Written Testimony of Bill Obermann
Air Program Supervisor
Denver Department of Public Health and Environment
On
"Examining the State of Air Quality Monitoring Technology"
Before the
Senate Committee on Environment and Public Works

April 10, 2024

Chairman Carper, Ranking Member Capito, and members of the Committee, thank you for the opportunity to testify on the topic of air quality monitoring technology today. My name is Bill Obermann, and I am the Air Program Supervisor of the "Love My Air" sensor-based air pollution program at the Denver Department of Public Health and Environment in Denver, Colorado. I have worked for Denver since 2019 and have seen our program grow from an initial grant-funded pilot to a full-fledged city-funded program with dozens of low-cost air monitoring sensors providing real-time air quality information and education to schools, community groups, and museums. This year, we are expanding our work to health clinics through a grant from the Kaiser Foundation Health Plan of Colorado. I am honored to lead such a unique program and we're excited to bring our experience to you today.

The Air Pollution Context in Denver

Concerns about air quality have rapidly increased in the last 10 years. Now on a typical summer day in Denver, checking the daily Air Quality Index, or "AQI", is as common as checking the weather. In fact, both the outdoor temperature and the AQI are combined into widely used weather smartphone apps.[1] The meteorologists at our local news channels discuss the weekly forecast and the daily AQI in the same morning segment.

Layer on top of that wildfires, and the public attention is at a fever pitch. The AQI as a public information tool becomes urgent during major wildfires affecting Denver. Nationally, six of the largest wildfires **ever** have occurred in the last seven years. One of those fires, the 2020 Bay Area Fire, at one point burned an area the size of Washington DC every 24 hours. [2]

The Response in Air Monitoring Technology

These new realities dramatically increase the need for public information on air quality and the market has responded by making air pollution monitoring data more affordable and accessible than ever. In the past ten years, many companies have emerged producing low-cost monitoring technologies that can monitor particle pollution as well as other pollutants (mostly those already regulated by EPA such as ozone, nitrogen dioxide, and carbon monoxide) and make that information available real-time. These "sensors" are so named to distinguish their technology from traditional "regulatory monitoring" systems

[1] A sample of popular smartphone apps with AQI data include the Weather Channel, AccuWeather, and WeatherBug.
[2] 17 Largest Wildfires in US History: https://earth.org/worst-wildfires-in-us-history/

that are much more expensive to purchase, must conform to specific siting requirements, and require a great deal of expertise and power to run continuously and accurately. These more sophisticated monitoring systems have been used for decades by air pollution control agencies to assess compliance with the Clean Air Act's National Ambient Air Quality Standards (NAAQS). The NAAQS are standards for the ambient air concentrations of ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead; in other words, the standards for key health-related pollutants in the air we all breathe.

Sensors are marketed to a wide variety of potential customers, including local, tribal, and state governments, neighborhood organizations, environmental nonprofits, and large industrial facilities as well as individual residents and homeowners. The needs of this customer base are very diverse, and therefore the specifications and features such as data quality and assurance vary widely. So do aspects like power requirements (many sensors are solar powered), cell data connectivity, data refresh speed, and how the data is displayed via apps or websites. Each organization has a distinct purpose or concern that underlies purchasing low-cost sensors, and therefore the market responds with an array of technologies.

Government has also responded in important and supportive ways, especially the EPA. The EPA's AirNow Fire and Smoke Map[3] is the public go-to source of data on smoke conditions when major events impact large urban areas like San Francisco, New York City and Washington DC. The data used by EPA largely comes from low-cost air pollution monitoring technologies. Many low-cost air sensors are purchased by individual people and installed on their own properties, and the data is streamed and then collected and broadcast by agencies such as EPA.

Denver's Love My Air Program

Our public health department is responding with the Love My Air program. When this program launched in 2018 with the backing of a Bloomberg Cities Mayor's Challenge Grant[4], we installed air quality sensors at 40 Denver Public Schools and displayed that information, real time, into school lobbies. At that time, the sensors and these communication approaches were new. The purpose of this grant was to improve student health outcomes, especially related to asthma, so we paired that installation with school-based outreach programming such as nurse and administrator trainings, in-classroom education, school community events, and offering air quality science curriculums. Today we continue to operate sensors at 33 schools and have expanded our programming into community and neighborhood groups as well as healthcare clinics.

The sensors provide real-time data on particulate matter with a diameter of 2.5 microns (one micron = one millionth of a meter), otherwise known as "PM2.5". This particulate matter is invisible to the naked eye but very impactful to public health because the particles themselves can be composed of many toxic chemicals and compounds (nitrates, sulfates, metals, organic chemicals, etc.), some of which are known carcinogens or negatively impact health. The primary sources of PM2.5 are combustion-related, such as vehicles, industrial boilers and heaters, home fireplaces, agricultural burning practices, and other

[3] EPA's Fire and Smoke Map is available at: https://fire.airnow.gov/

[4] Bloomberg Cities Network. September 22, 2021. *How Denver is empowering students to take action on air quality.* https://bloombergcities.jhu.edu/news/how-denver-empowering-students-take-action-air-quality

anthropogenic combustion events.[5] To a much lesser extent it is also composed of dust and other natural sources (e.g., pollen). Increasingly, PM2.5 is also emitted during wildfires, which can be transported thousands of miles.

When we breathe in PM2.5, the particulates are so small they can travel deep into our lungs and can even enter directly into the bloodstream. So PM2.5 is a concern not only for pulmonary issues like asthma and bronchitis, but also cardiovascular disease, such as cardiac arrhythmias and heart attacks, even premature death.[6] We already know PM2.5 worldwide is a major issue related to premature death, but the more research investigates the impacts of PM2.5, the more we understand there is no "safe" level of PM2.5 and all levels of government need to be involved in monitoring this pollutant and implementing programs to reduce it.

How New Air Monitoring Approaches Benefit Public Health

A key lesson from implementing Love My Air in schools is that the most engaged parties were the school **nurses**. In some of our schools up to 25% of the student population presents asthma-like symptoms or have been diagnosed with asthma. Therefore, nurses are on the front lines with asthmatic students and provide emergency medical assistance when necessary.

Importantly, nurses are also an example of **trusted partners** in a child's health and the community in general. Nurses find the data from our air sensors helpful in their daily care for children, and that use alone legitimizes our program.

Using this experience, we've learned to build and use trusted relationships to bring the Love My Air program to communities in Denver and beyond. Whether it is a nurse, a community-level organization, or a health-care clinic, we are more successful when we partner with individuals and organizations to bring awareness about air quality, how it impacts your health, and what you can do about it. There is much distrust of government organizations, especially in disadvantaged communities, so this link to trusted entities to introduce us and help form relationships is key.

Love My Air is headed in very exciting directions over the next two years. We are expanding our program into the healthcare setting by developing public health and air quality interactive kiosks for deployment in local community clinics, and we are frequently training nurses, teachers, administrators and community leaders about air pollution and public health. We purposefully take a small group approach to our outreach, focusing on the groups that want to engage and have a conversation. For example, we perform trainings with groups of nurses, host outreach events at public health-related events, employ teachers to train other teachers, and present air pollution trends from our monitoring network at community based nonprofit events. We also use some mass-communication approaches, such as our department's Twitter and Facebook accounts to provide information about our program. Importantly, we do not use these accounts to push air quality alert notifications from our sensor network. It is the State's responsibility to determine when there is an official public health alert due to air quality, and they do a

[5] EPA. *What is PM, and how does it get into the air?* https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM

[6] EPA. *Health and Environmental Effects of Particulate Matter (PM)* https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

very thorough job through social media and mainstream communications to push information on ozone alert days or other times when air quality conditions are poor. It has been and should remain the state's responsibility to issue these alerts.

In summary, our partners like the Colorado Department of Public Health and the Environment, the EPA and technology companies are broadcasting air quality data and real-time information to millions of people. Our fit as a public health department is to explain what this data means to people who care about it the most – particularly students, clinic patients, and health practitioners in Denver.

Emerging Monitoring Technology

It's key to note that the low-cost PM2.5 sensors Love My Air uses are not the only technology that is new in the evolving air pollution monitoring industry. We are also purchasing air quality monitors recently approved by EPA to provide high quality regulatory monitoring data, and for the first time they are priced reasonably. These monitors are distinctly different from our sensors because they are made by companies that have historically manufactured regulatory-grade monitors but now they have new, smaller instruments that can collect measurements at the same level of quality. For example, if the State of Colorado wanted to purchase these same smaller monitors to deploy in its regulatory monitoring network, they could. The main point is these monitors are available today at a fraction of the price they were only five years ago.

Recommendations for Action

1. *Provide A Path to Turn Sensor Data into Regulatory Action*

The next phase of monitoring through low-cost air sensor networks is understanding how the data can be used with regulatory-level monitoring data to act. Regardless of how the data is produced, there is an unprecedented level of air quality data being collected today. As a result, Denver and other local governments are being asked how this data is being used to improve air quality conditions, especially in neighborhoods disproportionately impacted by pollution.

The time is now for clearly communicating what level of data quality is acceptable for use in agency decision making and regulatory settings. This is especially pertinent for EPA and state-level air quality agencies since they hold the majority of the authority in regulating and enforcing air pollution limits at industrial facilities and ensuring that our ambient air quality standards are protected.

Our Love My Air program specialists and our stakeholders appreciate tremendously EPA's work thus far in evaluating sensor technologies, issuing testing protocols and performance targets for sensors, guidance on siting and installing sensors, and methods to correct sensor data by collocating and correcting data against higher quality ambient air monitoring data. Our program has been following these methods, and since it was one of the first in the nation, we also have been providing data and insight into these EPA tools for quite some time.

However, the biggest steps for EPA are yet to come. There are urgent needs to use sensor data to inform new policy and also to assess facility compliance. The conversation emerging is **how** to use sensor data in

air quality planning, especially for regions in nonattainment of federal air quality standards for ozone, particulate matter (PM2.5), and other pollutants. With the new annual PM2.5 standard just promulgated by the EPA,[7] many urban areas like Denver will have a challenge meeting attainment, and PM2.5 is generally the most popular pollutant to measure with low-cost sensors.

An equally important next step is how to use this data to evaluate facility compliance against state or federal air rules, regulations, and permits. For example, are sensors accurate enough to use along a fence line as a basis for enforcement at an industrial facility? The answer today from EPA is no, but we know that, over time, the sensor technology will improve, and higher quality measurements will become more affordable.

The State of Colorado stands out here because our state has taken initial steps in requiring air quality monitoring from sensor technologies. In response to 2021 state legislation, the Colorado Air Quality Control Commission adopted new rules in May 2023 that establish requirements for large facilities to conduct enhanced air monitoring in communities disproportionately impacted by air pollution. The Colorado Department of Public Health and Environment is now in the early stages of implementing this rule. Discussions include evaluations of the available air monitoring technologies today, air monitor placement and operational requirements, data collection and transmission processes, and reporting and sharing requirements for air pollution data. This is one example of how air sensor technology is starting to be introduced into state-level stationary source air permitting processes, and EPA can learn from this experience.

To summarize, the two biggest needs we have from EPA in this space are:

- How high-quality air quality data collected by local governments that follows EPA guidance and/or protocols can be used in air quality planning, especially for ozone and PM2.5 in nonattainment areas; and
- How local air quality monitoring along facility fence lines and in adjacent neighborhoods can be used to augment air compliance oversight by local, state and federal agencies.

2. *Provide Air Monitoring Equipment and Software, Analysis, and Education Directly to Local Communities*

While sensor equipment is "low-cost" in comparison to regulatory grade monitoring instruments, implementing an air sensor network program is not cheap. The complexity of installing, maintaining, and operating sensors, as well as the large volume of data they produce, is a significant challenge and learning curve for most local governments and smaller organizations, especially in historically polluted, disadvantaged communities.

This is another area where EPA can provide significant assistance. Oftentimes the organizations that would benefit the most from air quality monitoring programs are organizations that will have a very steep learning curve in implementation. The typical EPA grant process competitively selects an organization to pilot a sensor program, awards a grant, establishes a contract, and then requires the

[7] 89 FR 16202. *Reconsideration of the National Ambient Air Quality Standards for Particulate Matter* https://www.federalregister.gov/documents/2024/03/06/2024-02637/reconsideration-of-the-national-ambient-air-quality-standards-for-particulate-matter

program to implement and report progress. In our experience, many of these grantees have never implemented an air monitoring program before. Therefore, even developing quality control plan around data collection is difficult, which is just one of the first steps in establishing a monitoring program. Siting the monitor, maintaining the equipment and power, analyzing the data, transmitting it real time, and educating the public are also all significant challenges. In response, these groups contract many of these needs to private firms, diverting much of the funding from building capacity at the local government or community level to paying for consulting and sensor technology companies.

A new alternative would be EPA staff, or their contracted consultants, providing and installing monitoring equipment and their supporting database systems at the local level and educating local agencies and community health groups on how to use the data. With this support would come technical staff to install the network, connect the database, clean and process data, and ensure the network is maintained over the project period. Staff would also be onsite to educate community partners on data analysis results and how it could be used to improve oversight, rules, or requirements on local air pollution sources.

This is a different model than the traditional grant model used by EPA today, where the administration of a federal grant can be a barrier to entry for many small governments and organizations. This is also a different model than many granted entities hiring consultants to implement a program once EPA awards funds. Instead of granting money to small organizations, a competitive selection process could select organizations for participation in this program, but these resources could be supplied by EPA through either staff or their contracted vendors, of whom EPA would have oversight.

The Bay Air Center is an emerging example of such a program. The Center is funded by the Bay Area Air Quality Management District in San Francisco. This service is free of charge and helps implement community monitoring programs by providing services such as cleaning and analyzing data, developing informational materials and reports, and hosting educational seminars and trainings for community members on air pollution science and policy. This type of assistance connects experts in air pollution directly with the community groups and health professionals that are using air sensors. It's a key bridge to strengthen the validity and impact of these programs. EPA could take from this example and provide these services as well as equipment, database management systems, and data validation services.

Conclusion

As I made clear in my opening statement, Denver's Love My Air program is fortunate to have dedicated city funding to hire staff and operate our sensor network. We pursue grants to supplement expansion, but our core program is city-funded and we are unique in that respect. My team is composed of education experts, public health graduates, and monitoring technology professionals. Denver is fortunate to have this dedicated team that I get to represent today. But most local governments do not have the resources to staff this kind of program, even though the need is there. I believe what I have outlined as potential roles for EPA can help make programs like Love My Air grow in other cities where the resources and expertise are not available.

Thank you for this opportunity to testify and I look forward to your questions.