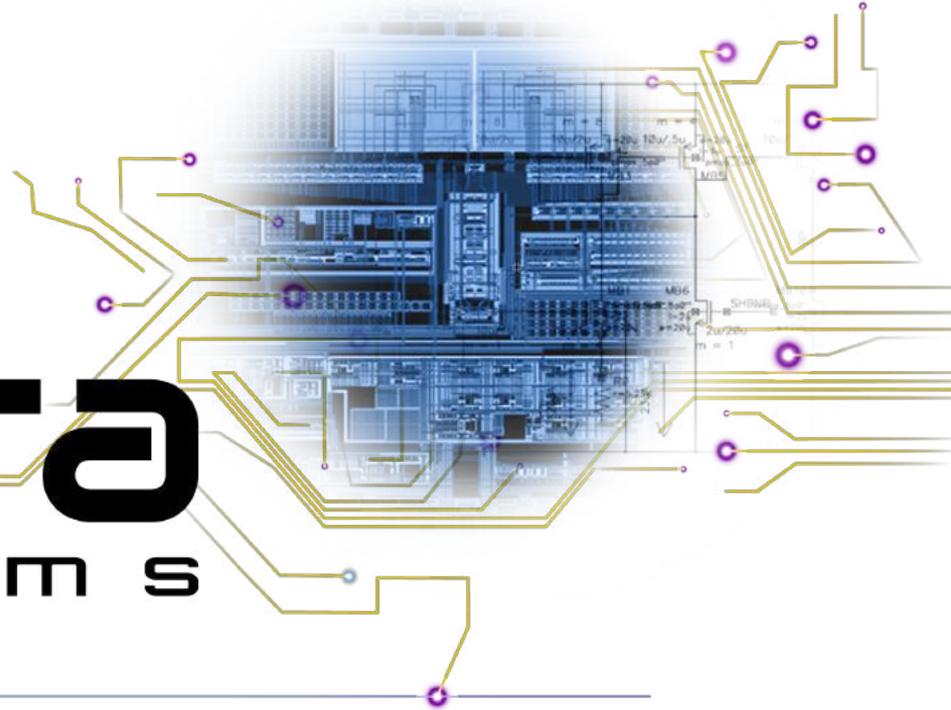


**Piera**  
S y s t e m s



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/year<sup>1</sup>

\$5 trillion in welfare costs<sup>2</sup>

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

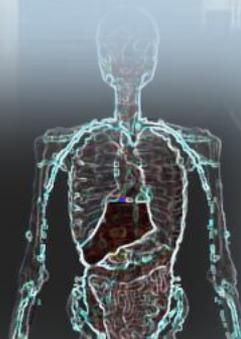
PM10



PM2.5



PM1 & below



# Let's Talk About Air



Clearly, bad air for many



Bad air locally



What about this one?

Simple answer is, we don't know ...  
... not until we measure it

Here's why ...

# Let's Talk About Air



## PM10

Vehicles  
Industries  
Construction  
Sandstorms  
Pollen



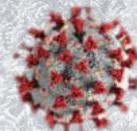
## PM2.5

Fires, Wild and Controlled  
Vehicles  
Industries  
Bacteria & Fungi  
Biomass



## PM1.0 - PM0.1

Cigarette & Vape Smoke  
Wood Burning  
Allergens  
Cooking  
Viruses



Why not measure it all?

# What Are We Measuring?



PM10



PM2.5



PM1.0 - PM0.1



EPA uses gravimetric and reference instruments co-located to report **only PM2.5 & 10.0**  
**Hundreds of miles apart, expensive, labor-intensive, and not real-time**



Ubiquitous low-cost sensors used indoors & outdoors in air purifiers and AQMs  
**Precision and accuracy susceptible to temp, humidity, drift, variance, etc; cannot measure below PM1.0; mass concentrations are only estimates**



Measurement Blackhole  
any current readings are guesstimates

# “What’s In Your Air?”



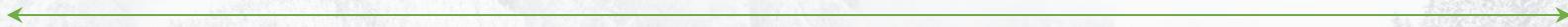
PM10



PM2.5



PM1.0 - PM0.1



Only way to get the whole picture

1. Accurately measure mass concentration
2. Measure coarse, fine, and ultrafine particles
3. Count individual particles, not just mass

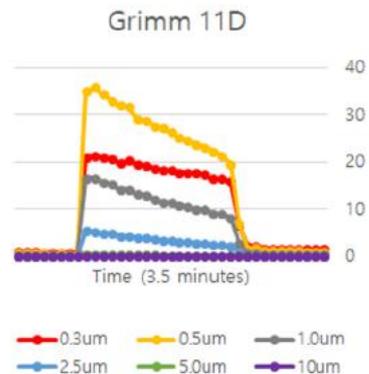
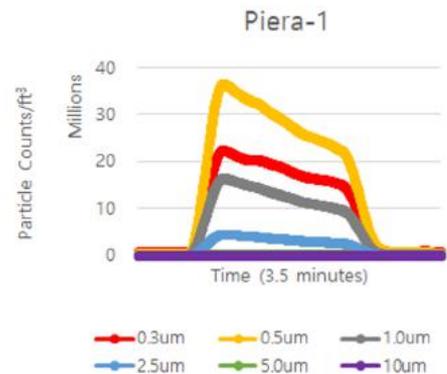
A highly accurate, affordable, easy-to-use particulate sensor did not exist ... until now

# Break-through Family of Sensors



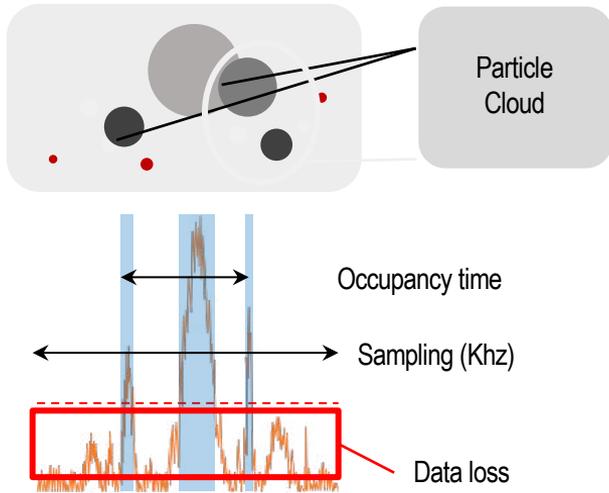
- Highly Accurate
- PM10 to PM0.1
- Particle counts and size, not just mass
- Software Defined
- >6000  $\mu\text{g}/\text{m}^3$
- <\$30-\$95

World's only certified sensor that accurately counts every particle from 0.1  $\mu\text{m}$  - 10  $\mu\text{m}$  in real-time



# Custom Photon Counting Processor

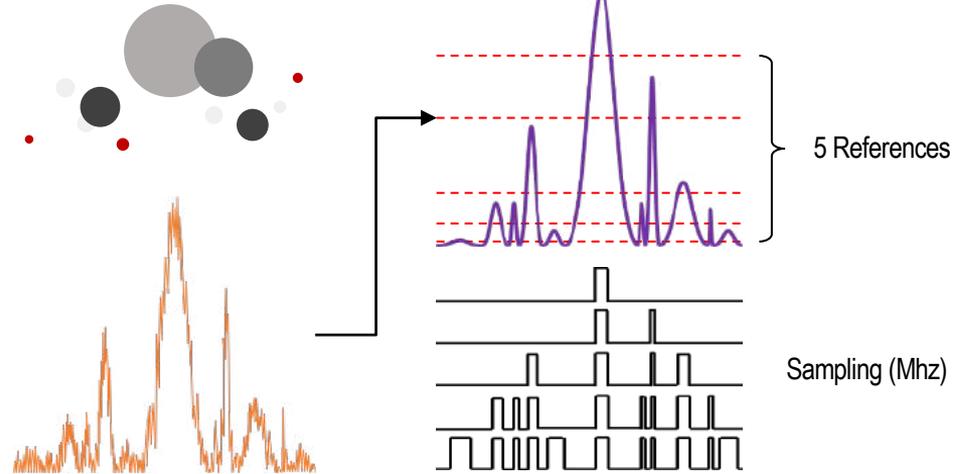
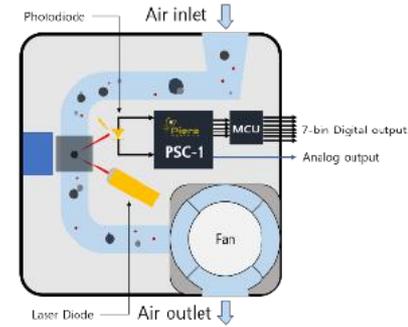
## Competition



Estimated Concentration  
PM2.5 only



## Piera



Software-Defined bin sizes  
count every particle

# Nothing Else Comes Close

	Detection Capability	Response Time	Accuracy	Particle Classification	Cost Effectiveness
	●	●	●	●	●
	●	●	●	●	●
 攀藤科技	●	●	●	●	●
 武汉四方光电科技有限公司	●	●	●	●	●
	●	●	●	●	●
 华盛科技	●	●	●	●	●
	●	●	●	●	●

# Ways to Partner With Us



## Integrate our Sensors

Build our easy-to-use, highly accurate, affordable sensor into your product



## Deploy our AQMs

Ready-for-deployment, fully integrated with the cloud and a powerful UI; lease, buy, or resell

# Canãree: Next Generation Air Quality Monitors



- Highly accurate indoor air quality monitor
- Leverages existing wireless access
- SenseiAQ™ real-time dashboard for alerts and insights
- Vape/smoke detection in real-time
- Secure cloud-based storage and analytics
- Flexible pricing models

[Canãree A1 for Aruba access points](#)

# 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 Dashboard



PM data analyzed and displayed on intuitive tools

# SenseiAQ Software and Dashboard

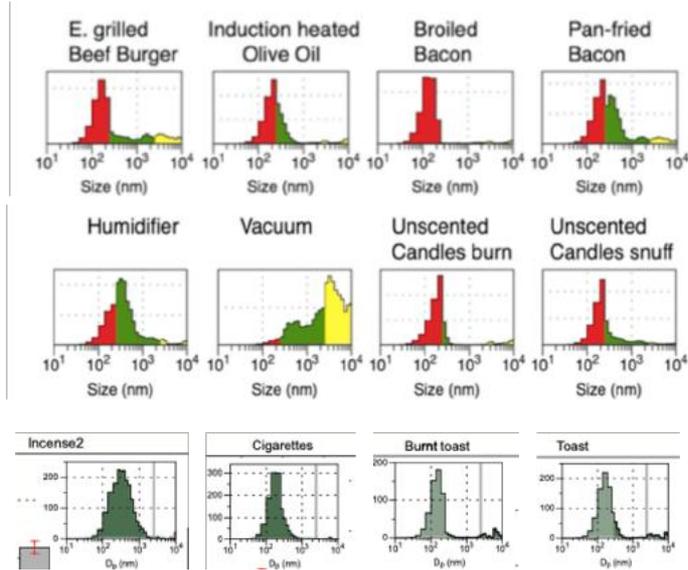
- Browser application for Windows/Mac
  - iOS, Android apps (Q2 '21)
- Standalone or connected to cloud
  - Our cloud or yours
- Dashboard: EPA AQI, vape/smoke, alerts
- Detailed analytics tab and logging capabilities
- Manage Canãree installation, setup, control
  - Maintenance, OTA updates, cleaning, monitoring
- API for integration with other applications



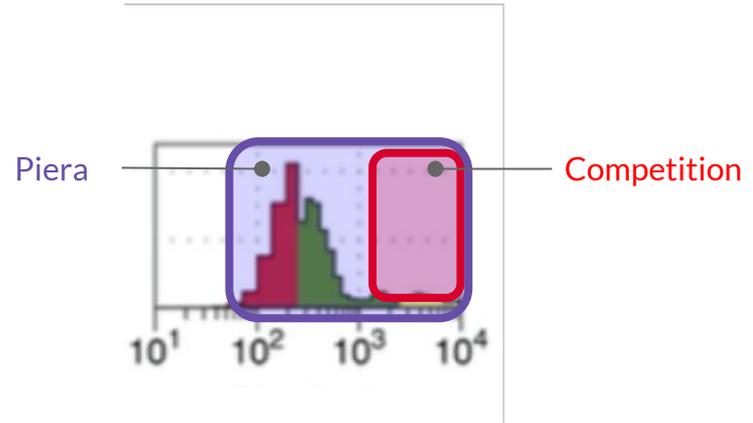
[sensei.pierasystems.com](https://sensei.pierasystems.com)

# Classification is the New Frontier

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



Pollutant signatures from Lawrence Berkeley National Laboratory



Only Piera can measure PM<sub>0.1-1.0</sub>  
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



SenseiAQ Cloud Dashboard enables event detection from remote sensors

The background image shows a modern building with a curved glass facade. A woman in a light-colored dress is standing in the foreground, looking towards the building. The building's architecture features a series of white, curved structural elements that create a rhythmic pattern. The lighting is bright, suggesting a sunny day.

# Applications and Markets

Indoor Air Quality Monitoring

Vape, tobacco smoke alerts in non-smoking areas

Air Purifier effectiveness, efficiency

Smart Spaces (cities, homes, buildings)

Pollution hot spots (high concentration)

# 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 Pira 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



# Rental Cars / Hotels

---

## Challenge

Patrons smoke and vape inside rental cars and hotel rooms leaving toxic emissions for next customers

Enforcement of no-smoking/no-vaping rules is difficult and so is measuring effectiveness of cleanup efforts

## Solution

Only Piera has the algorithms and accuracy to classify vape vs cigarette smoke vs contaminants

- Precisely time-stamp vape/smoke events
- Measure efficiency of cleanup efforts
- Provide deterrent against events occurring at all
- Assurance of a safe environment for future customers

---

For clean cars and hotels you need Piera

---



# AQM - Buildings

---

## Challenge

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

Studies show poor air hinders employee productivity; concerns significantly heightened due to pandemic

## 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

---



# AQM – Access Points

## Challenge

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

Studies show poor air hinders employee productivity; concerns significantly heightened due to pandemic

Leverage existing wireless access points

## Solution

Canāree and Aruba deliver secure, affordable AQM solution

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

For healthy spaces you need Piera

### THE NEED FOR INDOOR AIR QUALITY MONITORING

Employees, customers and the general public are now aware of the need to Monitor, Measure and Improve indoor Air Quality. Wildfires, Climate Change, Covid-19 and the increasing amount of time spent indoors has created a 'tipping point' for companies to take action. The source of most poor Air Quality is due to Particulate Matter (PM) a mixture of airborne solid particles and liquid droplets that can be inhaled and causes serious health problems. The World Health Organization (WHO) reports airborne particulate matter (particulate from 0.1-10 micrometer in size) as a Group 1 carcinogen and as the biggest environmental risk to health, with responsibility for about one in every nine deaths annually.

The EPA monitors and reports Outdoor Air Quality but not Indoors and their monitoring stations are quite far apart, expensive and do not update in real-time. The EPA's Air Quality Index (AQI) is a simple, easy to follow metric for classifying Air Quality and can be applied indoors. However, it doesn't classify sources of poor Air Quality. To do so requires more detailed information about particle size and count. A new class of Air Quality Monitors based on more accurate, higher resolution, real-time data about particle size and count has been developed by Piera Systems leveraging existing wireless access points from Aruba to quickly and cost effectively allow monitoring of Indoor Air Quality.

### A BREAKTHROUGH IN AIR QUALITY MONITORING: CANĀREE

Canāree™ is a low cost, Air Quality Monitor that when connected to Aruba Access Points operates as an IOT device that measures Air Quality instantly, calculating EPA's AQI and can leverage MS Azure cloud services for secure data storage and remote access to data. Piera's **SenseiAQ™** software application running on Azure is a Real-time dashboard that reports AQI together with additional analytics and alerts about indoor Air Quality. Canāree installs by simply plugging into an existing Access Points side USB connector without the need to remove the AP to install. Power and secure IoT communications are provided by the AP and Mobility Manager. Data is logged and stored on Azure IoT Hub for easy integration with existing Building Management Systems. Canāree is easy to install, configure, maintain and update and a network of Canāree sensors monitored by SenseiAQ can be easily reconfigured as needed.

### WHY ARUBA AND Piera Systems

- Highly accurate Indoor Air quality monitoring & management
- Leverage existing wireless access points to reduce costs, simplify installation and deliver real-time analytics
- SenseiAQ™ application provides real-time dashboard, alerts and insight to take action and improve indoor air quality
- Vape/Smoke detection in real-time
- Secure, Cloud-based storage and analytics integrates with existing IT and Facilities Management applications
- Flexible business models allow own/ rent/lease for short or long-term business requirements



Figure 1 Canāree

Canāree utilizes Piera Systems **Intelligent Particle Sensor (IPS)**, an optoelectrical sensor based on laser scattering. IPS utilizes Piera's proprietary **Particle Counting Integrated Circuit (PCIC)** a custom ASIC specifically developed for photon-counting and processing (3 granted US patents). PCIC can identify different sized particles and their concentration by directly counting pulses of different levels of photon energy, featuring superior accuracy, resolution and true real-time data acquisition compared to other sensors using a less accurate, slower LPO technique that 'estimates' overall Air Quality.

Canāree's real-time data on PM is stored on Microsoft's Azure IOT hub and SenseiAQ can classify its components and take actions to improve it. Canāree can identify uniquely vape and cigarette smoke using proprietary ML/AI algorithms. Alerts identify it's presence, concentration and persistence (how long it remains in the air). Knowing the source of PM, its location and severity provides insight and mitigation including changing HVAC systems, adding air purifiers, removal of the source or limiting access to areas with poor Air Quality.

# AQM - Outdoors

---

## Challenge

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

Causes numerous ailments to residents and measurably decreases life expectancy

## Solution

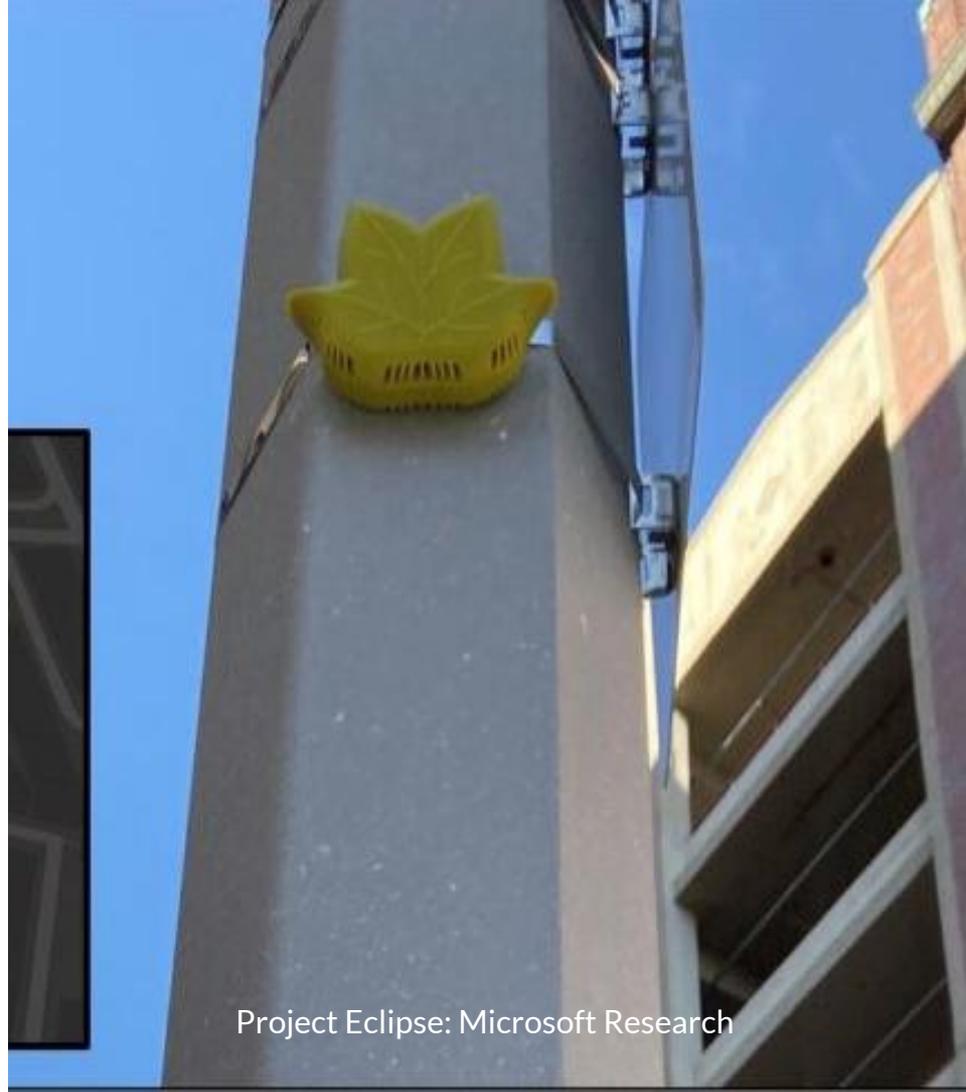
Only Piera has the accuracy & range for outdoor AQM

- 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

---



# Intelligent Home Monitors

## Challenge

Indoor air quality has a huge impact on your health and current measurement methods are ineffective

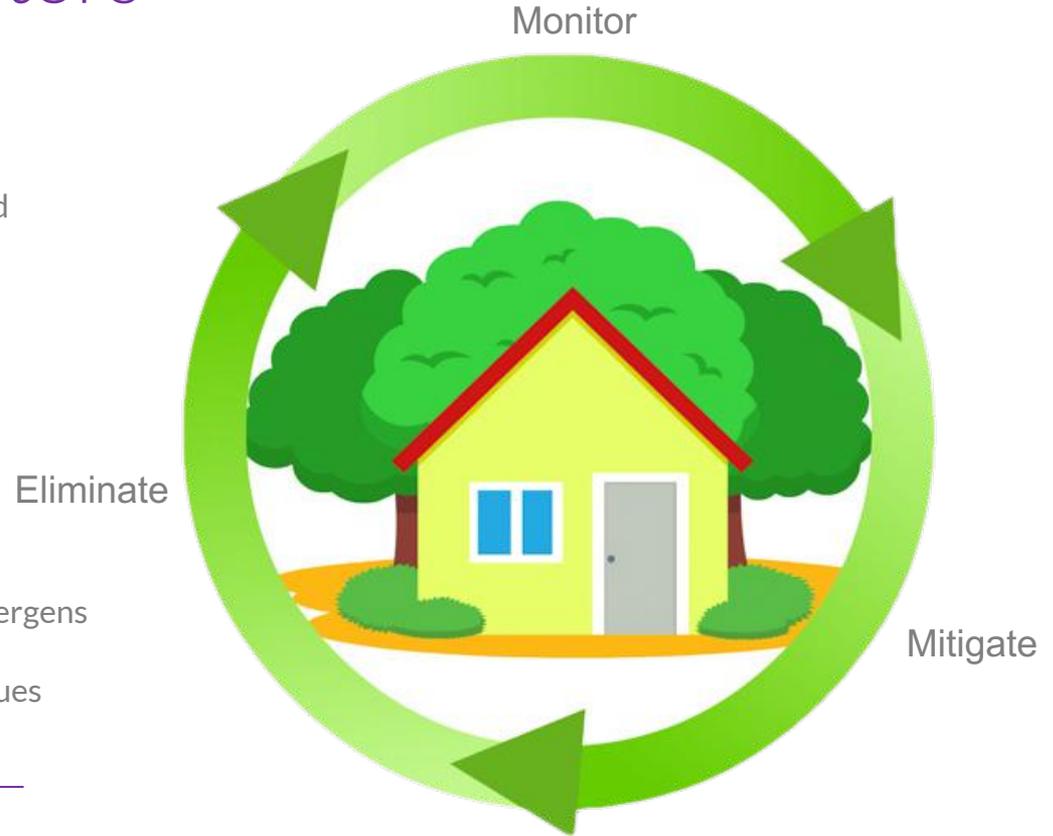
Pollutant sources and intensity of indoor air pollution continues to rise

## Solution

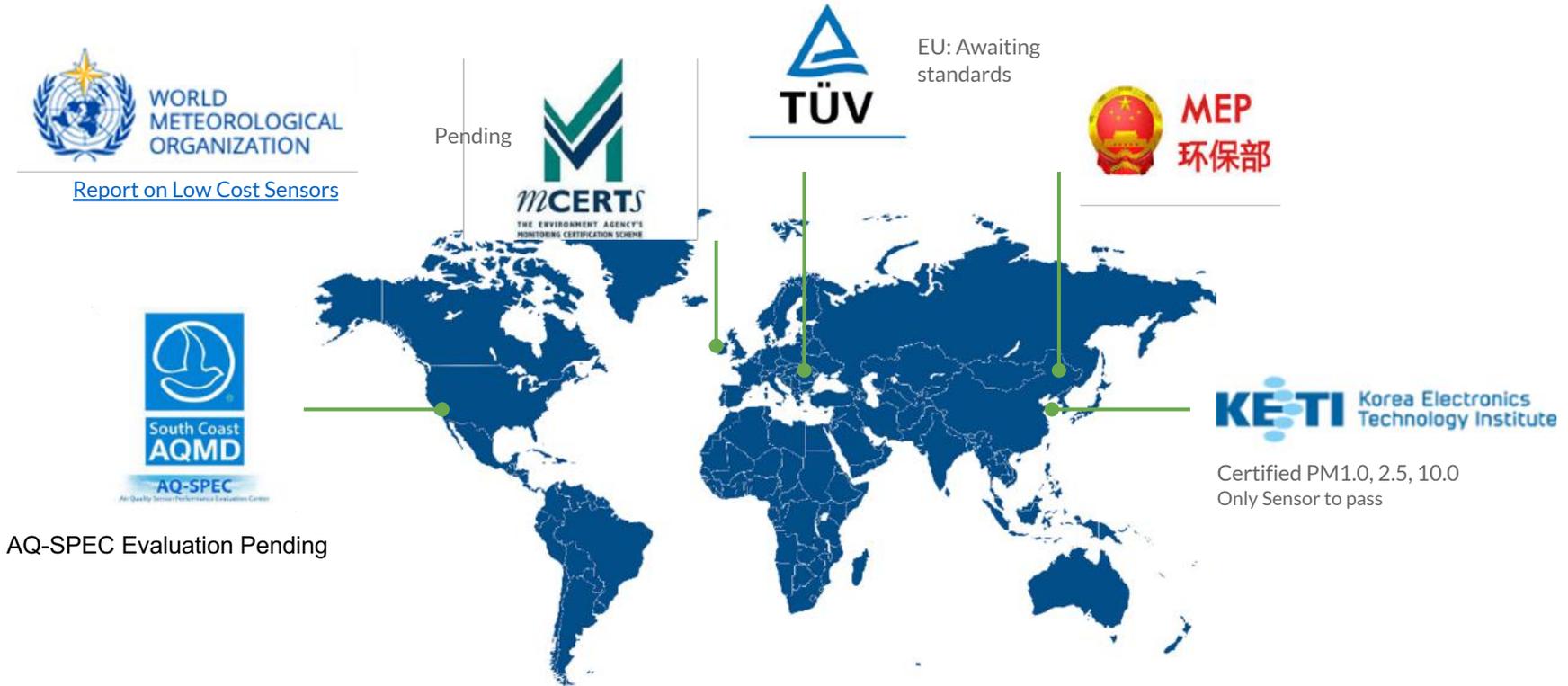
Accurately detect and mitigate indoor pollutants

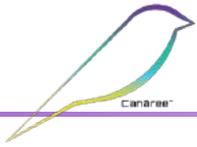
- Vape and smoke detection in real-time
- Measure wide range of pollutants from pollen to allergens to viruses
- Ensure efficiency and efficacy of mitigation techniques including air purifiers, HVAC Filters

Intelligent and healthy homes need Piera



# Certifications and Reports





## Canãree Roadmap

### Canãree A1

Now

Get started with easy install on existing APs

### Canãree I1

CQ2 '21

Expand coverage to non-AP areas

### Canãree I6

CQ3 '21

Particulates + temp/press/RH/VOC/CO2



# Useful links

---

Our home: [www.pierasystems.com](http://www.pierasystems.com)

Canaree A1 product page: [www.pierasystems.com/canaree-a1](http://www.pierasystems.com/canaree-a1)

Canaree for Aruba APs [brochure](#)

IPS-7100 sensor [datasheet](#)

Vape / smoke detection [video](#)

Questions?

[vin.ratford@pierasystems.com](mailto:vin.ratford@pierasystems.com)

[raj.seelam@pierasystems.com](mailto:raj.seelam@pierasystems.com)



## No more guessing, know exactly 'What's in your Air'

- Most accurate, scalable particle sensor in the world

## Future-proof your products

- Fine and Ultrafine particle detection is the future, be ready

## Let's partner on new possibilities

- Our disruptive technology empowers new markets and applications

A wide-angle photograph of a frozen lake at dusk. The sky is a deep, clear blue. The lake's surface is mostly covered in snow, with a narrow strip of dark water in the foreground. The water reflects the warm, yellow lights of buildings and street lamps along the far shore. Bare trees line the background, their silhouettes also reflected in the water. The overall mood is serene and quiet.

Additional Applications

# Data Centers

## Challenge

Direct Cooling requires good quality outdoor air to increase efficiency, lower costs.

Indoor Air Quality < PM1.0 affects reliability, uptime and operational efficiency

## Solution

Only Piera has the algorithms and accuracy to identify PM for both outdoor and indoor emissions

- Measure efficiency of Direct Cooling
- Precisely time-stamp events
- Provide deterrent against events occurring at all
- Assurance of a clean indoor environment

---

For data center operations you need Piera

---



# Construction Dust

---

## Challenge

Prolonged exposure to fine construction dust endangers workers' health

Regulators are requiring accurate monitoring of construction environments to protect workers

## Solution

Only Piera can detect ultrafine particles like silica dust

- accurately monitor and classify dangerous particles
- alert unsafe work conditions
- verify mitigation before workers return

---

For safe construction sites you need Piera

---



# Wildfires

---

## Challenge

Climate change is increasing duration and intensity of wildfires around the world

Wildfires produce significant PM2.5 and below emissions which are 10x more harmful than vehicle emissions

## Solution

Only Piera can detect fine, ultra-fine particles in wildfire smoke

- Build accurate region-wide hotspot maps which lead to better evacuation plans and safer conditions
- Industry's highest mass concentration limit ( $>6000 \text{ ug/m}^3$ ) means high reliability during wildfire season

---

To stay safe from wildfires you need Piera

---



# Asthma

## Challenge

339 million people have asthma; over 400,000 deaths a year; hundreds of billions in costs

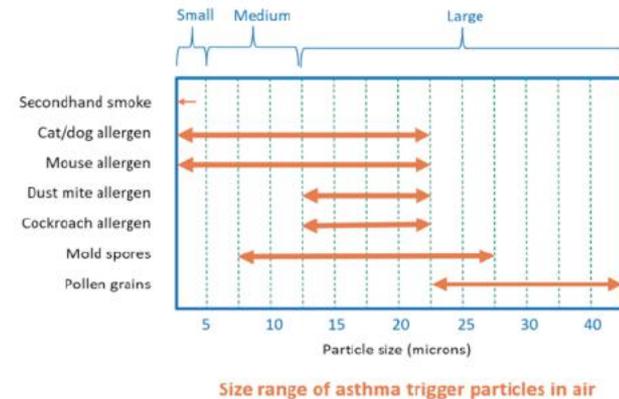
Wide range of triggers for asthmatics causing severe impact on quality of life

## Solution

Only Piera can detect entire range of asthma triggers

- Vape and smoke particle detection in real-time
- Identify safe and trigger zones in real-time
- Accurate classification of asthma triggers for better mitigation

To prevent asthma attacks you need Piera



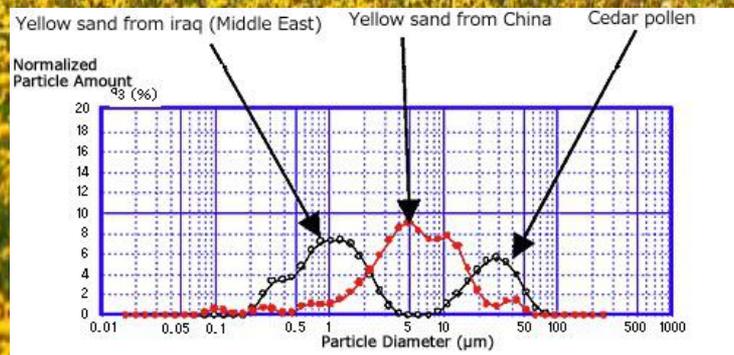
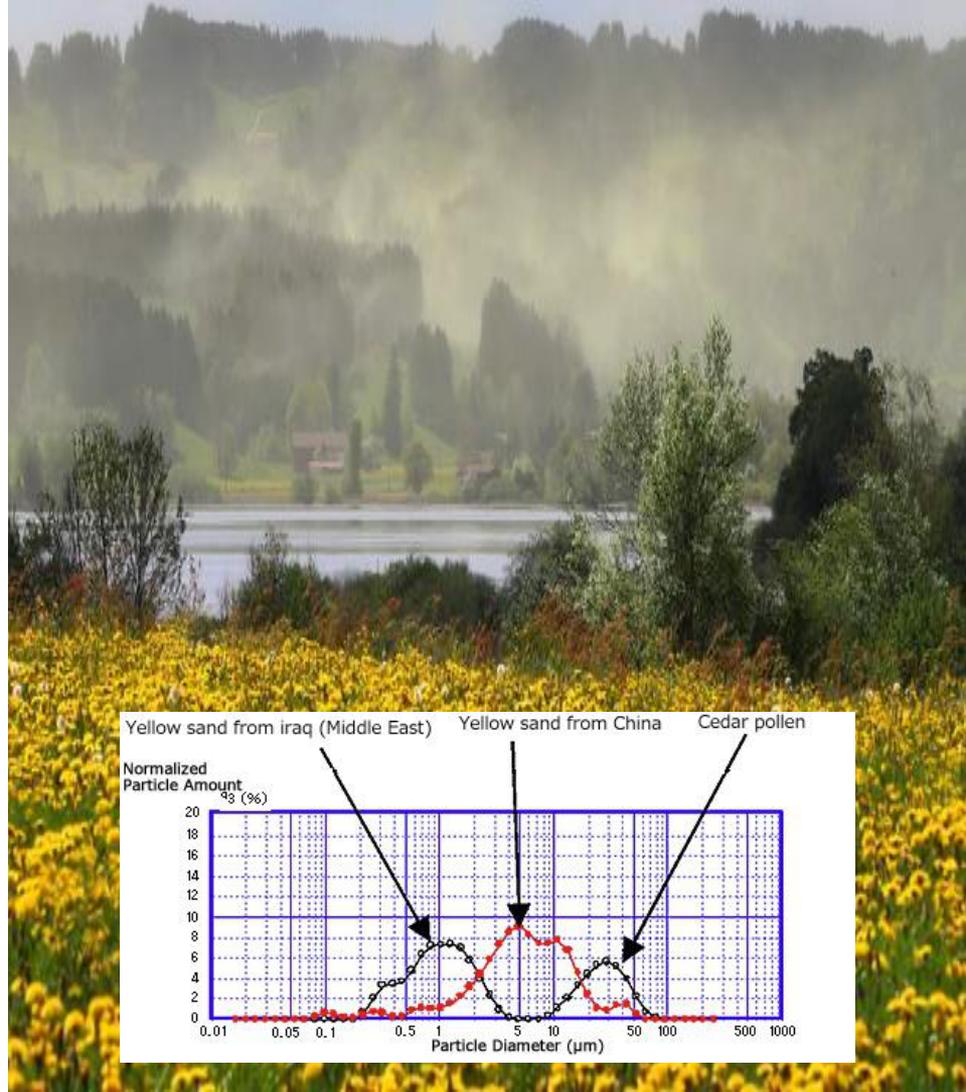
# Pollen

## 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