Managing Infection Risk for School Operations

Safe, healthy, inspiring learning environments

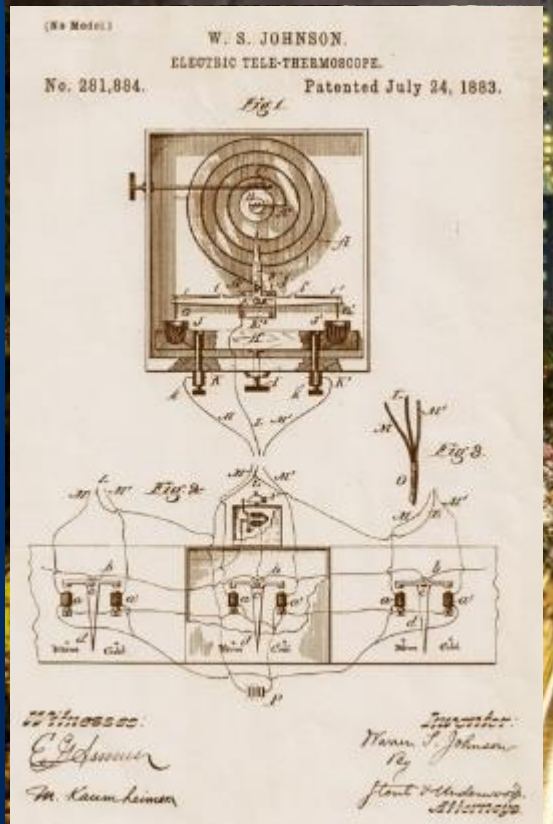
December 9, 2020

Johnson Controls

About Johnson Controls

Then:

In 1883 we pioneered AI in buildings when our founder, Professor Warren Johnson, invented the world's first intelligent thermostat.



W. S. JOHNSON.

ELECTRIC TELE-THERMOSCOPE.

No. 281,884. Patented July 24, 1883.

Fig. 1

Fig. 3.

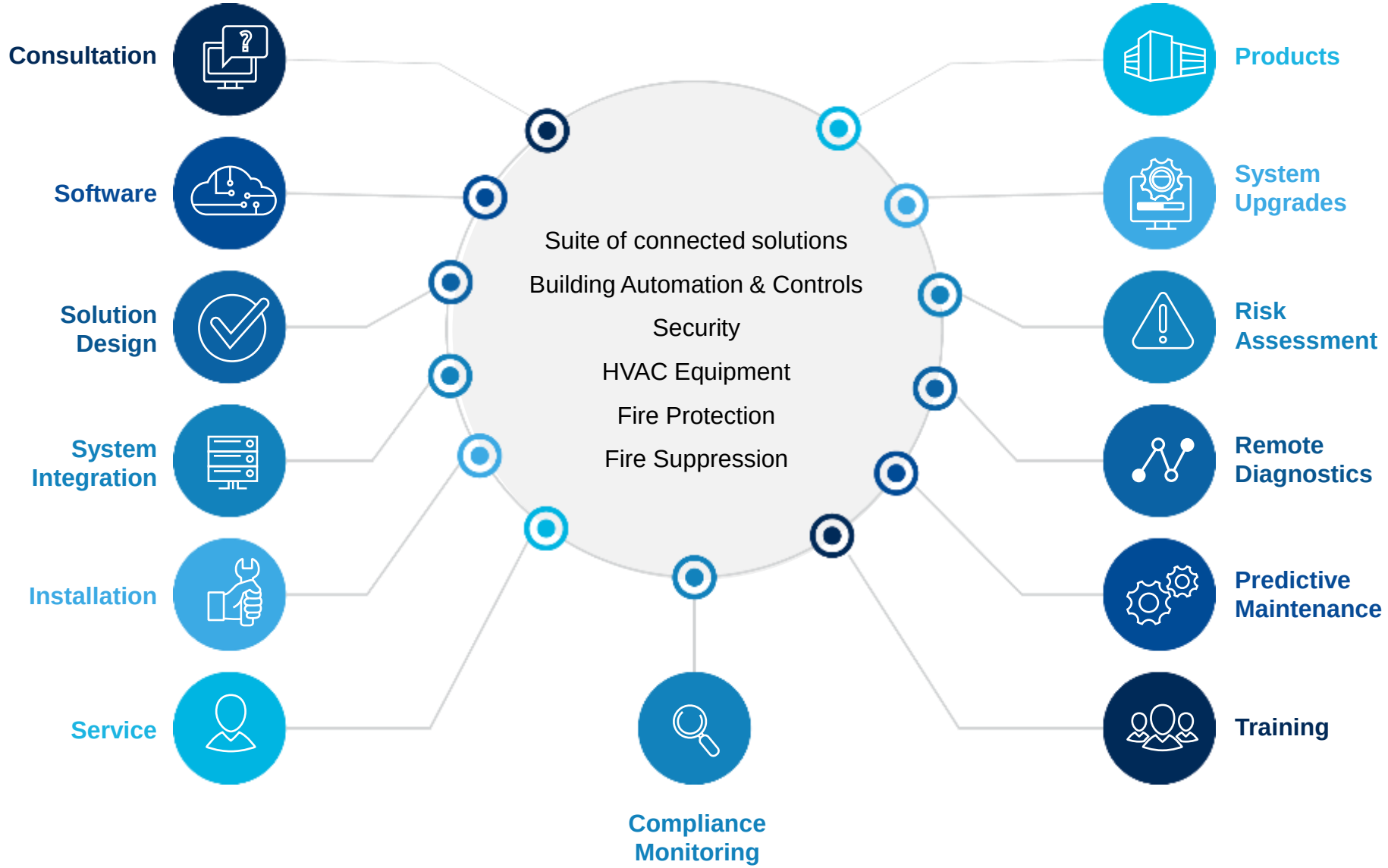
Now:

We're the largest pure play global powerhouse in intelligent buildings leading the charge with our broad portfolio of technologies.

Trusted leader in each of our solution categories

We have the world's largest portfolio of intelligent building products, technologies, software and services.

Johnson Controls named "Overall IoT Company of the Year" in 2020.



Understanding how infections spread in spaces is critical

Small droplets are likely to become aerosol and propagate beyond 6ft

…or enter the space's HVAC system

By breathing, sneezing, coughing, or talking, humans can generate infected airborne particles

These droplets can settle on surfaces…

…enter the respiratory tract of another person…

Source: Transmission of COVID-19 virus by droplets and aerosols: A critical review of the unresolved dichotomy https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7293495/#:~:text=In%20general%2C%20infected%20people%20spread,the%20size%20of%20the%20globs.

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Modes of Infection: Spread of COVID-19

Fomite Transmission
Touching infected surfaces

Strategies
- Handwashing
- "Touchless" solutions

Large Droplets
Quickly fall to surfaces/ ground

Strategies
- Masks
- Shields
- Physical Distancing

Aerosols
"Smoke filled room"

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

CDC 10/6/2020 update: Airborne transmission is infection spread through exposure to those virus-containing respiratory droplets comprised of smaller droplets and particles that can remain suspended in the air over long distances (usually greater than 6 feet) and time (typically hours). (https://www.cdc.gov/coronavirus/2019-ncov/more/scientific-brief-sars-cov-2.html)

The spread of viral infections within a space is a function of several factors, and each needs to be addressed to successfully mitigate spread.

1. # of infected individuals
2. # of susceptible individuals
3. Individuals' breathing rate
4. Exposure time
5. Type of virus
6. Clean air ventilation rate
7. Size of space

Source: HVAC filtration for controlling infectious airborne disease transmission in indoor environments: Predicting risk reductions and operational costs
Parham Azimi, Brent Stephens. Department of Civil, Architectural and Environmental Engineering, Illinois Institute of Technology, Alumni Memorial Hall 228, 3201 S Dearborn St., Chicago, IL 60616, USA

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Building a Defensive Fort:

What can be measured can be improved

Infection Control Approach to problem solving:

Maximum results for minimum effort

Keep infection out

Contain if it gets in

Clean

Building a Defensive Fort

Community Engagement

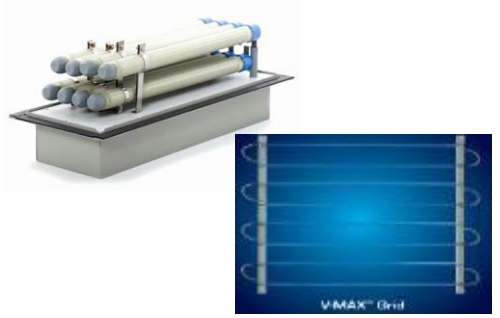
Isolation

Access Control

Contact Tracing

Ventilation

Filtration



Disinfection

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Key parameters in the Wells-Riley Equation

Building Operation

- Number of infectors
- Activity level
- Time in the space
- Mask Usage

Risk / Benefit of Occupancy

Clean air delivery

- Outdoor ventilation rate
- Filtration
- Disinfection

Opportunity for HVAC industry to respond

COVID-19 Science

- Infection rates
- Virus survivability
  - In Aerosols
  - On surfaces
- Expelled particle sizes

Adapt as new data is released

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Virologic Model as a basis

Wells-Riley Equation

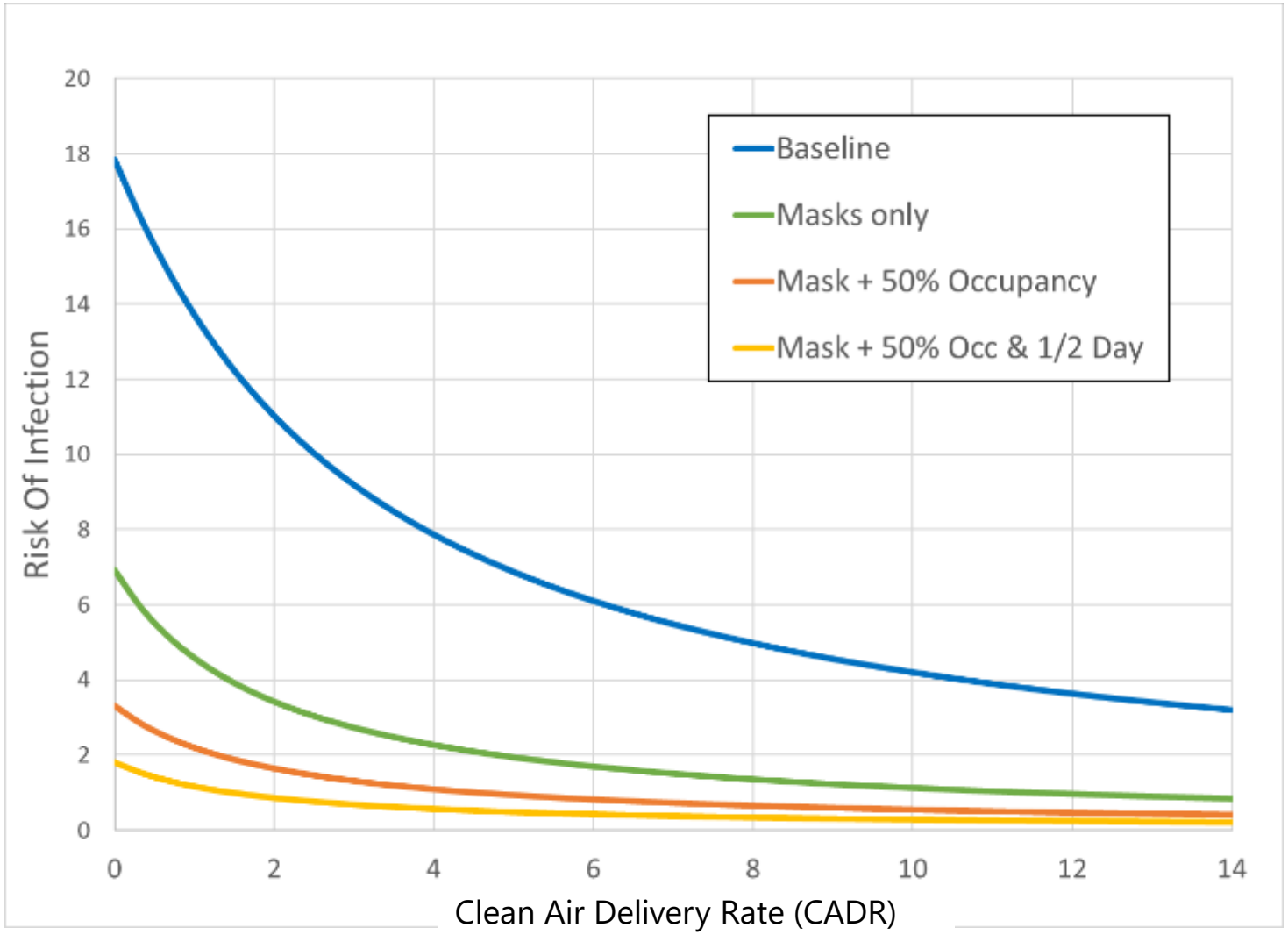
- Developed in 1978 – time tested
- Predicts the spread of infectious diseases
- Assumes steady state conditions/ well mixed air
- Quick
- Cost-effective
- Well-documented/scientifically recognized

Wells-Riley Equation

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

It has been widely used to predict the spread of measles, influenza, rhinovirus (common cold), as well as more recently, SARS and COVID−19

Impact of Behaviors + Building Operations on Infection Risk

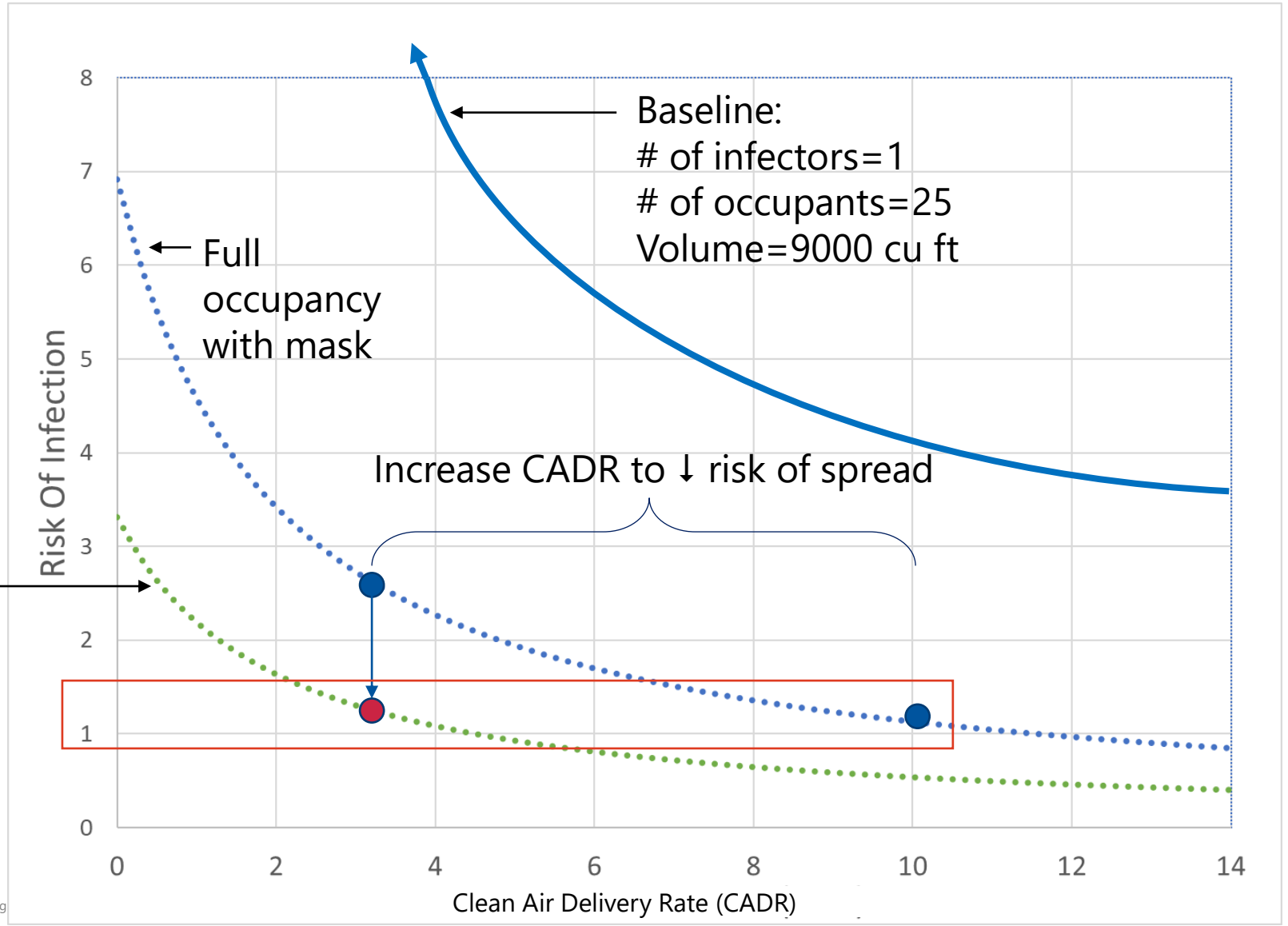


Building Operation

- Number of infectors = 1
- Number of Occupants = 25
- Time in the space = 7 hours
- Volume = 9000 cu ft

Impact of Behaviors + Building Operations on Infection Risk

- ✓ With masks
- ✓ 50% occupancy
- ✓ ½ days



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What can be measured can be improved

1. Collect data:
   - Building infection parameters
   - HVAC operating parameter
2. Review current infection risk
3. Establish infection risk goal
4. Implement solutions to meet infection risk goals
5. Monitor for continued Clean Air Delivery Rate (CADR) to ensure goals are met

https://www.johnsoncontrols.com/openblue/openblue-clean-air

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Applying the Solutions

Designed to defer, identify, prevent, and maintain safe & healthy learning spaces & places

Classrooms

- Disinfectant Lighting
- Fresh Air Solutions

- Vape Sensors
- Disinfectant Lighting
- Touchless fixtures

Bathrooms

School Nurse's Office

- Airborne Infection Isolation Room Solutions
- Disinfectant Lighting

Entryways and Front Office

- UV Sanitizing Gates

- Elevated Skin Temp Sensors

- Frictionless Weapons Detection

- Mass Notification

- Security Alerts on Contact Tracing

Mechanical Systems

- Filtration
- Humidification
- Fresh Air solutions
- UVGI systems
- JCI Enterprise Management
- Remote Services

Kitchen & Cafeteria

- UVGI Systems

- Cleansing Troffer

Mechanisms for Districts to consider during lean times

Tax-Exempt Lease Purchase

The least expensive form of financing offered to K12 School Districts

- Spread out the cost of the project over its useful life
- Utilize Opex vs. Capex funding
- Defer the first payment up to 12 months to allow time for Districts to access other sources (grants, stimulus money)

Performance Contract

A finance model that guarantees energy savings through energy- and operationally-efficient retrofits

- No new money needed to make payments
- Take advantage of scale by bundling measures that reduce Opex spend
- Financed up to 25 years depending on statute

Design, Build, Finance, Operate, Maintain (DBFOM)

An alternative delivery method for new facilities and large renovations that transfer the risk of design, construction, finance and operations to the private sector

- Guaranteed service levels and fixed cost of occupancy
- Improves cost-effectiveness via private sector innovation, experience, flexibility and access to resources

Infrastructure as a Service

Improvements paid for over time as benefits are received. Funding partner holds the assets

- No upfront capital investment
- Equipment can be purchased at end of contract for FMV or renew contract
- Payments can vary based upon the benefits received and agreed-upon terms

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OpenBlue Clean Air Success Story: School Reopening

A school serving over 800 students and 100 teachers required a reopening strategy to resume in-person classes. Along with implementing other CDC recommendations, the school consulted with their local Johnson Controls branch, their partner for over 20 years, on how they could update their HVAC system to meet current CDC and ASHRAE guidelines.

After analyzing the school's most occupied spaces and current airflow system, Johnson Controls installed UV-C lighting troffers to replace the standard 2x4 light fixtures to filter and disinfect air. The troffers are able to capture up to 99.97% of airborne pathogens as small as 0.3 µ.

To efficiently add more air changes per hour to spaces, standalone portable HEPA units were installed. The increased amount of air changes help to dilute and mitigate the spread of airborne pathogens. Johnson Controls' portable HEPA filters also have the lowest decibel levels in the industry making it uniquely suited for the education sector, so teachers and students can feel at ease and focus on learning.

Questions

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