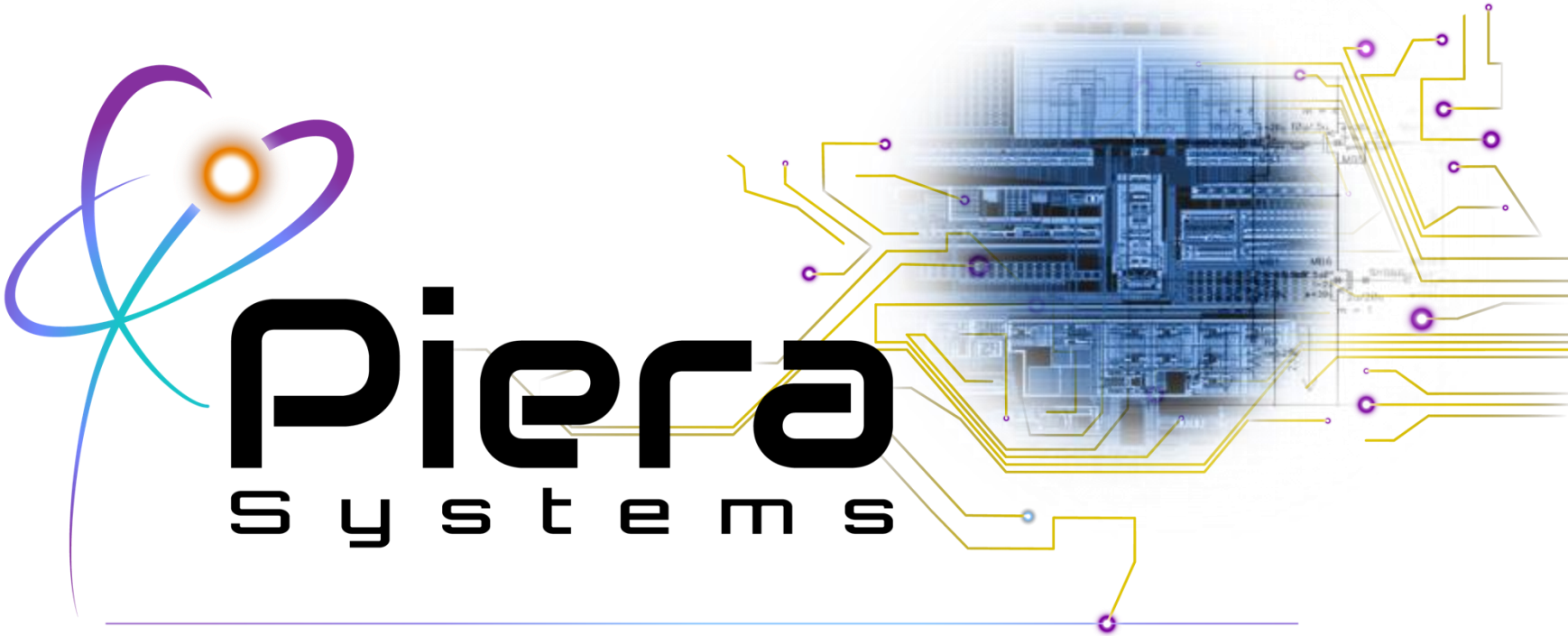


What's in your Air?

Why is Particulate Air Pollution Important?

It is Pervasive

It is Deadly

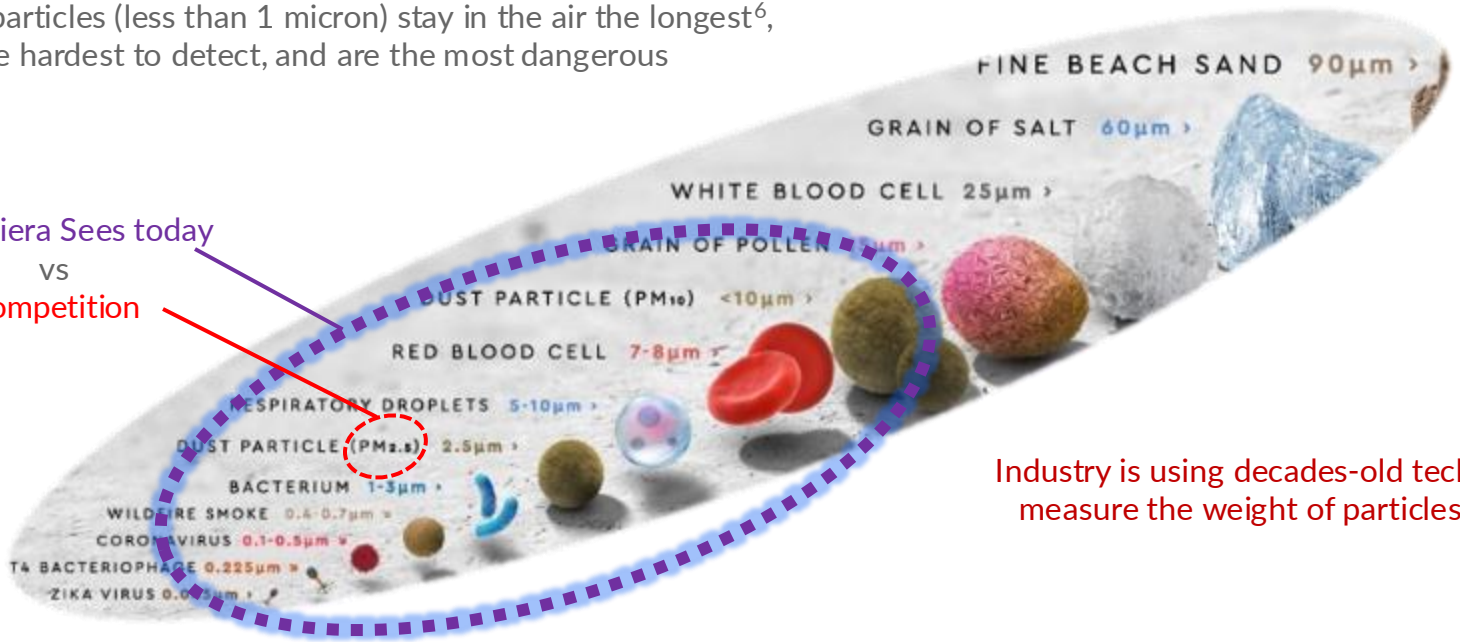
We Don’t Measure What Harms Us

The Problem

Air Quality most impacted by the smallest particles
There has not been a cost-effective solution to detect them

Smallest particles (less than 1 micron) stay in the air the longest[6], are hardest to detect, and are the most dangerous

What Piera Sees today
vs
Competition



Industry is using decades-old technology to measure the weight of particles (PM2.5)

Piera Systems

The Current State of Particulate Air Pollution Measurement

The Gold Standard: Scientific Measurement

$20k-$100k

Reports Particle Count, Size

0.1 ——— 10.0 microns

How 99.99% of measurements are made

Low-Cost PM Sensors

Estimated Particle Mass PM2.5

EPA: “No sensor measures mass concentration, they are all estimates”

The Result: Particulate Air Pollution goes unmeasured and undetected

Piera Systems

Break-through Air Monitoring Technology

World's only low-cost sensor comparable to a reference instrument

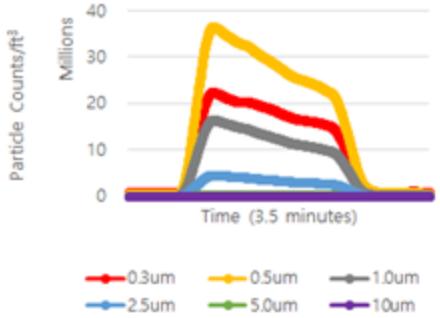
0.1 ——— 10.0 microns

IPS PM Sensors

Canāree Air Monitors
(PM, CO2, TVOC, T, H)

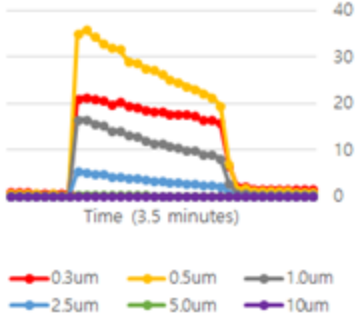
< $90

Piera



$22,000

Grimm 11D

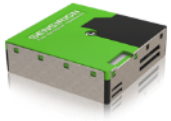


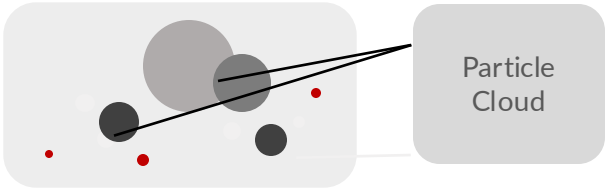
Independent particle count data a must for classification of pollutants, improving human health, and to meet ASHRAE241 IAQ Standard

Differentiated Technology: Mass & Particle Count

Competition

Sensirion



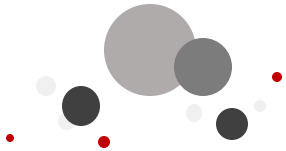


Estimates PM2.5
Green, Yellow, Red

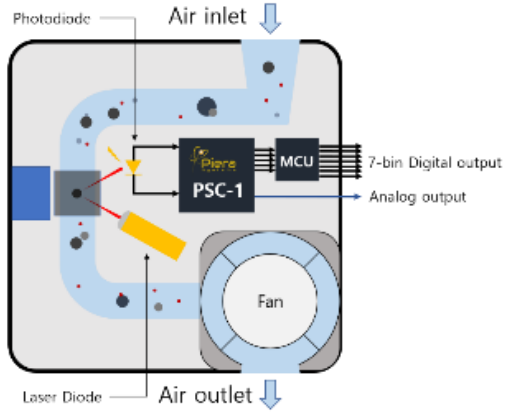
Sub-micron particles not detected

No Pollutant Sources

Piera



Photon-Counting



PSC-1: Particle Size, count in 7 unique bins
(0.1, 0.3, 0.5. 1.0, 2.5, 5.0 10 microns)

4 bins <1.0 micron

ISO 21501-4 certification available

Custom ASIC Data Identifies Pollutant Sources

Piera Systems

The Solution

Revolutionary technology identifies ‘What’s In the Air’ to provide actionable insights and reduce energy costs

0.1 ——— 10.0 microns

Particle Sensors, Air Quality Monitors

Air quality data aggregated in the cloud

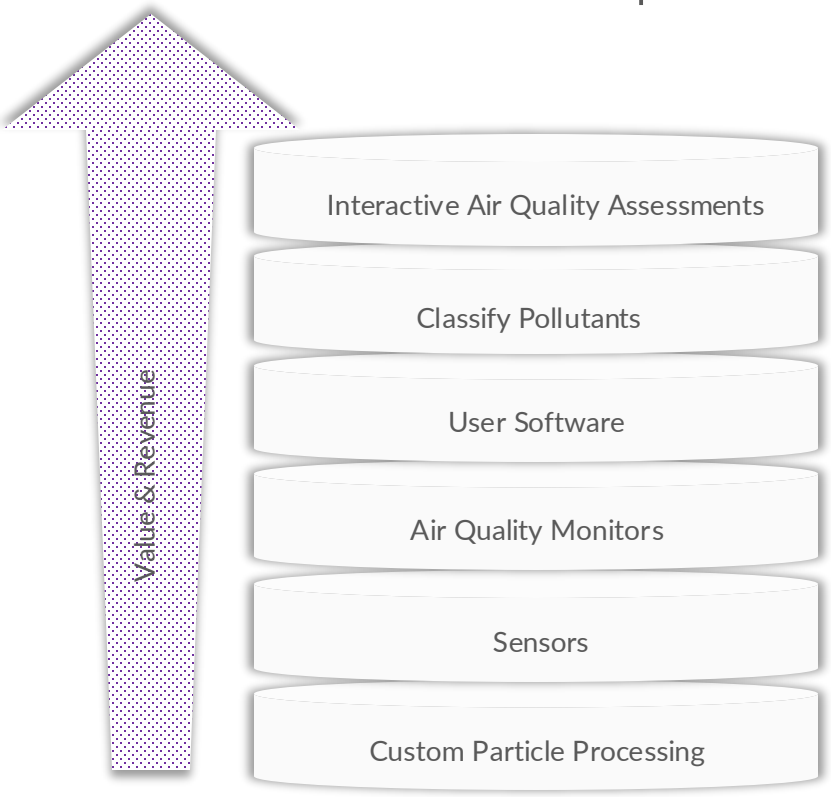
Software and services provide real-time alerts, insights, mitigation

AI/ML models classify pollutants for smart, healthy spaces

Accurately measure particles as unique signatures,
identify pollutants at a scalable price, monitor compliance to ASHRAE 241

Piera Systems

The Competition



	Piera Systems	Sensor Companies		AQM Companies	
		PLANTOWER 攀藤科技	SENSIRION	a	kaiterra / Carrier / IQAir
Interactive Air Quality Assessments	✓				
Classify Pollutants	✓				
User Software	✓			✓	
Air Quality Monitors	✓			✓	
Sensors	✓	✓		✗	
Custom Particle Processing	✓	✗			

Piera Systems

Products and Services

IPS Particle Sensors

- Integration into air quality monitors, air purifiers, and HVAC equipment

Canāree Air Quality Monitors

- Easy to deploy in Smart Spaces, Hospitals, Schools, and other verticals
- Wireless Access Points (HPE/Aruba)

SenseiAQ Software and Services

- Air quality monitoring subscription service
- Data and insights from SenseiAQ software
- Stand-alone application or connected to Piera MS Azure Cloud
- API for integration with third party applications
- Software updates

Pollutant Models

- Licensable, subscription service provided by Piera
- Customer developed in partnership with Piera
- OTA updates

IPS: A Software Defined Sensor Family

IPS Family			Eval	Series 5			Series 7
			PEK	Piera-525	Piera-5100	Piera-5500	Piera-7100
# of Particle Bins			7	5	5	5	7
Dynamic Range	Binning Output in PC and PM	<0.1	X*	X			X
		0.3	X	X			X
		0.5	X	X	X		X
		1.0	X	X	X	X	X
		2.5	X	X	X	X	X
		5.0	X		X	X	X
		10	X		X	X	X
Features	Output in Particle Counts		X	X	X	X	X
	Serial Key for Networking		X	X	X	X	X
	Firmware Upload Capability		X	X	X	X	X
	Limited Programmability		X		X	X	X

Piera Systems

Canāree Family of Indoor Air Quality Monitors

Canāree A1	Canāree I1	Canāree I5
Plug-n-Play Air Quality Monitor Measure particulates from PCs, mobile devices, and wireless access points USB powered Weight 42g	**Standalone Air Quality Monitor** Monitor particulates anywhere using WiFi, bluetooth, or ethernet & all features of A1 USB or external power Weight 42g	**Comprehensive Environmental Monitor** All features of I1 & temperature, pressure, humidity, & TVOCs USB or external power Weight 50g

Measure across entire PM range – PM0.1 to PM10
Built-in Vape/Smoke Detection
Fully integrated with the cloud. Intuitive UI included
Seamless integrations to BMS / BAS solutions
Dimensions: 8.98cm x 6.13cm x 2.06cm
Covers 100m^2, 1,000ft^2

Piera Systems

Canāree IX6

Configurable Indoor Air Quality Monitor with Vape/Smoke+Noise Detection

Accessories

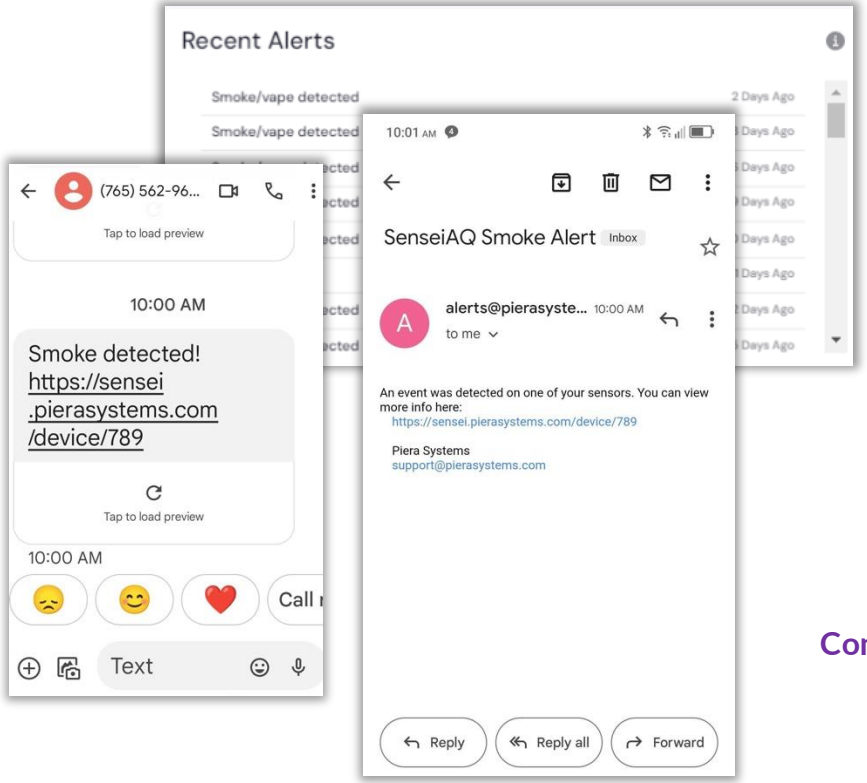
Features

- AI/ML based pollutant classification, indoor environment monitoring
- Patented particulate sensor IPS-7100 + T, RH, TVOC, Pressure, Sound
- Customizable with additional sensors (CO_2, CO, NO_2, NH_3, SO_2, O_2, O_3)
- Supports wireless, wired, BT communication
- OTA firmware updates
- Built-in VSD (Vape/Smoke Detection) module
- Intelligent air quality and health risk indexes
- High accuracy and reliability (8-yr Life)
- LED air quality status indicator
- Response Time 10 Seconds
- Real-Time Measurements (5 sample/second, second by second data)
- POE, USB Power, Battery Backup, SD local storage
- Size 12.7 cm D, 3.8 cm H, W 200g

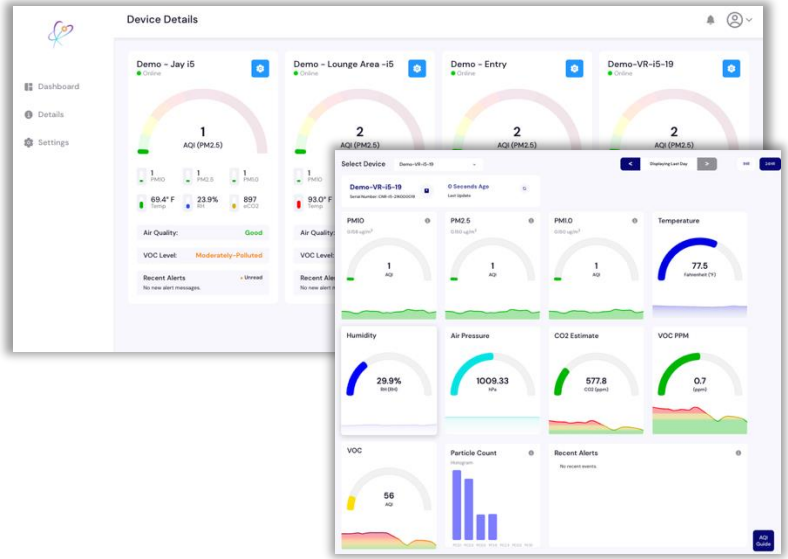
Piera Systems

Actionable Data and Alerts

Real-time text / email alerts and alert logs



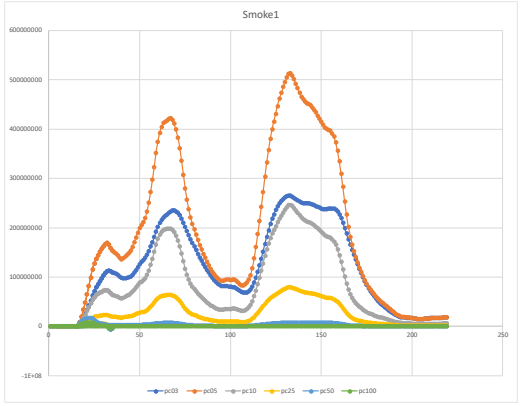
SenseiAQ Software and Dashboard



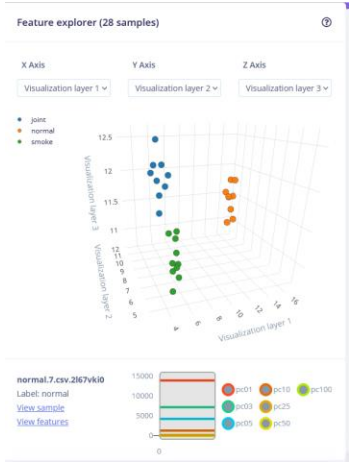
Comprehensive environmental data delivers healthy, energy efficient indoor spaces

Piera Systems

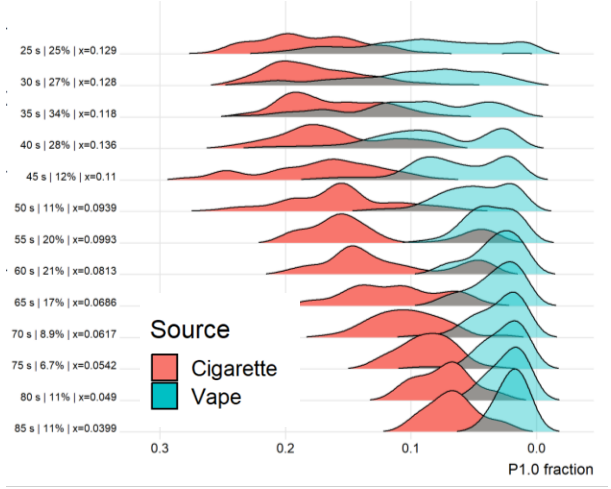
Detecting Vape, Smoke



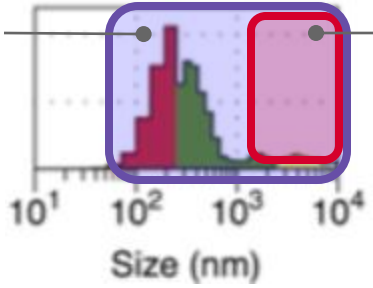
Classification requires accurate particle count and size data, from multiple ‘bins’, over time



ML/AI Model for Vape, Tobacco Smoke and Good Air



Time-Evolution of Size Fraction by Source [~5s intervals]



Only Piera can measure PM0.1-1.0 with 7 distinct particle sizes
Competition cannot classify particles

Why Does This Change The World?

The World Can Afford to Monitor All Sizes of Particulate Air Pollution

Everywhere, Anywhere

This Gives us Information to Protect Human Health

“If You Don’t Measure It, You Can’t Fix It”

Piera Systems

Diverse Markets & Applications

Healthy Bldgs

Vape/Smoke, Schools

Industrial

Outdoors

Energy Efficiency

Healthcare

Reduce Virus Transmission Indoors

Challenge

Reduce Covid-19 Transmission Indoors by up to 90 %[1]

Aerosol Transmission highest PC 0.3-1.0 um

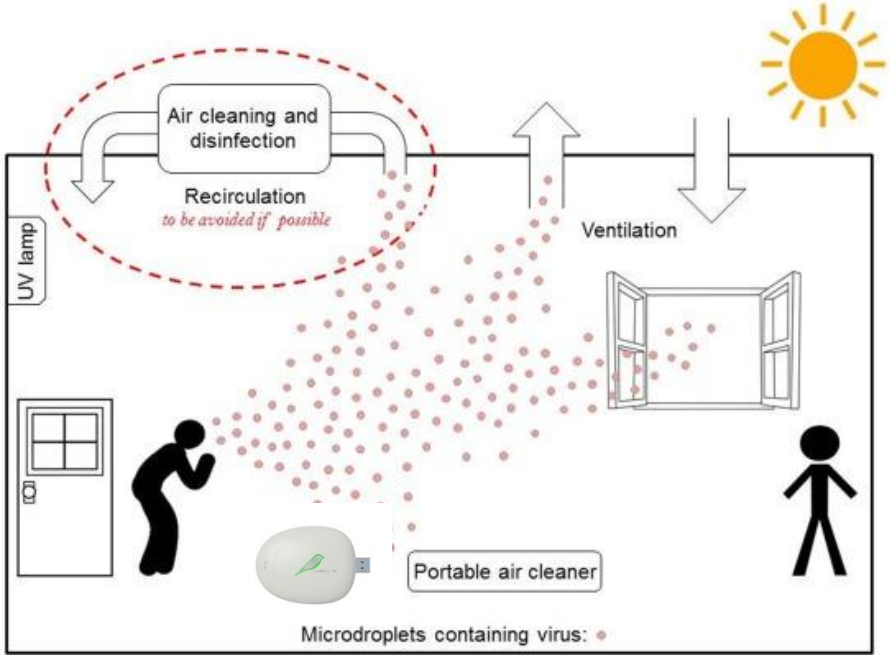
Monitor effectiveness of Mitigation Steps

Solution

5 or more Effective Air Changes based on Occupancy

Only Piera accurately detects ‘aerosol’ Particles <1.0 um

Accurate at all levels of concentration



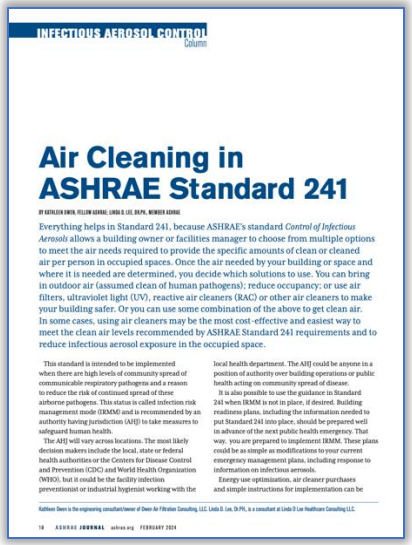
Real-time monitoring detects elevated particulate levels, mitigation effectiveness, reduces energy use by 10-20%

To reduce Virus transmission, you need Piera

1 - CDC, ASHRAE 241 Standard

ASHRAE, CDC, EPA IAQ Standards

Require measuring PC <1.0 um in real-time


INFECTIOUS AEROSOL CONTROL Column

Air Cleaning in ASHRAE Standard 241

BY KATHLEEN OWEN, FELLOW ASHRAE; LINDA D. LEE, DR.PH., MEMBER ASHRAE

Everything helps in Standard 241, because ASHRAE's standard *Control of Infectious Aerosols* allows a building owner or facilities manager to choose from multiple options to meet the air needs required to provide the specific amounts of clean or cleaned air per person in occupied spaces. Once the air needed by your building or space and where it is needed are determined, you decide which solutions to use. You can bring in outdoor air (assumed clean of human pathogens); reduce occupancy; or use air filters, ultraviolet light (UV), reactive air cleaners (RAC) or other air cleaners to make your building safer. Or you can use some combination of the above to get clean air. In some cases, using air cleaners may be the most cost-effective and easiest way to meet the clean air levels recommended by ASHRAE Standard 241 requirements and to reduce infectious aerosol exposure in the occupied space.

This standard is intended to be implemented when there are high levels of community spread of communicable respiratory pathogens and a reason to reduce the risk of continued spread of these airborne pathogens. This status is called infection risk management mode (IRMM) and is recommended by an authority having jurisdiction (AHJ) to take measures to safeguard human health.

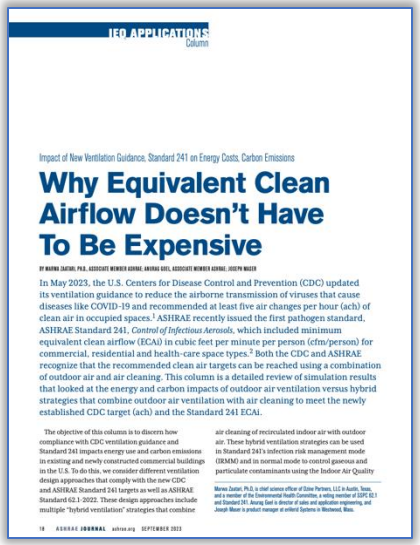
The AHJ will vary across locations. The most likely decision makers include the local, state or federal health authorities or the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO), but it could be the facility infection preventionist or industrial hygienist working with the local health department. The AHJ could be anyone in a position of authority over building operations or public health acting on community spread of disease.

It is also possible to use the guidance in Standard 241 when IRMM is not in place, if desired. Building readiness plans, including the information needed to put Standard 241 into place, should be prepared well in advance of the next public health emergency. That way, you are prepared to implement IRMM. These plans could be as simple as modifications to your current emergency management plans, including response to information on infectious aerosols.

Energy use optimization, air cleaner purchases and simple instructions for implementation can be

Kathleen Owen is the engineering consultant/owner of Owen Air Filtration Consulting, LLC. Linda D. Lee, Dr.PH., is a consultant at Linda D Lee Healthcare Consulting LLC.

18 ASHRAE JOURNAL ashrae.org FEBRUARY 2024


IEQ APPLICATIONS Column

Impact of New Ventilation Guidance, Standard 241 on Energy Costs, Carbon Emissions

Why Equivalent Clean Airflow Doesn't Have To Be Expensive

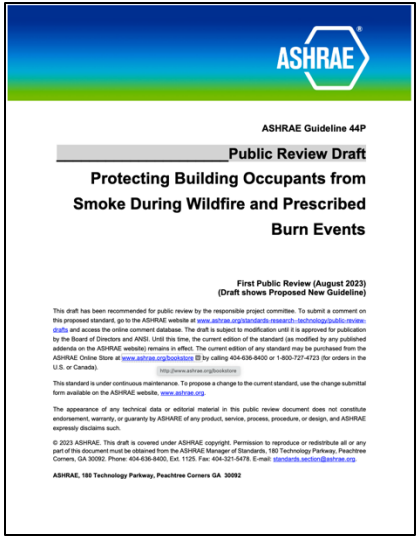
BY MARWA ZAITARI, PH.D., ASSOCIATE MEMBER ASHRAE; ANURAG GOEL, ASSOCIATE MEMBER ASHRAE; JOSEPH MAIER

In May 2023, the U.S. Centers for Disease Control and Prevention (CDC) updated its ventilation guidance to reduce the airborne transmission of viruses that cause diseases like COVID-19 and recommended at least five air changes per hour (ach) of clean air in occupied spaces.[1] ASHRAE recently issued the first pathogen standard, ASHRAE Standard 241, *Control of Infectious Aerosols*, which included minimum equivalent clean airflow (ECAI) in cubic feet per minute per person (cfm/person) for commercial, residential and health-care space types.[2] Both the CDC and ASHRAE recognize that the recommended clean air targets can be reached using a combination of outdoor air and air cleaning. This column is a detailed review of simulation results that looked at the energy and carbon impacts of outdoor air ventilation versus hybrid strategies that combine outdoor air ventilation with air cleaning to meet the newly established CDC target (ach) and the Standard 241 ECAI.

The objective of this column is to discern how compliance with CDC ventilation guidance and Standard 241 impacts energy use and carbon emissions in existing and newly constructed commercial buildings in the U.S. To do this, we consider different ventilation design approaches that comply with the new CDC and ASHRAE Standard 241 targets as well as ASHRAE Standard 62.1-2022. These design approaches include multiple "hybrid ventilation" strategies that combine air cleaning of recirculated indoor air with outdoor air. These hybrid ventilation strategies can be used in Standard 241's infection risk management mode (IRMM) and in normal mode to control gaseous and particulate contaminants using the Indoor Air Quality

Marwa Zaitari, Ph.D, is chief science officer of Ozone Partners, LLC in Austin, Texas, and a member of the Environmental Health Committee, a voting member of SSPC 62.1 and Standard 241. Anurag Goel is director of sales and application engineering, and Joseph Maier is product manager at enVerid Systems in Westwood, Mass.

18 ASHRAE JOURNAL ashrae.org SEPTEMBER 2023


ASHRAE

ASHRAE Guideline 44P

Public Review Draft

Protecting Building Occupants from Smoke During Wildfire and Prescribed Burn Events

First Public Review (August 2023)
(Draft shows Proposed New Guideline)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

This standard is under continuous maintenance. To propose a change to the current standard, use the change submittal form available on the ASHRAE website, www.ashrae.org.

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ASHRAE, 180 Technology Parkway, Peachtree Corners GA 30092


EPA is cracking down on deadly air pollution with a new rule – but it's not strong enough, some experts say

By Ella Nilsen and Jen Christensen, CNN
5 minute read · Published 8:00 AM EST, Wed February 7, 2024

Emissions from a smoke stack at the Essex County Resource Recovery Waste-to-Energy Facility in Newark, New Jersey, on January 21. Gary Hershorn/Corbis News/Getty Images

Piera Systems

Vape/Smoke Detection

Deployed in Schools, Hospitality Spaces

Canāree iX6 Vape Detector

Enforce vaping/smoking bans, Reduce **cleaning costs, Ensure healthy spaces**

BIG DEAL – Piera Vape Detector chosen by Ontario, CN Schools
Up to $3.0M/year for 3 years

Supply Ontario

Piera Systems

Silica Dust from Mining, Construction is the new Asbestos

The UK reduced daily exposure limits by half

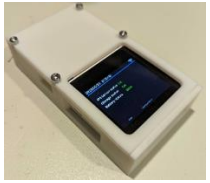
The US Has done the same

Solution requires wearable monitors to report exposure levels

Piera has been selected by Trolex and Hilti

TROLEX

IPS Inside

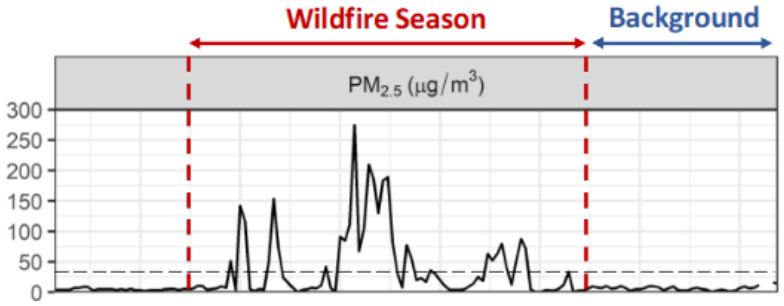


HILTI

Piera Systems

Protect Building Occupants during Wildfire Events

Focus on Fine Particulate Matter (<PM2.5),
establish background levels before wildfires arrive

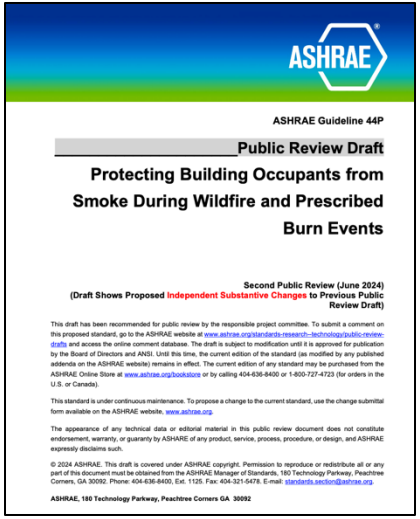


-- NAAQS value

PM2.5 Should be as Low as Reasonably Achievable (WHO <15 ug)

"Low-cost $PM_{2.5}$ sensors are increasing in availability so are highly recommended to be considered in new designs or added to existing buildings where practical. These sensors can act as one of the indicators of the effectiveness of any adaptations or design features of the HVAC system to reduce the impact of smoke on IAQ. They can also give information on when to trigger the **Smoke Readiness Plan**. In addition to measuring $PM_{2.5}$, some instruments include additional sensors such as for CO, CO_2, relative humidity (RH), or temperature"

Canāree AQM


ASHRAE

ASHRAE Guideline 44P

Public Review Draft

Protecting Building Occupants from Smoke During Wildfire and Prescribed Burn Events

Second Public Review (June 2024)
(Draft Shows Proposed Independent Substantive Changes to Previous Public Review Draft)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

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- WF Smoke loads filters faster – PM1
- ASHRAE 241 testing measures removal
- Portable Air Cleaners, filters
- Building Automation Systems
- Outdoor Infiltration – Airnow.gov

Indoor Spaces

Optimize Energy, Health, Occupancy, Usage

- Monitor — accurately measure the air quality
- Inform — derive insights, identify pollutant sources
- Mitigate — energy-efficient methods to clean the air

Install Monitors, collect data before investing in mitigation and committing to Sustainability or ROI goals

Piera Systems

The Team

Vin Ratford
CEO

A seasoned high technology executive experienced in sales, marketing, R&D, Vin has helped Entrepreneurs create businesses based on new technology in Semiconductors, Embedded Vision and Machine Learning/AI at Auviz Systems, Xilinx, AccelChip, Virage Logic, Mentor Graphics, Teradyne, Data General, Raytheon. BSEE from Northeastern University

Aaron Soh
Founder & CTO

Aaron developed the core ASIC technology, photon-counting particle sensing IC, which serves as the foundation of Piera Systems. A serial entrepreneur with 10+ years of analog circuit design and project management experience. He has specialized in solid state, and optical physics with 20+ patents and published papers regarding x-ray imaging data readout ASICs at IEEE Nuclear Science Symposium and Medical Imaging Conference. B.Sc in Physics and Statistics at University of Toronto.

Andy Soh
Chief Architect

Andy brings 40+ years of experience in analog and mixed signal IC design, having contributed to Piera's overall R&D efforts. He was General Manager/Lab Head at LG Electronics, and currently CEO of Luxen. He is also a professor at KAIST (Korea Advanced Institute of Science and Technology), and a commissioned Expert in Technology Level Evaluation by the Ministry of Science and ICT and Future Planning, Korea.
B.S. and M.S. from Seoul National University, MBA from MIT Sloan School of Management.

Staff: Semiconductors, Software, Firmware, IoT, IT, UI/UX, Cloud, AI, Environmental Sensing

https://pierasystems.com/about-us/

Piera Systems

No more guessing, know exactly ‘What’s in your Air’

- Most accurate, affordable sensors and air quality monitors

Gain Insight into your Air Quality

- Fine, Very-Fine and Ultrafine particle data needed to identify sources
- Measure effective Air Changes per Hour to reduce infection risk

Let’s partner on new possibilities

- Our disruptive technology empowers new markets and applications
- www.pierasystems.com