

What's in your Air?



CLIMATE CHANGE IS THE DEFINING PROBLEM OF THIS CENTURY

“AIR POLLUTION IS A PANDEMIC IN SLOW MOTION”

8 million deaths/year¹

\$5 trillion in welfare costs²

Untold damage to human health

Reality is Even Worse

We focus on what we see

AQI only reports PM10 and PM2.5
Tells you it's bad but not why

What we don't see is even more dangerous

"Fine particles, less than PM2.5, pose the greatest risk to health." – EPA

"Ultrafine particles, less than PM1, can penetrate into tissues and organs, posing an even greater risk of systemic health impacts." - WHO

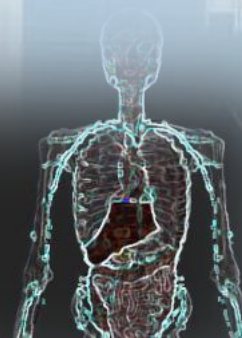
PM10



PM2.5



PM1 & below



THE RELATIVE SIZE OF PARTICLES

From the COVID-19 pandemic to the U.S. West Coast wildfires, some of the biggest threats now are also the most microscopic.

A particle needs to be 10 microns (μm) or less before it can be inhaled into your respiratory tract. But just how small are these specks?

Here's a look at the relative sizes of some familiar particles >

HUMAN HAIR 50-180 μm >
FOR SCALE

FINE BEACH SAND 90 μm >

GRAIN OF SALT 60 μm >

WHITE BLOOD CELL 25 μm >

GRAIN OF POLLEN 15 μm >

DUST PARTICLE (PM₁₀) <10 μm >

RED BLOOD CELL 7-8 μm >

RESPIRATORY DROPLETS 5-10 μm >

DUST PARTICLE (PM_{2.5}) 2.5 μm >

BACTERIUM 1-3 μm >

WILDFIRE SMOKE 0.4-0.7 μm >

CORONAVIRUS 0.1-0.5 μm >

T4 BACTERIOPHAGE 0.225 μm >

ZIKA VIRUS 0.045 μm >



Pollen can trigger allergic reactions and hay fever—which 1 in 5 Americans experience every year.

Source: Harvard Health

The visibility limits for what the naked eye can see hovers around 10-40 μm .



Respiratory droplets have the potential to carry smaller particles within them, such as dust or coronavirus.



Wildfire smoke can persist in the air for several days, and even months.

Air Quality Standards Target Outdoors



PM10



PM2.5



PM1.0 – PM0.1



EPA stations report Outdoor PM2.5, 10.0 Mass Concentration

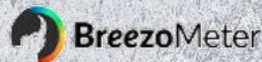
[WHO issues first air quality guidelines since 2005, Cuts PM2.5 emissions in half](#)



EPA on low cost sensors:

"A variety of strategies to overcome sensor performance issues are in development"

"No sensor measures mass concentration, they are all estimates"



Measurement Blackhole

Most Indoor Sources < 1.0

No Guidelines



Indoor Air Quality

2-5X bigger health threat, dominated by PM < 1.0 microns

Subject to drastic, and rapid changes

Ventilation, Filtration systems optimized for energy conservation, NOT Air Quality

Many air-cleaning products are ineffective

No Indoor Standards, Each building is different; **Monitoring essential**

An affordable Air Quality Monitor that can identify sources of pollution did not exist ... until now

An Effective Air Quality Plan



Monitor accurately measure the air quality



Inform derive insights, classify sources, identify causes



Mitigate employ effective methods to clean the air

Products



Intelligent Particle Sensors: B2B

Integrate our easy-to-use, highly accurate, affordable sensor into end products



Canaree: B2B, B2C

Ready-for-deployment, cloud integrated, SenseiAQ software; lease, buy, or resell

Canaree's Break-through Intelligent Particle Sensor

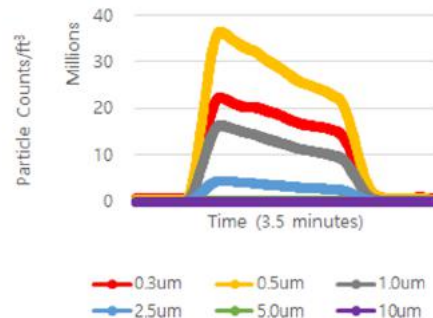


- Custom PSC-1 Processor
- Accurate, Calibrated to Reference Devices
- High Precision, Low Variation
- Accurate over full range PM10 to PM0.1
- Particle counts and size, not just mass
- Software Defined Family 3/5/7 bins
- Low and High Concentration > 6000 $\mu\text{g}/\text{m}^3$
- <\$30-\$95

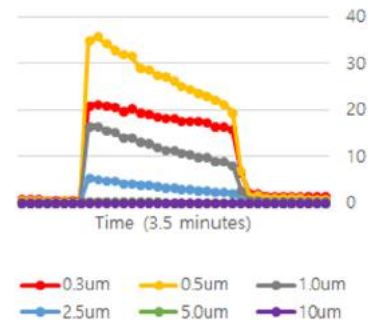


World's only certified low-cost sensor that accurately counts particles and sizes in real-time

Piera

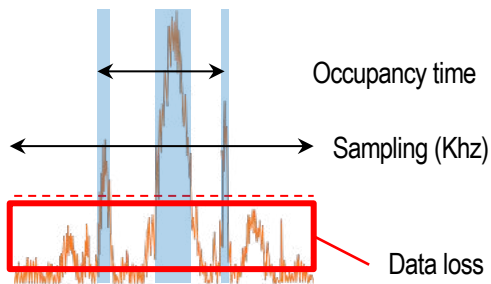
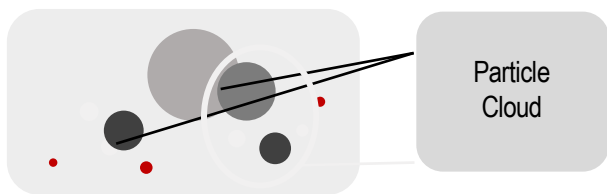


Grimm 11D



Custom Photon Counting Processor

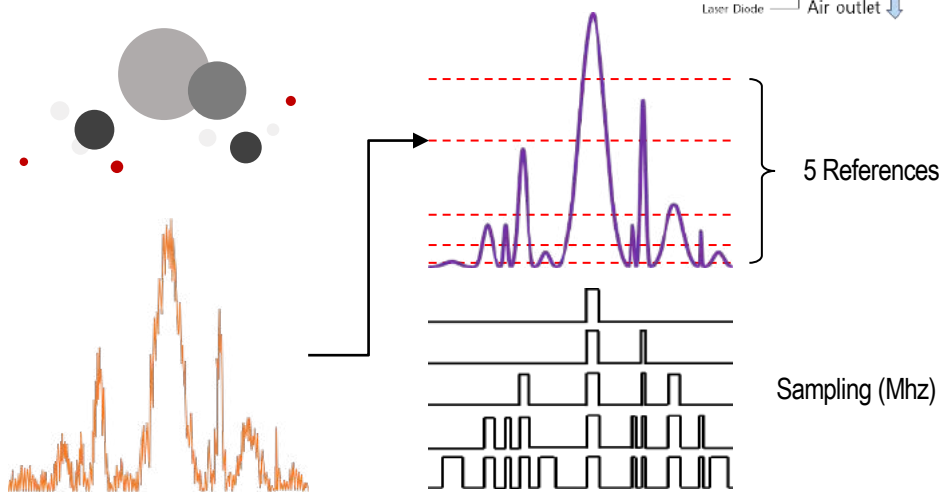
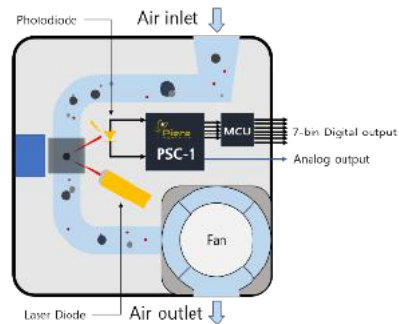
Competition



Estimated Concentration
PM2.5 only



Piera



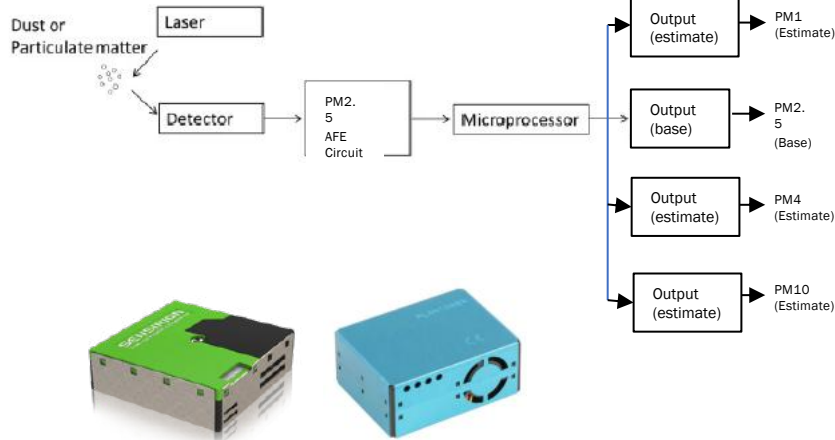
Software-Defined bin sizes
count every particle

Only Piera Can Classify



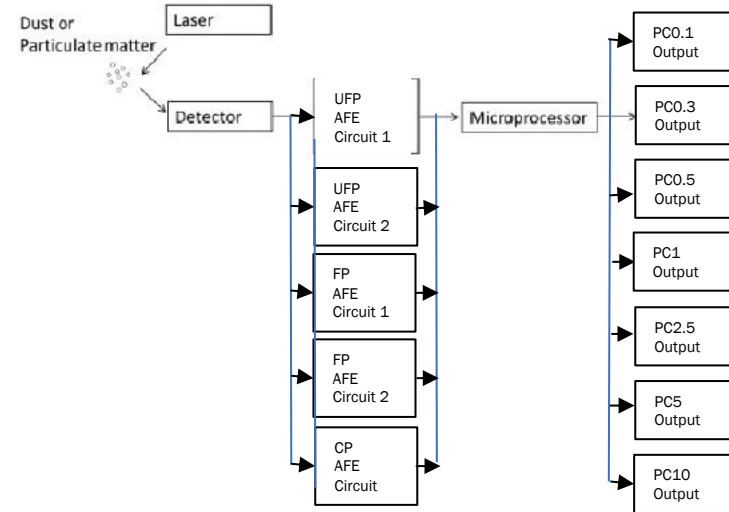
Competition

- Nephelometer only
- Counts PM2.5 particles and estimates other size particles



Piera

- Hybrid OPC; part nephelometer and part spectrometer
- Accurate measurements and not estimates



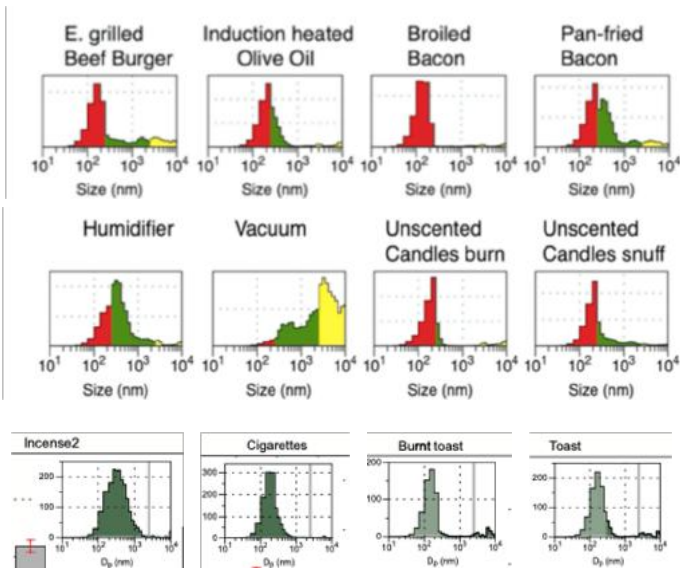
Nothing Else Comes Close



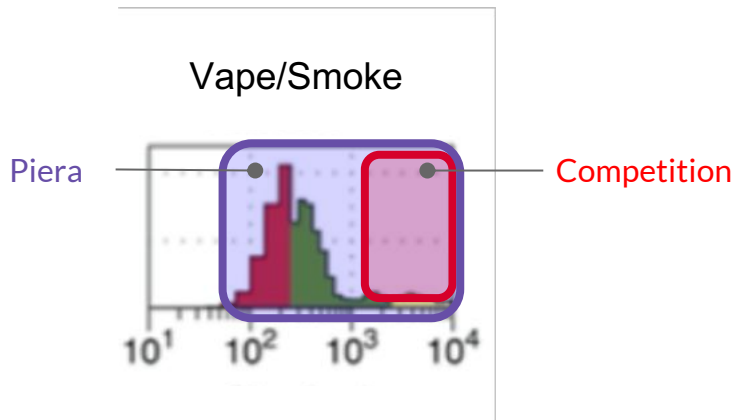
Detection Capability	Response Time	Accuracy	Particle Classification	Cost Effectiveness
●	●	●	●	●
●	●	●	●	●
●	●	●	●	●
●	●	●	●	●
●	●	●	●	●
●	●	●	●	●
●	●	●	●	●

Classifying Pollution Sources

Particle Count + Particle Size + Number of Bins = Particle Classification



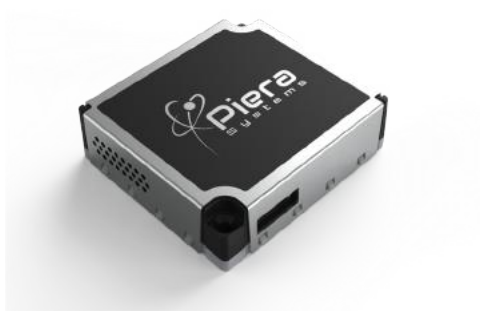
Pollutant signatures from Lawrence Berkeley National Laboratory



Only Piera can measure PM0.1-1.0
Competition cannot classify particles

Vape/Smoke Detection

- Highly accurate event detection; within 30 seconds
- Distinguishes smoke from vape with proprietary algorithms
- SenseiAQ displays events as they happen and logs them
- LED on Canaree flashes **red** for smoke and **purple** for vape



Events
Smoke detected - 1 day ago
Vape detected - 2 days ago
Smoke detected - 2 days ago
Smoke detected - 2 days ago
Smoke detected - 2 days ago
Smoke detected - 2 days ago
Smoke detected

MtShasta-Canaree

SenseiAQ Cloud Dashboard enables event detection from remote sensors

Get to the Source

28% of high school students vape creating hazardous environments at home and in school

Existing vape sensors are rendered ineffective by tampering with contaminants such as body spray

Only Piera sensors can measure below PM1.0 which you need to accurately classify smoke vs vape vs body spray

Deploy our sensors and classification algorithms in schools, hospitals, hotels, rental cars, homes ...
... wherever you need to deter smoking or vaping



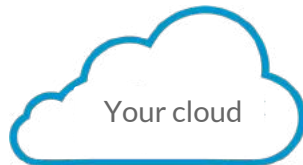
Canāree Family of Devices



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		

Buy, Lease, Resell

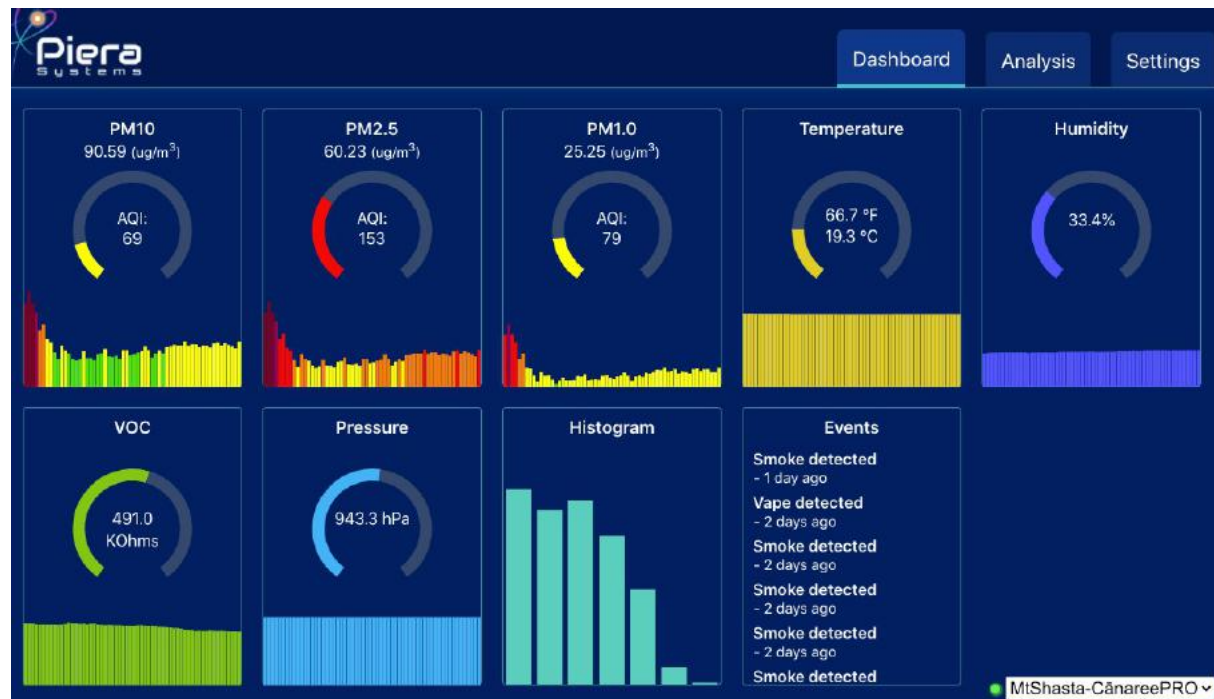
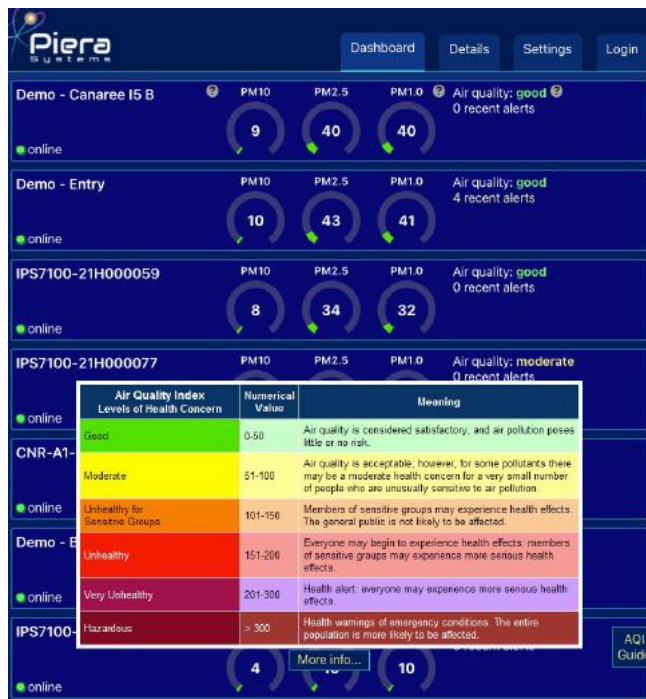
Complete Solution for AQM



Connect to wireless access points, PC's, mobile devices, or integrate into your product

Data aggregated in the cloud, yours or ours

SenseiAQ Software and Dashboard



sensei.pierasystems.com

Markets/Applications/Use Cases



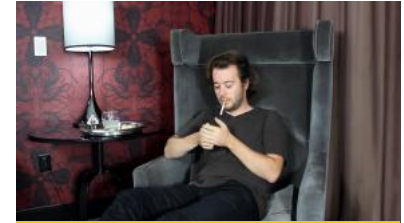
Smart Buildings



Clean Rooms



Construction Dust



Hotels /Casinos/AirBnb



Wildfires



Smart Cities



Healthy Home



Transportation

Wildfire Smoke

Challenge

EPA reports PM_{2.5}, 10 hourly, not locally
Smoke finds its way indoors, [travels thousands of miles](#)
Wildfires dominated by PM < 1.0
Peaks may coincide with other 'events' (Vehicle Pollution, Cooking)

Solution

Piera sensors, Canāree detect particle size and count < 1.0 μm
Can classify particles < 1.0 micron (smoke vs vape vs cooking)
EPA Guidelines: Monitor and Mitigate
Monitor overall effectiveness of mitigation steps
Replace Filters based on effectiveness not time.

During wildfire season you need Piera

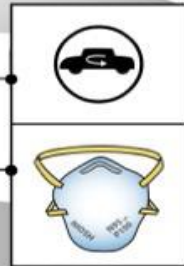


EPA Reduce health risks in areas with wildfire smoke:

Follow these tips, especially if someone in your family (including you!) has heart or breathing problems, is an older adult or child, or is pregnant.

DO

- Stay inside
- Pay attention to local advisories and check air quality ([airnow.gov](#))
- Set car A/C on recirculate (to keep smoke out)
- Keep a supply of medicine and non-perishable food
- Use a well-fitted N95 or P100 respirator if you go outside when it is smoky
- Prepare to evacuate if smoke levels get too high



KEEP AIR CLEAN

Close windows and doors.
Close fresh intake on A/C units.
If your home is too warm, try to stay with friends or relatives.

Use a portable air cleaner with HEPA filters properly sized for a specific room.

DON'T

- X Play or exercise outdoors
- X Fry or broil foods, which can add particles to indoor air
- X Use a fireplace, gas logs or gas stove
- X Smoke indoors
- X Vacuum, it can stir up dust



[airnow.gov](#)

Reduce Covid-19 Transmission

Challenge

Reduce Covid-19 Transmission Indoors by up to 50 %¹

Aerosol Transmission highest PM 0.2-2.5 um

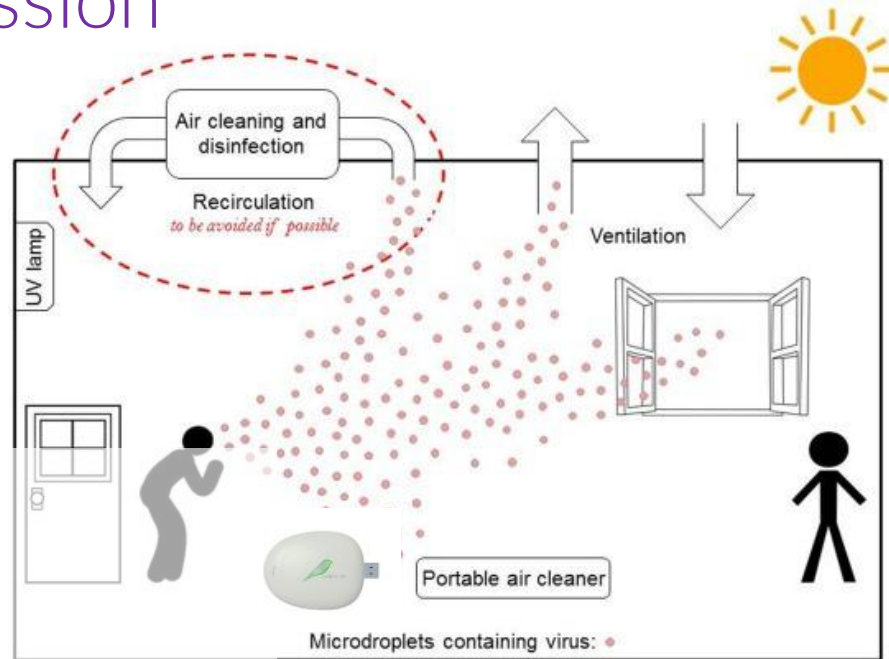
Monitor effectiveness of Mitigation Steps

Solution

Only Piera can accurately detect and classify 'aerosol' PM

Accurate at low concentrations establishes 'good' air

Real-time monitoring detects elevated particulate levels, mitigation effectiveness



To reduce Indoor Covid-19 transmission you need Piera

Respiratory Illnesses

Challenge

Multiple sources, triggers

1B affected, 544 Million chronic, 4 M/year die

ASTHMA, COPD, Bronchitis, Emphysema, Lung Cancer,
Cystic Fibrosis, Pneumonia

Solution

Avoid smoking, second-hand smoke

Canāree Monitors Indoor Spaces

Classify likely sources, vape and second-hand smoke alerts

To identify 'triggers' causing Respiratory
Illnesses you need Piera



Smart Buildings

Challenge

Optimize for energy efficiency, comfort and healthy spaces.

Monitor, Inform, Mitigate improves air quality

120 % ROI: staff productivity, employee health

Solution

Only Piera can detect ultrafine particles

- classify vape and cigarette smoke in real-time
- accurately monitor and improve indoor air quality
- seamlessly integrate into HVAC systems, air purifiers, and building management software

For healthy spaces you need Piera



HVAC Systems need the Accuracy

“... we found very strong correlation of submicron particulates with occupancy, unlike larger particles (>1micron) that did not correlate with occupancy.”

“Some fraction of these small particulates are respiratory, and our experiment showed that we could reduce their concentration through both increased fresh air ventilation and improved filtration (MERV13).”

“... we think today's standards are half of what they should be ...”

“Air cleaning products require in-situ monitoring and control”

Smart Cities

Challenge

Urban areas are some of the most polluted environments on the planet

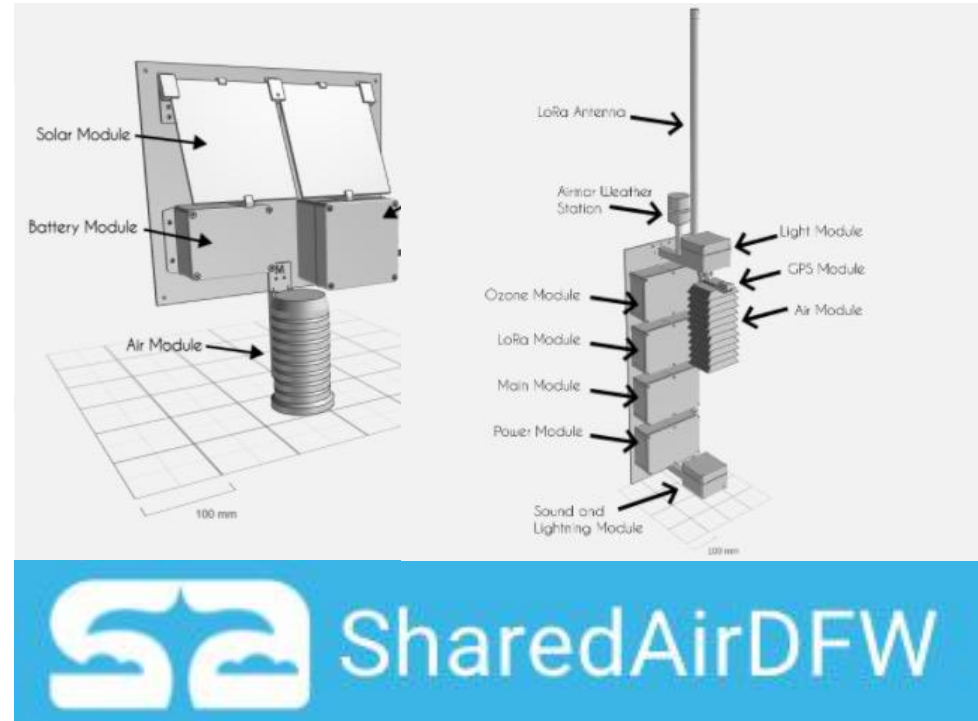
Causes numerous ailments to residents and measurably decreases life expectancy

Solution

Only Piera has the accuracy & range for outdoor AQM

- Highly accurate PM10 & PM2.5 measurements
- Industry's highest mass concentration limit ($>6000 \text{ ug/m}^3$) means low maintenance costs
- Build accurate city- and region-wide maps, identify hotspots, and trends; generate alerts

For smart, healthy cities you need Piera



Diesel Pollution

Challenge

Regulations reducing emissions due to Fulfillment Centers

Impacts health, employee productivity, urban areas

Measuring Diesel vs other sources (PM0.1-1.0 micron)

Solution

Only Piera can detect ultrafine particles

- measure diesel concentration in real-time
- accurately monitor and improve indoor air quality
- seamlessly integrate into HVAC systems, air purifiers, and building management software

For healthy neighborhoods you need Piera

Source: Prologis Torrance, CA



Rental Cars/ Lodging

Challenge

Patron's smoke and vape in rental cars, hotel rooms, airBnB leaving toxic emissions for next customers

Occupancy limits exceeded

Enforcement of rules, measuring effectiveness of cleanup efforts

Solution

Only Piera has the data to classify sources and occupancy

- Precisely time-stamp vape/smoke and other events
- Measure efficiency of cleanup efforts
- Provide deterrent against events occurring at all

For clean cars, lodging, you need Piera



Industrial, Construction

Challenge

Keep employees safe, healthy by monitoring air quality and eliminating pollutants

Size, Weight, Cost, Reliability

Measure at High Concentration levels

Solution

Only Piera can accurately detect and classify 'aerosols' $PM < 5.0$ microns

Meet OSHA and other requirements on workplace safety

UL Compliance, Safety and other certifications

For healthy industrial sites you need Piera



Pollen

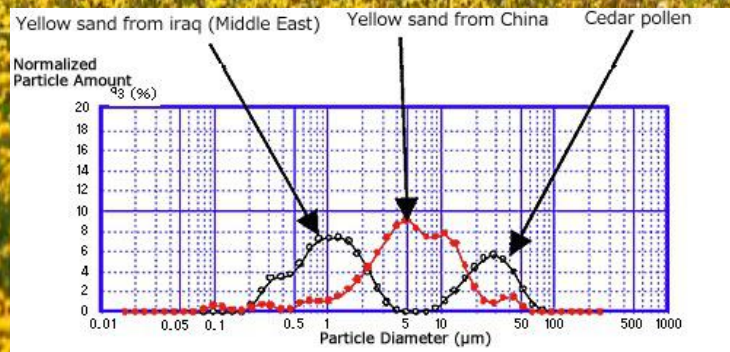
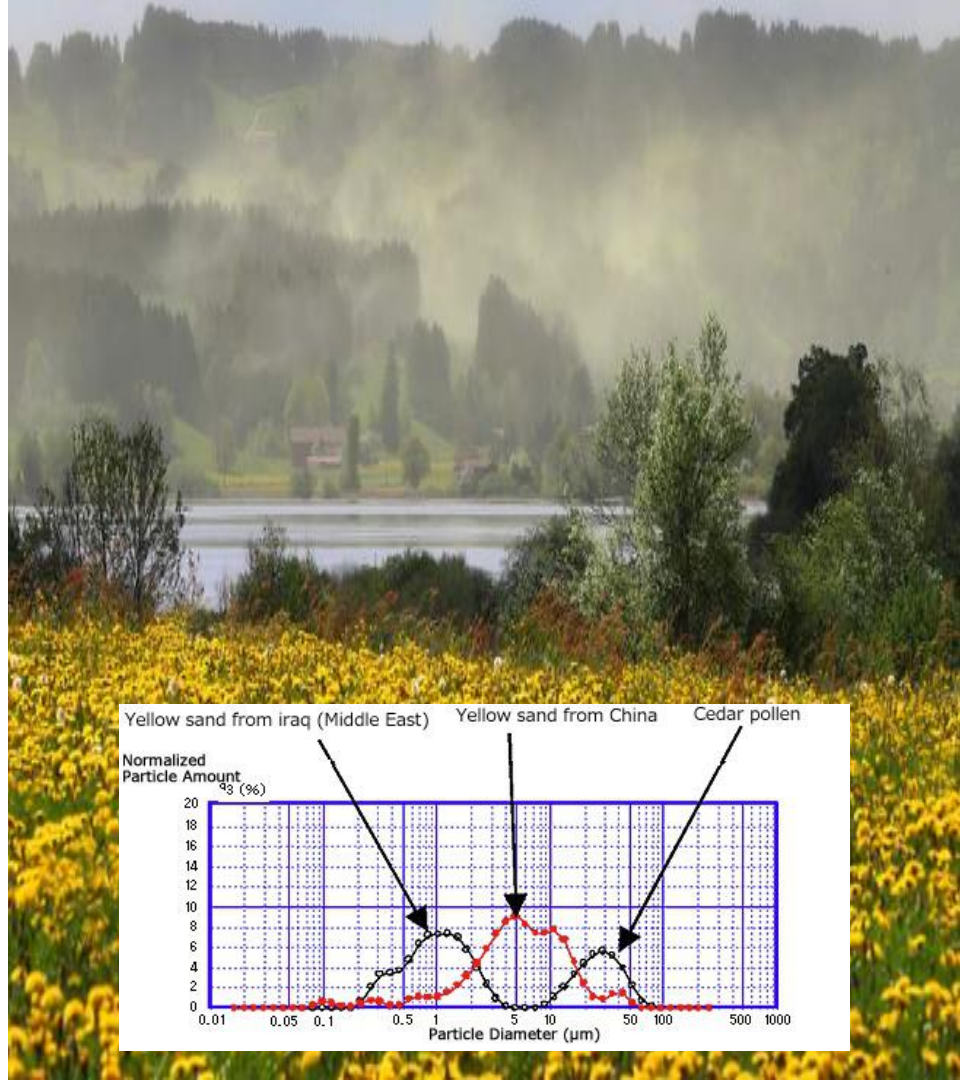
Challenge

EPA reports pollen but not locally
Pollen finds its way indoors
Wide range of particle size
Pollen peaks coincide with other 'events' (Yellow Sand)

Solution

Piera sensors detect pollen particle size and count
IPS-7XU is programmable from 0.5u to 100 u
Pollen count 'events' vs others

During pollen season you need Piera



Mold Mitigation

Challenge

Monitor Spaces during Remediation, Mitigation

Compare workspace mold levels to 'nominal'

Measure particle count across range of PM sizes continuously during remediation

Solution

Only Piera can count particles across the size of Mold

Continue remediation until particle counts reach 'nominal'

Final Testing ensures Mitigation successful



For Mold Mitigation and Remediation, you need Piera

Indoor Certifications: ASTM D8405-21

Challenge: Indoor Air Quality Test Standards

LEED – Building and its services not health of occupants

WELL – is for People, not prescriptive, audits,

RESET – Focused on Air: A, B, C Grade Monitors

ASTM D8405-1 Certification by AQ-SPEC

Solution

Indoor Air Quality Metrics based on EPA PM 2.5, 10 MC

Most sources of indoor emissions are PM <1.0

Canaree meets WELL, RESET Grade A specs at low cost

ASTM D8405-21 testing underway at AQ-SPEC

To monitor and create healthy indoor spaces
you need Piera



ROI for Improving Air Quality

- Improved IAQ for healthier, more productive employees
- Improved Employee Health = \$34 per sq. m
- Improved Staff productivity => \$410 per sq. m
- Possible ROI = 120 %



Increased Indoor
Air Quality



Healthier Employees,
Reduced Absenteeism



Increase in
Productivity

Indoor Air Quality Matters



People spend
more than **80%**
of their time indoors



Indoor Air Quality
is **2 to 5 x worse**
than outdoor air quality



Indoor air pollution
is ranked as one of EPA's
**TOP 5 environmental
risks** to public health



50% of illness are
caused by aggravated
indoor air pollution

[Source: 75F](#)

An aerial photograph showing a dense, vibrant green forest that meets a calm body of water. The water is a clear, light blue color, and the forest is composed of many small, rounded tree canopies, creating a textured green surface. The shoreline is irregular, with the forest following the curve of the water.

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

Let’s partner on new possibilities

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