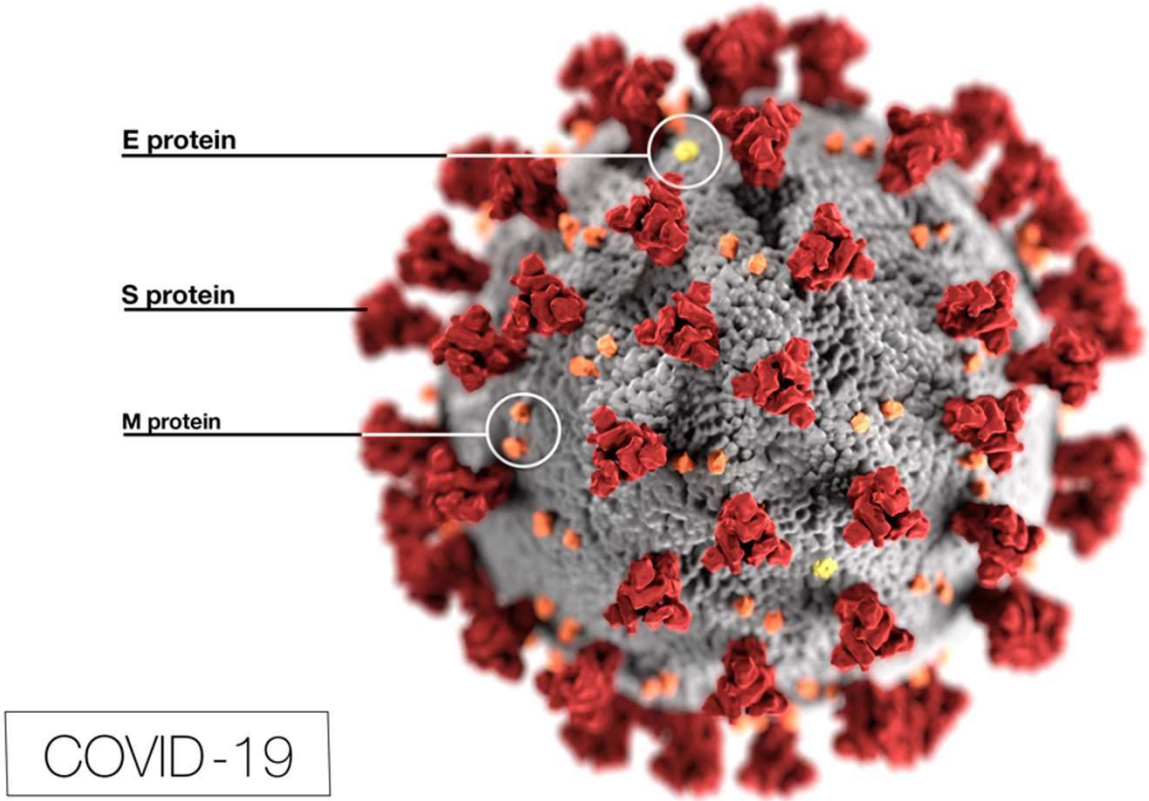
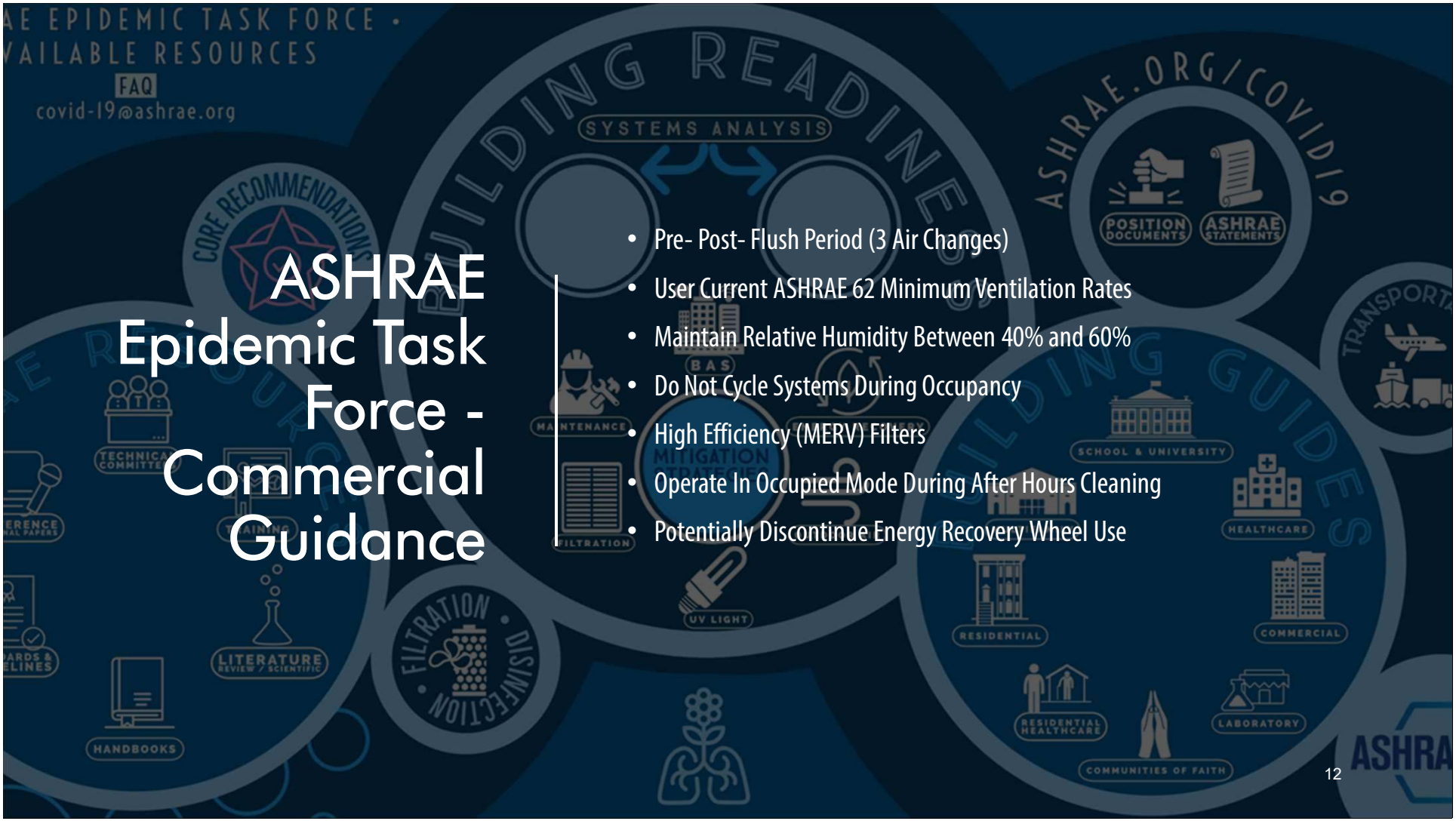


Image Source: Centers for Disease Control and Prevention


Pandemic Response



ASHRAE Epidemic Task Force - Commercial Guidance

- Pre- Post- Flush Period (3 Air Changes)
- User Current ASHRAE 62 Minimum Ventilation Rates
- Maintain Relative Humidity Between 40% and 60%
- Do Not Cycle Systems During Occupancy
- High Efficiency (MERV) Filters
- Operate In Occupied Mode During After Hours Cleaning
- Potentially Discontinue Energy Recovery Wheel Use

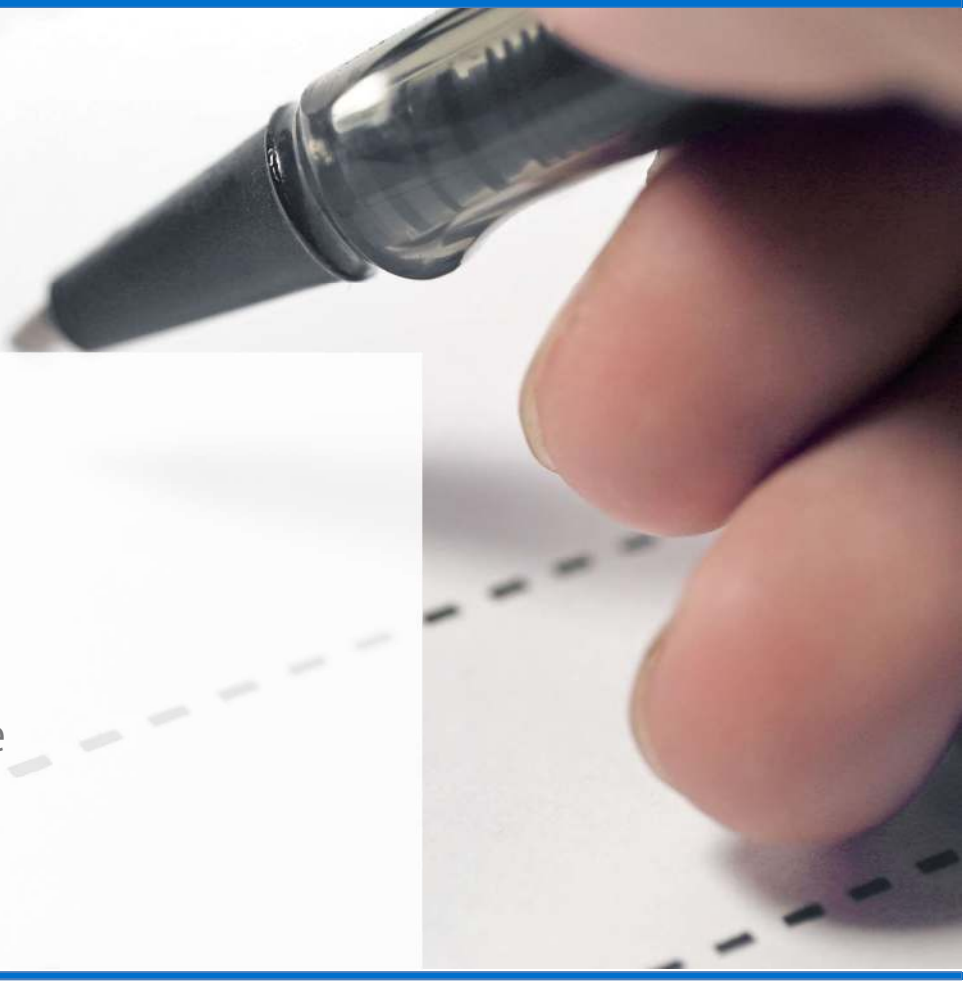
Energy Consumption for Reduced Demand Control Ventilation

- Building Design
  - 165,000 FT^2 Urban Office Building
  - 230,000 CFM Supply Air Flow
  - 36,500 CFM Code Minimum Ventilation Air (15%)

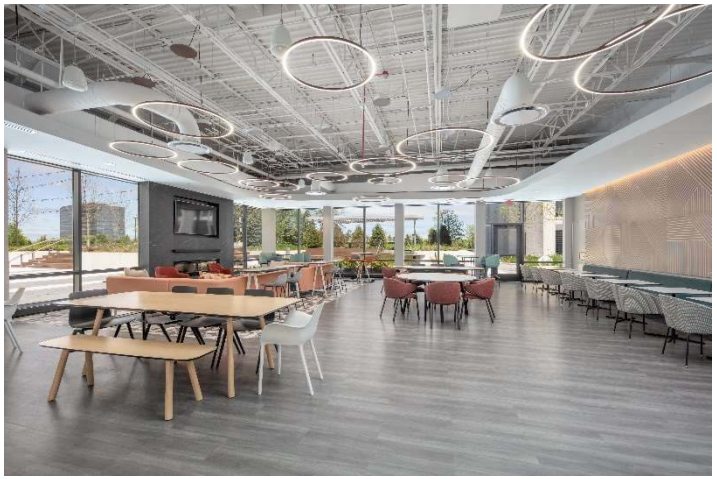
- Energy Impact of Demand Control Ventilation (DCV)
  - Normal Operation: Minimum Ventilation: 54.3 kBtu/FT^2/year
  - Maintain 1,000 PPM CO_2 or Less: 50.9 kBtu/FT^2/year
  - Maintain 800 PPM CO_2 or Less: 51.5 kBtu/FT^2/year
  - Maintain 600 PPM CO_2 or Less: 55.2 kBtu/FT^2/year

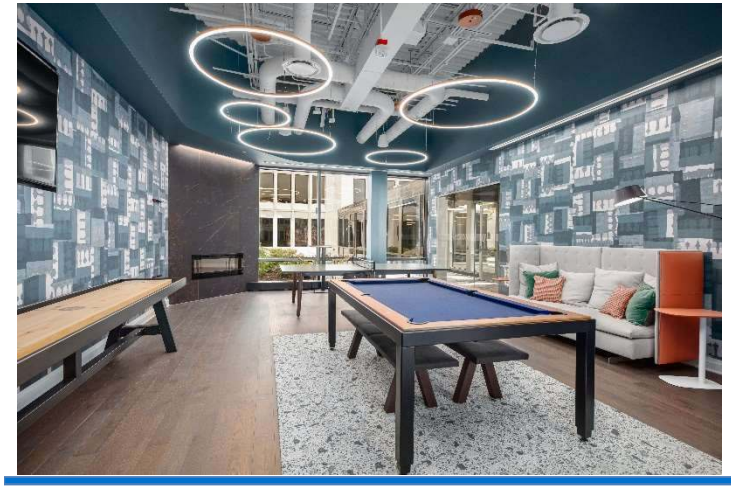
Outdoor Air Is 410 PPM in Chicago

Manage What You Measure



- Audits
  - CDC / ASHRAE Audit (Pandemic Response)
  - Risk Assessments
  - Indoor Air Quality Assessment
  - Checklists for Daily Rounds
- Pre- and Post- Occupancy Measurements
  - Handheld Sensors Provide Flexibility & Response
- Sensors & Monitoring
  - Through BAS
  - Analytic Systems

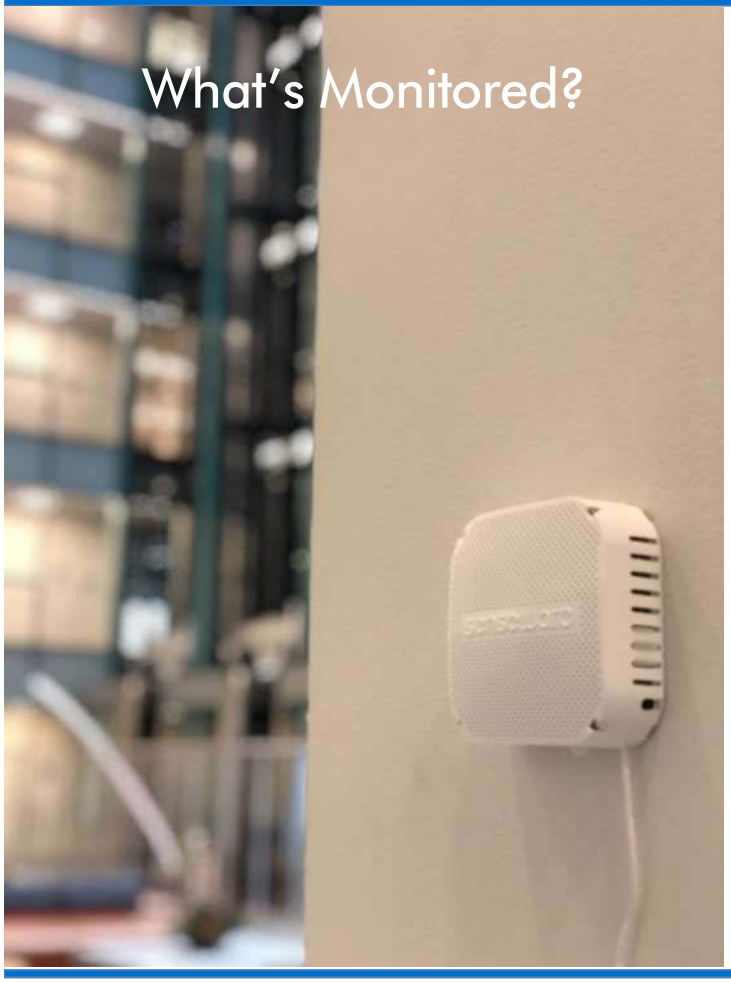




Building locations with sensors

- Lobbies
- Amenity Centers
- Fitness Centers
- Conference Centers
- Tenant Lounges
- Office Space
- Air Handling Unit Returns

What's Monitored?

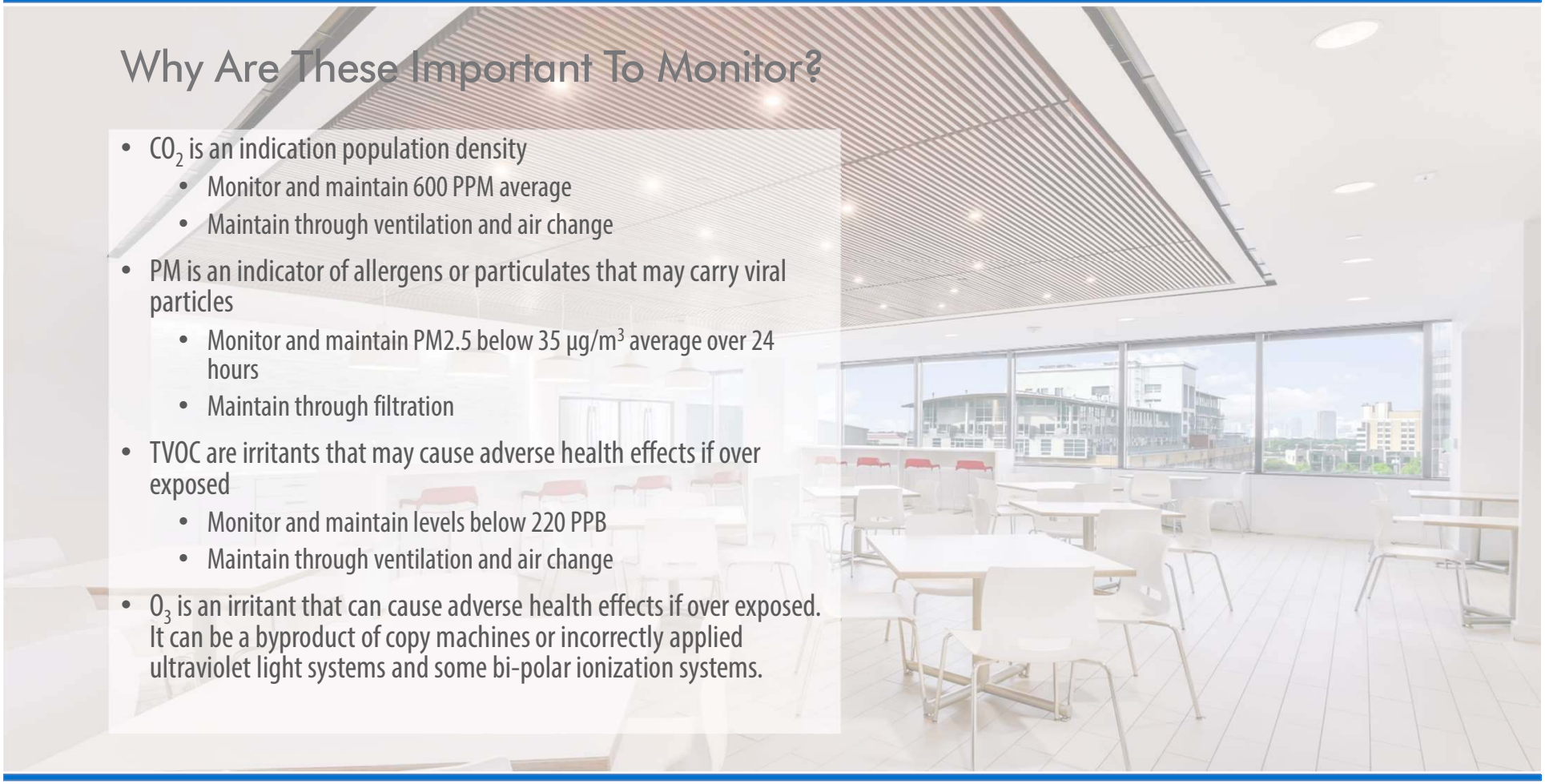


Each sensor tracks

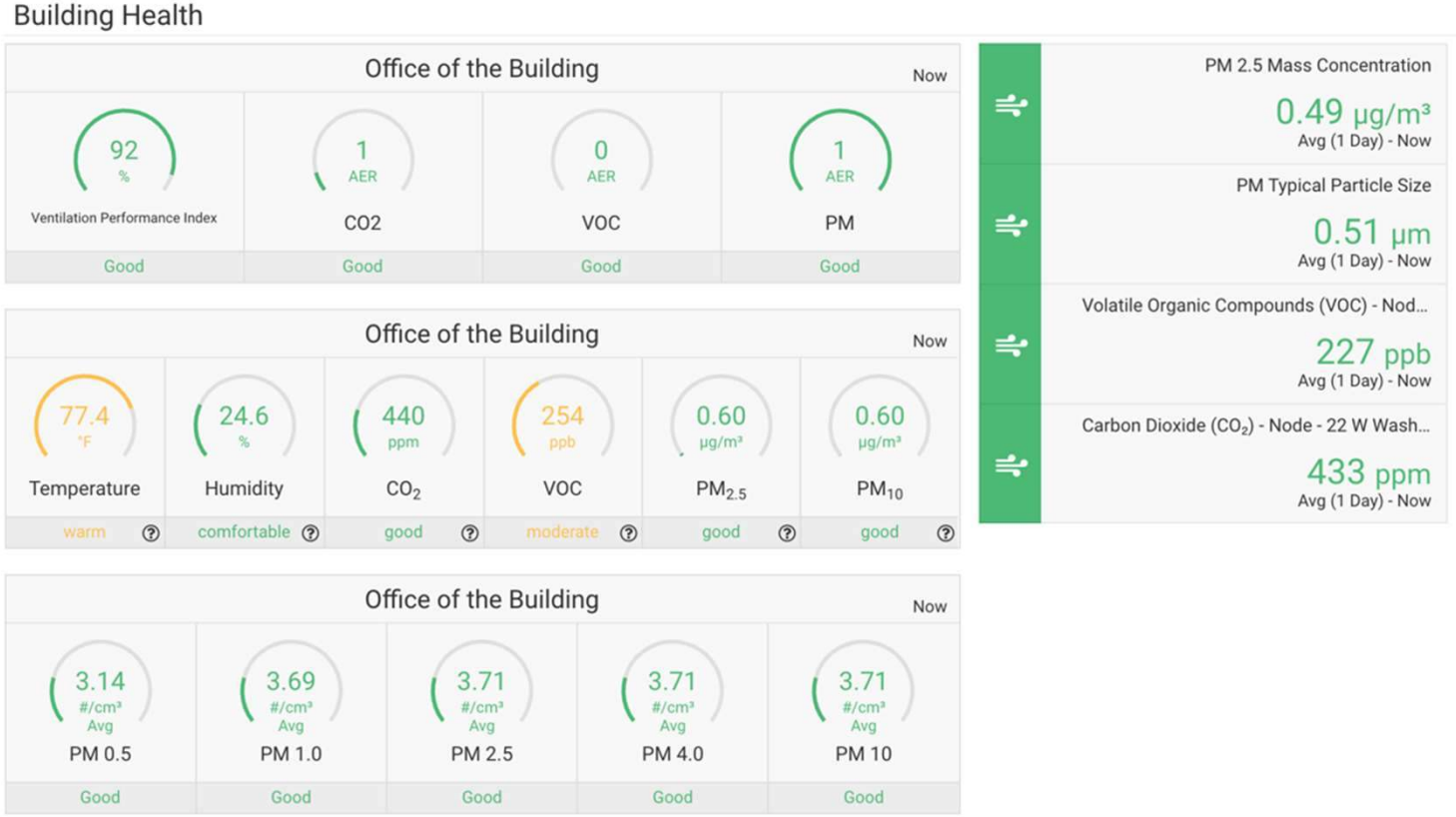
- Temperature & Relative Humidity
- Carbon Dioxide (CO_2)
- Total Volatile Organic Compounds (VOCs)
- Particulate Pollution (PM-1, 2.5, 4 & 10)
- Ozone (O_3)

Why Are These Important To Monitor?

- CO_2 is an indication population density
  - Monitor and maintain 600 PPM average
  - Maintain through ventilation and air change
- PM is an indicator of allergens or particulates that may carry viral particles
  - Monitor and maintain PM2.5 below 35 µg/m^3 average over 24 hours
  - Maintain through filtration
- TVOC are irritants that may cause adverse health effects if over exposed
  - Monitor and maintain levels below 220 PPB
  - Maintain through ventilation and air change
- O_3 is an irritant that can cause adverse health effects if over exposed. It can be a byproduct of copy machines or incorrectly applied ultraviolet light systems and some bi-polar ionization systems.



Indoor Air Quality Data Informs Operations




8600 LOBBY – Volatile Organic Compounds (VOC) – Warning
TVOC Spikes Due to Cleaning At Night
TVOC Spikes From Hand Sanitizer Station
(VOC)
350
300
250
200
150
100
50
0
7. May
8. May
9. May
10. May
11. May
12. May
13. May

Energy Consumption for Pre- / Post-Occupancy Purge Ventilation

- Building Design
  - 165,000 FT^2 Urban Office Building
  - 230,000 CFM Supply Air Flow
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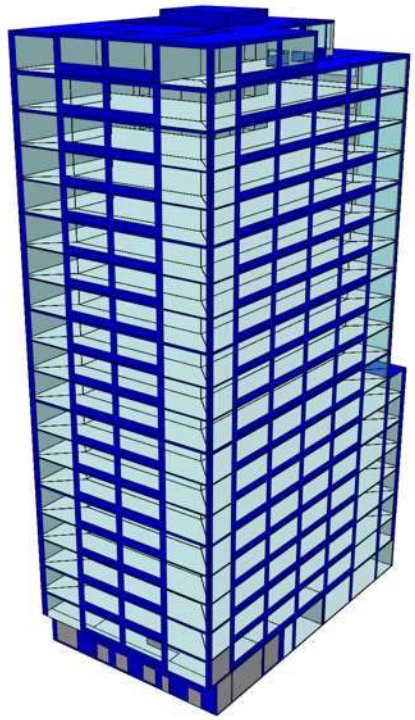
- Energy Impact of Purge Ventilation
  - Normal Operation: Minimum Ventilation: 54.3 $kBtu/FT^2$/year
  - 3 Air Changes Pre- / Post-Occupancy Purge: 65.7 $kBtu/FT^2$/year



21% increase annually

Resilience – Finding The Balance

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Your buildings, only better.