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EXAMINING THE STATE OF AIR QUALITY MONITORING TECHNOLOGY

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The committee met, pursuant to notice, at 10:03 a.m. in room 406, Dirksen Senate Office Building, the Honorable Thomas R. Carper [chairman of the committee] presiding.

Present: Senators Carper, Capito, Markey, Kelly, Padilla, Sullivan.

STATEMENT OF THE HONORABLE THOMAS R. CARPER, A UNITED STATES
SENATOR FROM THE STATE OF DELAWARE

Senator Carper. Good morning, everyone. I am pleased to call this hearing to order.

Though air pollution can be a complex topic, as we all know, the goal of this hearing is pretty simple. It is to examine the role that low-cost air quality sensors can play in helping us collect more data about the quality of our air so that we can do a better job of protecting public health and engaging communities in those responses. That is really what we are up to.

Today, we will discuss how new air quality sensor technology is making it possible for State and local air quality agencies to work with businesses and with their communities. In particular, we are going to hear about how low-cost sensor technology is supplementing existing data gathering and how the technologies are evolving, as well as how local regulators are incorporating these sensors into their own work.

Low-cost air quality sensors are becoming an important tool in the toolbox of air agencies, but it is important for us to distinguish what their limitations are so that they can be integrated successfully into community-level public health initiatives. As you know, almost anybody can buy one of these sensors, almost anyone. They cost a couple of hundred dollars.

The Environmental Protection Agency refers to these low-cost devices as sensors. They should not be confused with monitors that our States use to regulate air quality under EPA guidance. This distinction between sensors and monitors is important, so let me just repeat it. Today, we are going to be talking about sensors, which are low-cost tools to collect data on specific pollutants. We are not talking about the monitors that States use, our States, my State, and other States here, use for regulation under EPA direction.

Low-cost air quality sensors are not replacing regulatory monitors. Regulatory monitors are far more sophisticated. They cost tens of thousands of dollars and are the backbone of EPA's ability to regulate air quality across this Country of ours.

Many of us already have low-cost air quality sensors in our own homes. Carbon monoxide detectors and smoke detectors "sniff" the air and alert us when a problem is detected. The air quality sensors that we are going to discuss today work pretty much the same way.

As members of this committee have heard me oftentimes say, everything I do, I know I can do better. I think that is true for just about all of us, and it is also true for reducing air pollution. We as a Nation can and must do more to address pollutants in our air. Despite our Nation's significant strides since passing the Clean Air Act of 1970, air pollution still

negatively impacts far too many Americans, especially in low-income communities, including communities of color.

The Center for Air, Climate, and Energy Solutions found that people of color are disproportionately exposed to an air pollutant called fine particulate matter, also known to most of us as soot. Exposure to these small but powerful pollutants is linked to lung and heart problems, especially for our kids or people with chronic respiratory diseases. The good news is that low-cost air quality sensors can help detect this kind of pollution, and those sensors are being used appropriately in a growing number of communities.

I believe we have a moral obligation to ensure that all Americans, no matter what their ZIP code might be, are free from the burden of pollution, air pollution in particular. That means equipping communities with tools to improve individuals' access to information about the quality of their air. Sensors help us do that.

Some of you might recall that this committee held a hearing in July of 2022 that discussed the risks of living near or downwind of facilities that emit air pollution. Harmful air pollutants disproportionately affect these so-called front-line communities, but many Americans today do not even know they are being exposed to dangerous levels of air pollution. That is why sensors are critical, because they sniff the air and detect

pollutants that the human eye or the human nose cannot detect. This technology is getting better and more affordable by the day.

Collecting local air data helps States, it helps tribes, it helps communities find pollution hotspots and identify facilities that may be generating excess pollution. Low-cost sensors also save air agencies money by enabling them to direct resources to where the worst pollution is.

As I often say, find out what works and do more of that. Today, we will hear from one of our witnesses about what is working with low-cost air quality sensors in, among other places, Denver, Colorado, one of the best examples of a local air agency working proactively with health care organizations, with schools, and with neighborhoods.

In other places across our Country, cities and local groups are working with their air regulators at the State level. For example, Utah's Department of Environmental Quality is partnering with the University of Utah, as well as with other State and local organizations, to stand up a new air quality sensor program on the west side of Salt Lake Valley. This program will provide almost instant local air quality information through air maps and through alerts.

These sensors complement regulatory monitors. For example, during the wildfires last summer in Delaware, the Delaware

Department of Natural Resources and Environmental Control, we call it DNREC, used data from 11 regulatory monitors, data from the National Oceanic and Atmospheric Administration, and data from low-cost sensors to track air pollution. Using all three sources, DNREC was able to quickly issue public health advisories for vulnerable residents.

In closing, clean air is good for human health. It is good for our economy, and it is good for our planet. It is good for all of us. We look forward to hearing today from our colleagues as they arrive and from our witnesses on the ways in which low-cost air quality sensors can help us reduce air pollution and protect public health.

Before I turn to Senator Capito, I want to thank not just our witnesses for being here and testifying today and preparing for this hearing, I want to thank our staff for helping to find you and to convince you to come today and to share some thoughts and responses to some of our questions. We appreciate the good staff work that has been done.

With that, let me turn to our Ranking Member, Senator Capito, for her opening statement. Senator Capito, you are recognized.

[The prepared statement of Senator Carper follows:]

STATEMENT OF THE HONORABLE SHELLEY MOORE CAPITO, A UNITED STATES
SENATOR FROM THE STATE OF WEST VIRGINIA

Senator Capito. Thank you, Chairman Carper, and thank you all for being here with us today, and I appreciate the travel, and I appreciate the expertise that you will bring.

I think we can all agree that clean air is vital to the health and well-being of Americans across the Nation. However, I am a bit concerned about the Administration and some of the neglect I have seen in the major flaws in the air monitoring data quality. It seems as though the Administration is prioritizing an agenda while misallocating taxpayers' dollars on projects that have limited benefits to our public health and welfare.

First, I think it is important to acknowledge that Americans enjoy some of the cleanest air in the world and recognize just how much air pollution in the United States has been reduced. According to the EPA, between 1980 and 2022, the combined emissions of criteria air pollutants and precursor pollutants was reduced by 73 percent. Hazardous air pollutant emissions have also similarly declined.

Despite this fact, many Americans are led to believe through inaccurate claims that our air quality is getting worse, when, in fact, air quality has significantly improved and can get better. Congress has made significant investments to

support the ambient air quality monitoring network. The Federal Government partners with States, localities, and tribes to build and operate the system. This network is comprised of official stationary air monitors that gather data to inform regulatory decisions and determine regulatory compliance.

While use of these official monitors has been generally successful, deficiencies with one model's accuracy and reliability demonstrate the need to ensure that the monitoring system is maintained at the highest standards and is the most accurate it can be.

One year ago, EPA modified a measurement method on the Teledyne PM Mass Monitory used to track and measure particulate matter. These monitors are crucial to inform potential regulatory actions undertaken by the EPA and the States, including implementation of the National Ambient Air Quality Standards, or the NAAQS.

Peer-reviewed analysis reported that the monitors had led to over-inflated measures of fine particulate matter, or PM 2.5. In other words, the monitors led the EPA and States to believe that the air quality was actually worse than it actually was. These artificially high readings date all the way back to 2017 when they were first deployed. Those Teledyne monitors had a significantly high bias relative to other monitors, including the gold standard reference monitors that the Chairman spoke

about.

On February 14th of this year, the EPA issued a proposal to retroactively modify PM 2.5 data reported from the Teledyne monitors from when they were first deployed from the years of 2017 through April of 2023. The EPA proposal notes that more than 400 Teledyne monitors in our official ambient air monitoring network were consistently producing PM 2.5 data that was 20 percent higher than the real concentration levels.

To be clear, this level of inaccuracy could be stated as unprecedented. It is absolutely critical that EPA prioritize correcting this unprecedented error, which they are doing, and refocus on high-quality, accurate monitoring data that is relied on for regulatory compliance. This is where the EPA's focus should be in a monitoring context before the agency promotes the use of emerging and less accurate sensors.

Despite the challenges faced by the existing network used for regulatory purposes, there has been a choice to prioritize funding for less-accurate, difficult to use, low-cost monitors. The partisan American Rescue Plan and Inflation Reduction Act funded the use of less accurate and reliable low-cost air quality sensors.

A recent GAO report identified key challenges and data deficiencies associated with use of those low-quality air sensors. GAO found that users face difficulty understanding the

capabilities, operations, and maintenance requirements and accuracy of those sensors.

Particularly, GAO noted users often lack the knowledge to select the right sensors or deploy them in a way that best fits their intended use to gain accurate and actionable data. This leads to confusion when the data lacks the high degree of confidence necessary to make regulatory decisions and can cause misunderstandings about the concentration of air pollutants that are affecting our local communities.

Of particular concern, GAO points out that the EPA has not taken basic steps to address issues with sensor use, such as issuing guidance on how to make the sensors more usable for communities. This confusion can undermine confidence in EPA and State regulatory actions, as well as cause our communities and residents to panic about their air quality and misallocated resources.

I am concerned that spending more money on new, unproven, and inaccurate monitors that can't be used reliably to direct our regulatory action will at best be a waste of money or a misplaced priority. Instead, we need to make improvements in the existing monitoring network so that we can build on the substantial progress that have made to improve our air quality.

With that, I yield back, Mr. Chair.

[The prepared statement of Senator Capito follows:]

Senator Carper. Thank you, ma'am.

We are now going to turn to our panel of witnesses. I had a chance to meet all of you personally and to welcome you. We are delighted that you were able to come today.

First of all, I am going to start off with Mr. Omar Hammad. Has anyone ever mispronounced your name?

Mr. Hammad. Often.

[Laughter.]

Senator Carper. Okay. We will try not to do that today. Mr. Hammad is an analyst in environmental policy in the Research Science and Industry Division of the Congressional Research Service, which does such great service for all of our Country and certainly for folks on this committee. I understand that your work focuses primarily on environmental policy issues, including the Clean Air Act, indoor air quality, the National Environmental Policy Act, and environmental permitting. Before joining CRS, Mr. Hammad worked in the Air Progress Branch at the Environmental Protection Agency in Region 2.

Our second witness is Mr. Bill Obermann. Mr. Obermann, good to see you. He is an Air Program Supervisor at the Denver Department of Public Health and Environment. In this role, I am told that Mr. Obermann manages the Denver Department of Public Health and Environment's Love My Air Program. I love that title, Love My Air Program.

Love My Air is a city-led air quality monitoring program that provides real-time air quality information and education to residents of Denver. Mr. Obermann has been with the City since 2019, but has over 25 years of experience in air quality and transportation planning industries.

Third, last but not least, we are going to hear from Ms. Anne Austin, who I believe is from Austin. This doesn't happen every day; it is pretty cool. We are going to hear from you, Ms. Austin.

I understand you are the former Principal Deputy Assistant Administrator for the Office of Air and Radiation at the Environmental Protection Agency, and also a former EPA Region 6 Administrator. Prior to joining EPA, Ms. Austin spent her career working for the Texas State government. What did you do, working for the Texas State government?

Ms. Austin. I served at the Texas Commission on Environmental Quality and also the Texas General Land Office.

Senator Carper. Thank you. We thank all of you again for your preparation. We thank all of you today for your service and for joining us here today to testify and to respond to the questions that we have.

Mr. Hammad, I am going to ask you to please lead us off, our lead-off hitter, and proceed with your statement, if you are ready. Thank you.

STATEMENT OF OMAR HAMMAD, ENVIRONMENTAL POLICY ANALYST,
CONGRESSIONAL RESEARCH SERVICE, LIBRARY OF CONGRESS

Mr. Hammad. Chairman Carper, Ranking Member Capito, and members of the committee, good morning, and thank you for this invitation to appear before you on behalf of the Congressional Research Service.

I am Omar Hammad, and I am an analyst in environmental policy. My testimony draws on my area of specialization at CRS, the Clean Air Act and air quality monitoring.

The U.S. Environmental Protection Agency, or EPA, defines low-cost air sensors as a class of non-regulatory technology that is lower is cost, portable, and generally easier to operate than the air monitors used for regulatory purposes. Some stakeholders have asserted that EPA, State and local air agencies should consider the use of low-cost air sensors in their regulatory regimes due to competitive costs, increasingly better technologies, and expanded coverage.

This testimony summarizes my written statement that I offer for the record and aims to introduce and address the elements of this debate. I will discuss ambient air monitors, also known as regulatory monitors, and their uses; low-cost air sensors and their uses; and the benefits and challenges of both technologies.

Congress recognized the need to address air pollution,

establishing the Clean Air Act with the purpose of protecting and enhancing the quality of the Nation's air resources and providing assistance to State and local governments in connection with the Air Pollution Prevention and Control Programs.

Under the Clean Air Act, EPA is to issue national ambient, or outdoor, air quality standards known as the National Ambient Air Quality Standards, or NAAQS for short, for criteria pollutants. There are currently six criteria air pollutants: particulate matter, ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead.

Establishing NAAQS does not directly limit emissions or compel specific emission controls. Rather, it represents EPA's formal judgement regarding the level of ambient air pollution that will protect public health with an adequate margin of safety.

Ambient air monitoring is the systemic long-term assessment of pollutant levels by measuring the quantity and types of pollutants in the surrounding outdoor air. The Clean Air Act directs EPA to promulgate regulations that establish an ambient air monitoring system throughout the United States.

Regulatory monitoring sites established primarily by State and local air agencies will differ from site to site in the number and type of required monitors and pollutants monitored at

each site. These monitors must meet EPA-designated reference or equivalent methods for monitoring.

Regulators, researchers, communities, and others have relied on the network of ambient air monitors to provide the data needed for studies, source permitting, NAAQS attainment and implementation, air quality alerts, and a host of other applications.

Low-cost air sensors, unlike ambient air monitors, are non-regulatory and relatively low-priced devices, often priced below \$2,500 compared to the regulatory monitors that can reach prices of up to \$50,000. Advancements in technology, micro processing capabilities, and miniaturization have led to an expansion in the availability of low-cost air sensors to measure a variety of air pollutants.

According to the U.S. Government Accountability Office, the use of low-cost air sensors is increasing, driven in part by policy and public interest in air quality stemming from wildfire smoke, neighborhoods near pollution sources, and other concerns.

EPA is involved in the advancement of low-cost air sensor technology, including performance evaluations and best practices for effective use. EPA found that these low-cost air sensors are generally less accurate than their more expensive regulatory counterparts, and stated that data from new air sensor instruments should not be used in a regulatory context at this

time, unless those instruments meet all applicable regulatory requirements. EPA did note that they could be used in identifying pollution hotspots, providing local community-scale air monitoring, assisting in the site selection for new or relocated regulatory monitors, and conducting scientific research.

Ambient air monitoring networks have provided reliable air quality data throughout the Country for decades. In recent years, some observers have raised concerns about the increase in cost to establish and maintain regulatory monitors. Some States and local air agencies assert that low-cost air sensors have been successfully used to supplement regulatory monitors and fill data gaps. Some contend the sensors help decision-makers address specific needs, such as directing limited enforcement resources to achieve emission reductions, saving time and money.

Federal agencies have also made low-cost air sensors available for deployment to wildfire locations upon the request of firefighting agencies. Stakeholders have noted the low-cost sensors have been particularly useful for monitoring wildfire smoke in areas without regulatory monitors.

This concludes my brief remarks. Thank you for the opportunity to testify. I look forward to your questions.

[The prepared statement of Mr. Hammad follows:]

Senator Carper. Mr. Hammad, we thank you for your testimony. We look forward to asking you some questions in a couple of minutes, but let us now turn to Mr. Obermann.

Mr. Obermann, please proceed. Welcome.

STATEMENT OF WILLIAM OBERMANN, AIR PROGRAM SUPERVISOR,
DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, CITY AND COUNTY OF
DENVER

Mr. Obermann. Thank you. Good morning, Chairman Carper, Ranking Member Capito, and members of the committee and fellow panelists. My name is Bill Obermann, I go by Bill. I am an Air Program Supervisor at the Denver Department of Public Health and Environment.

I manage the Denver Love My Air Program, and it is a program that uses air quality sensors to generate real-time pollution measurements for the residents of Denver.

Denver has been in nonattainment of the EPA's standard for ozone since the early 1990s. Add in our population growth, wildfires, and the unique geography of our city up against the mountains, and you have a persistent ozone pollution issue, as well as other pollutants like PM 2.5, which is fine particulate matter 2.5 millionths of a meter in diameter, as you know.

Ozone and PM 2.5 drive our air quality index in Denver and the alert system that is then operated by the State. It is as common to check the air quality index and scan for air quality alerts as it is the weather on a typical summer day in Denver.

This is the context in which the Love My Air Program exists today. It is an example of how local governments are responding to educate the public about health and air quality. We take

real-time data from our sensors and display it on TV screens in 33 Denver public schools. We also have a smartphone app and public website for any member of the public.

Our information is easy to consume and timely. For example, nurses use our information when caring for asthmatic children on high air pollution days. Our program started in the schools, and what we learned is the most responsive population were the nurses. It is best to use these trusted partners to help build more awareness around air quality and health. Today, we are expanding our program into three local health clinics, because they too are trusted partners in health.

So here we are at a pivotal point. Sensors are providing more information on air quality and the official air monitoring equipment by EPA in State agencies is also becoming more affordable and ready for real-time display. The big questions are, how can these monitoring technologies be used to improve health outcomes? From our perspective, there are two ways that Congress can help.

The first way is to direct EPA to establish how air quality monitoring data from programs like ours can be used to complement State analysis and decisions on where to further reduce air pollution, especially in ozone and PM 2.5 nonattainment areas.

EPA has been issuing guidance, as Mr. Hammad said, on how

to operate sensor technologies and networks and performance testing of different sensor technologies, and all that assistance has been very helpful. Denver corrects its sensor data using the State monitoring network and using some of those EPA protocols.

We agree with the GAO report that there is clearly an emerging need to take the next steps in clarifying how our data can be used in a regulatory context. This is even more relevant with the EPA's newly revised annual standard for PM 2.5.

Second, we need to understand how local air quality data captured near large industrial facilities, like refineries, can be used. EPA has guidance that details how this data needs to be collected so it can complement, but not replace, air monitoring conducted by State and Federal agencies.

Today, our air sensor data would not be considered high enough quality to use in an enforcement setting, and we agree with that conclusion. We use our data almost exclusively today as a public health education tool.

But these monitoring technologies are constantly improving, and we will continue to get pressure from our residents on how to take action with this data in a regulatory context. We are only a few short years away from collecting high-quality data at a large scale in our neighborhoods and neighborhoods all over the Country, particularly those adjacent to industrial sources

of air pollution.

I want to reiterate that EPA has been a great partner thus far by establishing data quality standards by publishing things like the Air Sensor Toolbox online available for everyone. We ask that the EPA continue to work directly with us and States to start to answer how sensor data can be used in air quality planning and assessing facility compliance.

EPA should continue to support the local level by providing monitoring equipment and even helping us install it on the ground and help us validate our data. The EPA resources could be increased here as more communities start to use this technology and more of them become available on the market.

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

[The prepared statement of Mr. Obermann follows:]

Senator Carper. You bet. Thanks again for joining us. Thanks for those words, and thanks for what you do with your life, serving our Country.

Mr. Obermann. Thank you.

Senator Carper. We are now going to hear from Ms. Anne Austin, who is from Austin. I don't think we have ever had, in the years that I have been chairing, someone who has a name that just rings a bell like that. That is great.

We are happy you are here. Please feel free to go ahead with your statement, and we will ask some questions once you are finished. Thank you. Welcome.

STATEMENT OF ANNE AUSTIN, FORMER PRINCIPAL DEPUTY ASSISTANT
ADMINISTRATOR FOR THE OFFICE OF AIR AND RADIATION, U.S.
ENVIRONMENTAL PROTECTION AGENCY

Ms. Austin. Chairman Carper, Ranking Member Capito, and members of the committee, thank you very much for the opportunity to testify on the topic of air quality monitoring technology. It is a pleasure to be with you here today and in such good company with my fellow panelists.

As you know, the U.S. has experienced dramatic progress in air quality in recent years, and these improvements have spanned Presidential Administrations and hold true for criteria air pollutants such as ozone and PM, greenhouse gases like CO₂ and methane, and hazardous air pollutants like formaldehyde and benzene.

As envisioned by Congress and embedded in the Clean Air Act, this progress is built on cooperative federalism between the USEPA and its State, local, and tribal partners, as well as a backbone of high quality, regulatory-grade monitors. It is important to note that as our air quality has improved, and while the NAAQS have become more stringent, the contribution of air pollution from forest fires and international transport have grown in significance. This makes a high-quality monitoring network and the ability of EPA and its State and local partners to provide regulatory relief through Clean Air Act tools like

exceptional events even more important.

Consequently, nonattainment designations for areas that cannot meaningfully address the background, fire-related, or international contributions will not address the remaining air quality issues in our Country, and this raises the important issue of the current state of technology with respect to air monitors and sensors and where low-cost, portable air sensors fit into the picture.

As you know, EPA, State, local, and tribal partners have long relied on a robust monitoring network which complies with quality control and quality assurance measures and data quality specifications that conform to Federal reference methods and Federal equivalent methods used for regulatory purposes. These monitors are subject to Federal regulations, and in short, they are carefully tested, very carefully calibrated, and carefully maintained because of the important role the data generated from the monitoring networks plays in the regulatory decision-making at the local, State, tribal, and Federal levels.

The appeal of low-cost air sensors is readily understandable, as they are widely accessible to individuals, as well as interested parties. They are good tools with which to explore one's local environment and to learn more about air quality and perhaps may even have a role to play with respect to identifying local air quality issues that merit further

monitoring and analysis by a regulatory agency.

However, and among other things, the personal air sensors lack quality control and quality assurance measures. They have not been subjected to the same rigorous FRM and FEM testing and analysis, and they may have high levels of variability between the different instruments.

In short, they are certainly an air quality tool, and they have their place in that toolbox, but the technology has not yet been subjected to the same level of rigorous testing and analysis that the existing monitoring network has stood up to for years, albeit with its own shortcomings. Therefore, low-cost sensors may not quite be ready for prime time when it comes to being fully incorporated into the Clean Air Act required network utilized for agency regulatory, permitting attainment, and enforcement decisions.

Instead, it would be worthwhile to refocus our attention, energy, and resources to Clean Air Act programs focused on the most pressing air quality issues grounded in cooperative federalism and focused on a robust, high-quality regulatory monitoring network. For one, how Federal funds are directed via intergovernmental organizations and State and local and tribal agencies. All of those organizations have raised longstanding concerns about the relative lack of resources for building and maintaining that robust monitoring network for criteria and

hazardous air pollutants.

Furthermore, EPA has repeatedly proposed to shift Federal resources for PM 2.5 monitoring to a different part of the Clean Air Act, which would limit Federal funds, require a 40 percent cost share for States, and potentially divert State and local resources from other priorities. Fortunately, these proposed shifts have yet to be implemented.

Third, you have also seen the reduction of key State, local, and tribal experts on EPA air quality programs and with respect to the science advisory boards. This should also be reversed to ensure that the proper perspective and leveraged expertise is provided when these decisions are being made at EPA.

Fourth, there is a significant need to address comparability issues between FRM and FEM standards to mitigate challenges for future PM NAAQS attainment designations. And fifth, as Ranking Member Capito highlighted, there is a clear and present need to address positive biases identified in the EPA's air quality system. This is critical, given the recently updated PM 2.5 primary standards and the tight timeline under which States must provide initial area designations and subsequently craft State implementation plans.

In conclusion, while personal air sensors can be useful tools to better understand our air quality, and they may be

useful indicators, they are not dispositive. The existing air monitoring network which we rely upon for regulatory decision-making deserves our far greater focus, energy, and resources now and in the future.

Thank you for the opportunity to provide testimony, and I stand by for your questions.

[The prepared statement of Ms. Austin follows:]

Senator Carper. Thanks very much.

I am going to telegraph my pitch. I am going to give you an idea of what I am going to ask next, but first, I am going to ask a question about FRM and FEM standards.

Before I do that, one of the things we try to do in this committee is look for consensus. Sometimes, it is not that hard to find. Other times, it is pretty hard and we have to work at it especially diligently.

The question I am going to ask you after I ask you to talk to us about it, FRM and FEM standards, the question I am going to ask you is where do you think there is agreement among the three of you? Where do you think there is agreement among the three of you and the relevant issues before us? Where do you think there is disagreement, and how might we reduce that disagreement?

First of all, Ms. Austin, FRM and FEM standards, not everybody knows what we are talking about. Just give us a quick primer.

Ms. Austin. I would be happy to. Thank you for the question, Senator Carper.

FRM standards, the Federal Reference Method, is considered the gold standard by EPA as it relates to monitoring networks. Very rigorous testing and analysis is required for that label to be attached to a monitor. FEM is an equivalent method that EPA

can also designate to monitoring technology when new ones come online and as technology continues to innovate.

Then, you have the more recent advent of the low-cost air sensors, which are not subject to those two types of federally recognized and required methods of analysis and data collection.

So the FRMs and FEMs are standardized. The low-cost air sensors are not at that place yet, and quite frankly, understandably so. I think one thing that everybody on the panel could agree on is that technology innovation within this space is a good thing. We want to continue to innovate.

The better data, better technology that is at a lower cost is good for the public. It is good for the U.S. taxpayer. But at the same time, rushing lower cost technology for the cost of something new does not necessarily put us in the right position from a regulatory standpoint to ensure that we have maintained that public trust and confidence that, when regulatory decisions are made, it is on correct data that is going to be durable.

I hope that helps.

Senator Carper. It does.

Let me ask you the same question, just for your thoughts on this, Mr. Obermann, and then Mr. Hammad.

Mr. Obermann. Sure, thank you, Mr. Chairman.

I believe Ms. Austin is correct. We do have a problem with our air monitoring network, the regulatory monitoring network.

It is in need of attention.

Our State programs maintaining these pieces of equipment, some of them decades old, there is need for funding there and attention, no doubt about it. We are on those monitoring locations co-locating our air sensors to ensure that our sensors are reading correctly. I see that equipment a lot in the field.

The need for those programs to be fully funded, especially as we are now in Denver and other cities looking very carefully at the new annual PM 2.5 standards, those regulatory monitors will be depended on more than ever. I think there is some consensus there.

Are there other questions I can answer for you there?

Senator Carper. No, that is good. Thank you.

Mr. Hammad, same issue. Anything you would like to add or take away?

Mr. Hammad. I will just say, according to EPA, the Federal reference methods are designed to provide the most fundamentally sound and scientifically defensible concentration measurements, so they serve as the basis of comparison upon which to judge all other measurements.

The FEMs are intended to use innovation and innovative technology to provide comparable levels of monitoring as FRMs. FRMs and FEMs will differ from low-cost air sensors because they will undergo technical and administrative reviews. A lot of

quality assurance is going to go into them; a lot of testing is going to go into them.

Low-cost air sensors, there are no standard methods for testing, data collecting, or siting. They provide data that is non-uniform, non-standardized. But again, depending on who is using it and for what the data is being used, they could provide insights into further information that might be needed.

However, we don't differ in terms of what the FRMs and FEMs are meant to do and their use and benefits, and we can agree all on that.

Senator Carper. How would you explain that to your grandmother if she was on this panel, sitting up here with us? Seriously, how would you explain it to your grandmother? Is your grandmother still alive?

Mr. Hammad. They passed away.

Senator Carper. Well, that is too bad. They are listening.

Mr. Hammad. If I was going to explain it to my grandmothers, I would tell them that there is, for regulatory purposes, the government is going to use for their monitoring monitors that they have checked, double-checked, and triple-checked, assess the network, assess how they are laid out, assess how they collect the information. They co-locate monitors to make sure that they are operating the way they are

supposed to operate. They make sure that the data they are getting from these are useful and accurate to a degree where, if there is something off, they can assess what is off and correct it, as well.

They have important uses and purposes. They last for decades. The information we get from them is a very important and reliable source of data.

Low-cost air sensors, like other emerging technologies, my grandmothers saw the advent of cell phones, and they saw how they came to be, but like all technology, with the advancements in micro processing and the miniaturization of data and technology, these low-cost air sensors have become smarter. They have become better tools to do what they are meant to do.

Senator Carper. All right. Well, I am sure that your grandmothers are looking down and saying, that is our boy. Thank you for that response.

Now, Senator Capito.

Senator Capito. Thank you. My first question was going to be to Mr. Hammad, but I think you have already answered it, and that is the difference in the technology and quality. I think we have established that, on the Federal reference monitors, and then the portable low-cost. I think we pretty much understand what that is. It is a licensing thing; it is an accuracy thing.

I brought up, Ms. Austin, in my comments about the

Teledyne. I am a bit confused, because everybody is saying that these low-cost air monitors are not being used in a regulatory environment. I have a map here that shows the regulatory monitors and then, in the blue, it has the Teledyne monitors, which are meant to augment, I think, what is going on with the regulatory monitors.

Are you telling me that these blue dots don't really have any effect in terms of finding data for regulatory purposes?

Ms. Austin. My understanding is that they do, in fact, have and have been used for regulatory purposes. As I am sure you all know, the EPA recently proposed an update for the PM 2.5 data from T640 and T640-X PMS monitors manufactured by Teledyne, and have proposed to actually retroactively apply the network data alignment equation to all of the hourly, unaligned monitors in EPA's air quality system.

Senator Capito. Let me just stop you there.

Ms. Austin. Sorry. Yes, it is a lot.

Senator Capito. Thinking about the grandmothers, and I am thinking, what that is saying is what I think I said in my opening statement, is that they have to recalibrate their data because it was inaccurate.

Ms. Austin. Yes. That is correct, going back to 2017. The reason why that is so important is because, as you are looking at a NAAQS designation and whether or not an area falls

in or out of attainment or stays in attainment is critical to States.

Senator Capito. Okay.

Ms. Austin. The reason for that being, and if you don't mind, I will use the State of West Virginia as an example. As I understand it, you have some monitors that are showing that you have 9.1, 9.2 micrograms per cubic meter of PM concentration in different parts of the State.

Well, if those monitors are Teledyne monitors and are one of the two models that have been used and need to have that information retroactively corrected for the high positive biases that have been recorded over the past six to seven years, that could make the difference, potentially, whether or not those areas fall into nonattainment or are considered attainment areas. That has subsequent regulatory and economic repercussions that could be rather significant.

Senator Capito. Right, right. Okay, so that is the point, is, and thank you for that clarification.

So, this concerns me, because as we see this NAAQS or the PM 2.5 moving down, those that are on the edge or close to the edge, it is going to have a big impact if there was inaccurate data. So they will be correcting that. But I think it does go to, it is going to impact regulatory. I don't think we can say that these low-cost monitors are impacting any regulatory data.

Is that a true statement?

Ms. Austin. Yes, I would say that they certainly inform. EPA would not go through the process of seeking to correct the data inaccuracies, which I think they do a very solid job laying out the rationale for making that correction.

Senator Capito. Right, thank you.

Mr. Obermann, what is the Denver, what is your particulate matter? Where are you measuring right now?

Mr. Obermann. Where are we measuring in our concentrations of PM 2.5?

Senator Capito. Yes.

Mr. Obermann. We are just below that 9 micrograms per, it depends on what years you are looking at.

Senator Capito. So, 8.9, or 8.5, or are you way below?

Mr. Obermann. No, we are, I would say, in between 8.5 and 9.

Senator Capito. Okay. So what impacts is that going to have on Denver's ability to do new projects, economic development, manufacturing? Is this going to have some impacts on that as that moves down and you are close to the nonattainment area?

Mr. Obermann. There will certainly be much planning in process if we actually become nonattainment for PM 2.5. We don't have that clearly stated yet, that is not a formal

declaration that has been made for the Denver area. It could be multiple counties. It depends on which counties would become non-attainment, potentially, for PM 2.5.

Would there be impacts to business in, say, Denver County if that happened? Yes. Yes, absolutely. There would be control technologies, most likely, that would be implemented at certain types of facilities that are high emitters of PM 2.5, and we would go through an extensive regulatory process at the State level, which we do today, it is why I know so much about it, with ozone, to bring reductions down, not only from industry, but also transportation from even other practices that generate air pollution that aren't just at an industry.

Senator Capito. There are, agriculture, yes. Right, yes. Yes, I think that is a good point. This will have a lot of impacts on economic development, so we have to get accurate data, certainly at the minimum, accurate data.

When you were talking about your citizens' use of the index, I was thinking back to maybe six months ago when we had the Canadian wildfires. I was following every day what the index is on this, so I really see what the public health implications are to be able to access that.

I just pulled up the Weather Channel, actually, when we were talking, to see if they have it still on there since we are not in a crisis kind of thing. It is all right there, so you

can see it.

Would those measurements be on a regulatory measure, or are those on low-cost measurers, or do we know?

Mr. Obermann. Yes, I appreciate that question. The air quality index that you are viewing through your smartphone, while I don't know exactly which one or app you are using, is most likely based on the regulatory monitoring network, the FEM-FRM network.

Senator Capito. It is? Yes.

Mr. Obermann. Love My Air, for example, in that city program, we do not push air quality alerts out to smartphone apps or anything like that.

Senator Capito. You don't?

Mr. Obermann. We do have our own AQI generated for our school program, where when you walk in the school building, it is the conditions outside of the school that has an air sensor on it. Those students, that community, does see our AQI calculation, which is based on EPA's, but the mass communication of AQI and air quality alerts in Denver is all handled by the State, and that is based on their reference network.

Senator Capito. Yes, okay. All right. Thank you.

Senator Carper. You bet. We have been joined, as I am sure you noticed, by a couple of Senators who thought a lot about these issues and have been very much involved with them,

particular Senator Markey. I will recognize you, and then Senator Padilla. Welcome. Thanks for joining us.

Senator Markey. Yes, thank you so much, Mr. Chairman. We are well into a new information era, but our air quality monitoring systems can be seen to be stuck in the stone age. Black, brown, low-income communities that live in the shadow of air pollution deserve better. They deserve to know what they are breathing, and they deserve to have regulators do something about it.

To tackle this problem, I introduced the Technology Assessment for Air Quality Management Act, cosponsored by 11 of my Senate colleagues, which would report on air quality monitors and sensors that provide a holistic understanding of local air pollutant measurements. It would also support additional staff at the Environmental Protection Agency who would provide accessible information advice and resources to communities about how to use air quality tools and, importantly, the data which they produce.

Mr. Obermann, do you agree that low-cost, local air quality sensors can complement regulatory monitors, finding pollution in fence line communities that these monitors might miss?

Mr. Obermann. Absolutely.

Senator Markey. Mr. Obermann, can this information be used to spur action that addresses air pollution in fence line

communities and other pollution-burdened communities?

Mr. Obermann. Yes.

Senator Markey. Thank you. That information could support decisions to issue alerts to wear an N-95 mask, to use mass transit, to halt outdoor activities, all across the board. It could be used for that purpose, sir?

Mr. Obermann. Yes, I think it could be used for that purpose if we had more clarification and understanding with EPA on how to use that data for mass air quality alerts through the State's existing system.

Senator Markey. Yes. So I would welcome my colleagues' support for my legislation to provide more access to and information on these important technologies. Just getting the information then requires a response to it, but we first have to have the information.

As the author of the Environmental Justice Air Quality Monitoring Act, last Congress, I fought for the inclusion of funding for air quality monitors and sensors in the Inflation Reduction Act, including \$3 million just for low-income and disadvantaged communities. And that funding is already being put to work with \$2.1 million heading to Massachusetts. I thank the Chairman for all his work on that issue. The Mystic River Watershed Association received \$500,000 for a new network of air quality monitors in Charlestown, East Boston, Everett, and my

hometown of Malden.

I grew up breathing dirty air. I lived in an environmental sacrifice ward in Malden, Massachusetts, where there was just a big black cloud. The Malden River was completely polluted. The Malden River was three blocks from my house. My mother used to say, Eddie, whatever you do, don't swim in the Malden River, because it was kind of black with a pre-Jimi Hendrix purple haze over it. When your mother says don't swim in the Malden River, you know that you are not growing up on the Mississippi like Tom Sawyer.

Senator Carper. Did you say purple haze?

Senator Markey. Purple haze.

Senator Carper. Thank you.

Senator Markey. Thank you so much, and thank you for maybe actually being one of the only people who remember that great song, long ago and far away.

Mr. Obermann, in your experience, with Denver's Love My Air Program, was it important to have outcomes for communities beyond just a collection of data?

Mr. Obermann. Yes. I would say, in the future, we are looking at how this data can be used for more outcomes than just public health education and awareness, which is how we are using it today. A big reason we are only using it at that level today is, one, the sensor technology is not robust enough to bring it

into a regulatory context, but that technology is improving. We are about to buy six high-quality monitors. They have come down in price dramatically.

They are FEM monitors, so they are that higher-grade of monitoring technology. And here we are in this city, able to buy them and deploy them. As we deploy those pieces of equipment at health clinics in front-line communities, we will absolutely be looking for how can this data be used in the policy and regulatory space.

Senator Markey. Thank you. Thank you, Mr. Obermann.

Thank you, Mr. Chairman. Thank you.

Senator Carper. Thank you. Thanks for all of your work in these fields.

Before I turn to our next questions from Senator Padilla, I am going to ask unanimous consent to enter into the record materials on the differences between sensors and regulatory air quality monitors. Is there objection? Hearing none, so ordered.

[The referenced information follows:]

Senator Carper. Senator Padilla, how are you doing? Good morning.

Senator Padilla. I am doing well, Mr. Chairman.

Senator Carper. Welcome. Good to see you.

Senator Padilla. Thank you. Thank you for organizing this hearing today and the opportunity to discuss the air quality monitoring technology, something that the State of California has more than 50 years of experience with. We have maintained one of the most extensive air monitoring networks in the world, actually, not just in the Nation, but around the world, which allows us to track progress and identify opportunities to act decisively to protect public health. It is both about air quality, but also about public health.

Mr. Obermann, I want to thank you for your leadership in Denver. As you know and as you mentioned in your testimony, in California, we have a lot of experience with this, especially in the South Coast Air Quality Management District, the Bay Area Air Quality Management District, where they have worked diligently to deploy low-cost air monitoring sensors in impacted communities.

My first question for you is, how can we best share these experiences and best practices across jurisdictions and certainly across State lines?

Mr. Obermann. Yes, thank you for the question. We are

sharing information between the air quality management districts, for example, in California frequently. They are definitely great partners, and there is actually an international conference on sensor technology starting April 30th through May 4th. I know both the air quality management districts will be there presenting. They have great staff and stories to tell about how they have been using sensors in those communities, and they serve as a model, really, for the rest of the Country.

So we share information just between agencies on occasion, and we also, there are several conferences nationally where we present on our sensor programs to each other.

Senator Padilla. Just to be clear, specific, and intentional here, the information sharing, it is not just data that is collected or how it may be interpreted, analyzed, acted upon, but also just evolving technologies and practices, programmatic information exchange?

Mr. Obermann. Yes, we definitely exchange information around what technologies we are using, how that data is corrected against the regulatory monitoring network, for example, and how we use it in our public health and awareness programs.

Senator Padilla. Great. You have spoken well and eloquently about the need to maintain this as a priority.

I appreciate the Chairman's leadership and the work of, frankly, Democrats in Congress when we were very intentional in crafting the American Rescue Plan and the Inflation Reduction Act to include significant resources to help disadvantaged communities who are disproportionately impacted by poor air quality and tend to have less monitoring capabilities, less ability to obtain accurate air quality data, et cetera.

Recent EPA awards have gone to California applicants like the Pala Band of Mission Indians to enhance air monitoring on their tribal reservation. Another recipient has been the Comité Civico del Valle organization to upgrade real-time air monitoring networks in the Salton Sea area of California. I think the recent influx of funding will enhance monitoring to other underserved communities.

Mr. Obermann, next question for you is, what can the Federal Government do to make it easier for local or tribal jurisdictions to lessen the learning curve in implementation of low-cost air quality sensors?

Mr. Obermann. Yes, thank you for that question. It is to provide boots-on-the-ground assistance. It is for EPA and other technical experts, consultants that they have oversight over, to be in those communities helping them not only stand up the sensors, and that is critically important because where is the sensor located, or even higher quality monitoring equipment that

they could buy. It might not be a low-cost air sensor.

Like I mentioned, Denver is purchasing monitors that are higher quality. Some of those grants could absolutely go towards purchasing higher quality monitors. They are not each \$50,000 anymore.

So, where do you site those? How do you power them correctly? How do you compile the data, and then even some assistance on what does that data mean for your health? There is a lot more assistance that EPA and the States could provide at the local level to show communities what this data really means, especially as higher quality data is collected.

Senator Padilla. Can you speak to any specific or additional efforts needed to help avoid improper sensor selection, for example, or incorrect data interpretation so we can actually just make sure the program is effective, but we build the trust and support from communities that rely on it?

Mr. Obermann. That is an important point. I think, with the EPA's first round of community air monitoring grants, while Denver did not receive one, I do know that there is a quality assurance plan that they require from those grantees, meaning if you are going to implement this type of sensor in this type of context, what is the quality assurance? What is the quality of the data that you are planning to collect?

I think that is a really good requirement EPA has put in

there to answer that question, so that we know what the quality is of these different sensors when they are used in these programs.

Senator Padilla. Thank you very much. Keep up the good work.

Thank you, Mr. Chairman. One last note, I am eagerly awaiting your Earth Day playlist.

Senator Carper. One of the songs might have "purple" in it. We will see.

I have several more questions, but I am going to yield to Senator Capito. Thanks very much for joining us. See you later.

Senator Capito. Yes, thank you, Mr. Chairman. I have to scoot after I have asked my final question here.

Mr. Hammad, the low-cost sensors have been known, obviously, we have talked about this, inaccurately high pollution levels while operating in high humidity or smoky or other less-than-ideal circumstances. So, are there negative side effects that State agencies face with regard to risk communications or public trust that could result if publishing inadvertent high pollution levels, what kind of impacts would that have in terms of trust and communication?

Mr. Hammad. Thank you, Senator. I will point out that the Teledyne monitors that you were pointing to earlier, those are

regulatory monitors. They are not low-cost air sensors.

Senator Capito. Right, okay. Thanks for that distinction. And they are inaccurate?

Mr. Hammad. Those are the ones that need the corrections. So, those are FEMs, not FRMs, but FEMs and FRMs are both combined regulatory monitors. FEMs use innovative technology like light and lasers to check optically how much particulate matter is in there, whereas a reference method monitor for PM would use something like a filter that you would send to a laboratory to test.

Senator Capito. Do you happen to know, this is not the question I was going to ask, but now that we are on this, do you happen to know how that discrepancy was discovered by the EPA?

Mr. Hammad. So, the State air agencies had been pointing to this since roughly 2019, 2020 to some of these discrepancies that they were finding, because they have co-located. Again, they don't have just one PM monitors or two PM monitors. Oftentimes, three or four air monitors are in their monitoring site. They will have several of them, and they will run them to ensure that they are getting accurate measurements.

The FRMs are what we base, in this Country, EPA bases everything off of the FRMs. The FRMs do not give you real-time data, but they will give you sometimes 24 hour or three day, you pull it through a filter, and then you send that filter to the

laboratory, and it will tell you how much particulate matter of a certain size exists. You use that to then make sure that your Federal equivalence method, your FEM regulatory monitor, is reading correctly.

In the T640, T640-X corrections that were noted earlier, EPA pointed to the fact that there had been, according to temperature variations, humidity variations, wildfire smoke issues, there have been issues where, with low temperatures and high humidity, these monitors, the equivalent monitors, the FEMs, which are still regulatory, were reading abnormal data that wasn't correlating to the FRMs. Based on the weather data and all the other sensor data that is available at these regulatory monitoring stations, EPA is able to go in and make the corrections based on the location of where your monitoring station is.

Senator Capito. And the other data that they have. So, this has been in front of the EPA since 2019 with State monitoring agencies, and they are just now getting around to figuring this out?

Mr. Hammad. Well, they needed to then formulate the actual correction equations with Teledyne to figure out, well, how do they adjust based on location, based on the technical expertise of the people who manufacture the monitors along with EPA's expertise. They lay it out in their technical support document

that they published in that February 14 Federal register, but they had to work with Teledyne and the scientists that EPA had to figure out how, based on your location and how to correct this.

Senator Capito. How to do it. Did they put a date on that, like when they would complete that?

Mr. Hammad. The corrections, they proposed the corrections on February 14th. The comment period closed March 14th. They will finalize it; I don't know when. Once it gets finalized is when they will push out the correction, but they have the equations ready to roll out. They will work with the State agencies to perform those corrections.

Senator Capito. Well, it would be very timely with this new regulation coming out to make sure that we are dealing with correct data. I think we would all agree with that.

Thank you all very much. Thank you.

Senator Carper. Senator Capito, thank you. Thank you very much.

I understand Senator Kelly is trying to join us today, but hopefully he will arrive while we are all still here.

I have a question for Mr. Obermann. The term Love My Air Program. I love that. That is really a cool way to label a program, make it alive and real. Where did that come from? Words actually matter, and I like the choice of those words.

Mr. Obermann. Sure, yes, thank you for the question, Chairman. Our program name came from our own staff from within our department. We were working with our communications group and when through several options and came up with Love My Air. It is not a very exciting story, but that is really where it came from.

Senator Carper. I was just thinking, maybe in our respective States, we could come up with something like Love My Senator.

[Laughter.]

Senator Carper. I don't know if we could get away with that. Probably not.

Mr. Obermann, seriously now, the City of Denver is a pretty clear example of how local governments are using low cost air sensor data to educate the public about health and about air quality. My question, and I will have a follow-up to this as well, but my question is: in addition to informing students about whether to stay indoors or play outside, how else does the Love My Air Program benefit public health?

Mr. Obermann. Yes, thank you for that question. The ways that Love My Air benefits public health is much more than just sensors displaying information in a public school or even emerging now into health clinics. It is not just about the data; it is what does that data mean for students, for the

community, for whoever we are streaming that data to.

So, we accompany our data with a lot of education, and our education is very group and small group focused. It is not broadcast to the millions of Denver residents. It is working in classrooms. It is doing teacher trainings. It is doing nurse trainings about air pollution and health.

So, it is working at an individual level, and we find that is a really successful way to have a dialogue about what this information means and how it is important to either their own personal health or the care that they administer to others, such as nurses. Really, our air pollution monitoring and the sensor network, it is an introduction to a discussion about air quality, and I would say we probably spend 75 percent of our time actually working with individuals to understand air pollution and health.

Senator Carper. Good, thank you.

Do you know if there are any other cities that are replicating the efforts that you all have taken in Denver with your Love My Air Program?

Mr. Obermann. Yes, there are. Yes, thank you for that question. There are several others that are replicating our programs. We even licensed that name, Love My Air. There is an entity in Wisconsin that is implementing a Love My Air program in Milwaukee public schools. Some of our adjacent counties in

Denver along Denver's front range are also replicating the Love My Air Program and using that same name.

But the emergence of these programs, particularly in public health departments, is rapid. Not only with the EPA grant funding to help start many of those programs, as you are all well aware of, but also, I will say this: our Love My Air Program is not EPA funded. It never has been.

Our program was funded initially by a generous grant from the Bloomberg Foundation in 2018, and now, we are expanding into health clinics through another grant from the Kaiser Permanente Foundation. There is a lot of interest even from grant-making entities other than EPA to fund these types of programs from a public health standpoint.

Senator Carper. I am going to ask you for the record, if you could just give us some idea of what other cities that are interested in replicating what you are doing in Denver, who might they contact and how might they contact that person or persons. You don't have to respond right now. You can just respond for the record.

Mr. Obermann. Some of the other people in other cities that are replicating?

Senator Carper. If someone wanted to reach out to you all in Denver.

Mr. Obermann. Oh, that can be myself. Yes, Bill Obermann

at the Denver Department of Public Health and Environment.

Senator Carper. All right, that is good. I like to say find out what works, do more of that, right?

I will go ahead and ask, because I think we have sort of asked this already, but the City of Denver is a pretty clear example of how local governments are using low-cost air sensor data to educate the public about health and air quality.

I think you may have already addressed this, but I will ask it again, anyway. In addition to informing students about whether to stay indoors or play outdoors, is there anything else that the Love My Air Program does to benefit public health that you want to mention?

Mr. Obermann. Love My Air is engaged in a number of policy contexts at the State level. I want to be clear: we don't use our sensor data today in any policy settings like at State air quality rulemakings, but I am involved there quite a bit. Knowing the information that comes from our sensor network, plus all the dialogue, like I mentioned before, 75 percent of our time is spent in dialogue with communities, hearing their stories, knowing those front line communities, bringing their stories, and bringing them to air policy convenings at the State is critical, and Love My Air has a big role to play there.

While we do not use our data today in those policy settings, we certainly bring the voices of those communities

that are experiencing that air quality.

Senator Carper. Okay, thank you.

Mr. Hammad, in your written testimony, I believe you mentioned that low-cost air sensors have been particularly useful for monitoring wildfire smoke in areas without regulatory monitors. Question, how does the Federal Government use low-cost sensors and their data to inform citizens about healthcare risks from wildfires?

Mr. Hammad. Thank you, Chairman. Led by the United States Forest Service, the Interagency Wildland Fire Air Quality Response Program was created to address risks posed by wildfire smoke. The program has a national cache of air sensors and other equipment and deploys technical specialists called air resource advisors during large smoke events.

Air resource advisors may provide, install, and operate low-cost air sensors and other equipment. It is portable in nature. They develop smoke forecasts and share the information with wildfire response teams, air quality regulators, and the public.

They also have, as I mentioned in my statement, they have air sensors that they will loan out to firefighting agencies upon request, as well.

Senator Carper. Thanks.

Beyond Denver, how are other communities and local air

regulators using low-cost sensors to identify hotspots that need more resources?

Mr. Hammad. Some local air agencies have used non-regulatory low-cost air sensors to help direct their regulatory enforcement resources. They use them to locate hotspots and then implement targeted inspection initiatives. This can be to go after truck idling or to inform regulatory inspections that might happen less than frequently in one location or another.

Senator Carper. All right.

We have been joined by Senator Kelly. Senator Kelly, good morning. How are you doing?

Senator Kelly. Thank you, Mr. Chairman. Sorry I am late.

Senator Carper. No, you are right on time.

Senator Kelly. I deferred my time to Senator Rosen, so I had to go to the back of the line in Armed Services.

Thank you to all of our witnesses for being here today. I want to start with Mr. Obermann. So, air quality, obviously, a pressing issue in the west, in Arizona, but really throughout the western United States. As I imagine has already been discussed, worsening wildfires, interstate and international air emissions have also had real impacts in the State of Arizona, especially when it comes to particulate matter and ozone pollution.

Right now, in the Phoenix metro area, we are seeing ozone

concentrations increase even as the region's emissions of ozone precursors, the chemicals that contribute to ozone, are going down. So, the chemicals are going down, but ozone concentration is still going up. This means that a region is being pushed into a more serious classification of nonattainment without having a full understanding of what steps can be taken to bring the concentrations back down.

What leaders in Arizona have been calling for is a renewed commitment by EPA, both at the regional and headquarters level, to focus on the data and science to help understand these new challenges. That is what I think makes this hearing important today.

Mr. Obermann, I know that the Denver region is also in nonattainment for ozone pollution. Can you speak to some of the regional issues like wildfires in western States, like Arizona and Colorado, and how this makes air quality attainment more challenging and why?

Mr. Obermann. Sure, thank you for that question, Senator Kelly. Wildfires are a persistent and major impact to air quality. We have experienced that in Denver, much like other western cities.

With the new PM 2.5 annual standard, I think the pressing need to understand how wildfires qualify as exceptional events will be very important. Whether it is called an exceptional

event though, for nonattainment area planning and conformity with the Clean Air Act, it is still a public health issue. Wildfires are really, I believe, one of the principal reasons we are here today talking about air sensors, because the public is more aware of air quality through the wildfires we have experienced and through the response of the sensor network than ever before.

So, the need for understanding how that data can be relayed to people and relayed timely and accurately is more important than ever. The nonattainment issues around ozone that we have had in Denver since the early 1990s, we agree that much of that pollution is also transported. It is not due specifically to wildfires, since we know that wildfires are really emitting precursor emissions to ozone, as you mentioned, but ozone is transported, certainly, from States upwind of ours.

The more research we do in ozone pollution, the more we find that that transport, we have little control over, so what kind of things can we do on the ground that would actually reduce emissions that admit the precursor pollutants of ozone. We are working very hard on that in the Denver region. We will continue doing so through the next decade.

Senator Kelly. How many of these low-cost sensors do you have deployed?

Mr. Obermann. We have them deployed in 33 schools, Denver

public schools, and several others just really for reference, network, and QA-QC.

Senator Kelly. And they give you both ozone concentration and precursor chemicals?

Mr. Obermann. No, they only read PM 2.5, particulate matter 2.5. They do not read ozone, and they do not read other, what we would call precursor pollutants, like NO2 to ozone.

Senator Kelly. Is that because they are, are there sensors available that do?

Mr. Obermann. Yes. The reason we use PM 2.5 is partly the age of our program. At the time our program was implemented, PM 2.5 sensors were some of the best technology on the market, the most reliable technology. We can correct it against the reference monitoring network that is operated by the State.

So it is not to say that we wouldn't monitor ozone in the future or emissions, pollutants like nitrogen dioxide. We could, and we actually will be in those higher quality monitoring stations that we are going to be buying this year and next.

Senator Kelly. What would an ideal system look like of monitoring? What would you want if you could get all the data? How many would you deploy in a city the size of Denver?

Mr. Obermann. Yes, thank you for that question. The ideal monitoring system we would deploy would monitor multiple

pollutants at the same time, and that is what we are purchasing. Much of the air sensor technology available today really monitors one or two pollutants. That is what makes it more affordable.

The city can purchase multiple monitors that they put in one box, and we can purchase up to 10 of those over the next several years and disperse them throughout the city. In a city the size of Denver, about 10 is a good number, and that is partly because some of these pollutants we monitor don't vary tremendously location by location. PM 2.5 doesn't vary tremendously location by location.

Ozone is a regional pollutant, so there is not really a need to monitor that on every block. But there are other pollutants like black carbon, nitrogen dioxide, certainly other pollutants that we can monitor today that do vary tremendously location to location.

Senator Kelly. When a pollutant like nitrogen dioxide or black carbon varies location to location, can you then infer some kind of vector from it, and say, well, since we have this variation, we can say that it is coming from a certain location, or at least a direction?

Mr. Obermann. We, today, do not look at our data at that short of a time period. We look at trends over, say, the last month or the last year. Do we see hotspots in our network, even

our PM 2.5 sensor network, when we look at a day-to-day? Yes, but I wouldn't say that there are persistent hotspots that we see from our PM 2.5 network today.

We don't know if we are going to see that when we start to implement our NO2 monitoring that I mentioned we are going to be purchasing in the future here. So the answer is, we don't really know yet if we would see a lot of variation in those pollutants, but we are going to find out.

Senator Kelly. Thank you, and Mr. Chairman, can I have a few more minutes, or are you ready to wrap it up?

Senator Carper. I am ready to hear more from you. Go right ahead.

Senator Kelly. Ms. Austin, I appreciate the comments in your testimony about how the EPA and the need to invest in more resources to help regions track regulated pollutants. I think another important aspect of this issue is developing region-specific models to help air quality officials understand what needs to be done to improve air quality.

Can you expand a bit on what kind of costs are involved in developing these regional airshed models, and can you explain why modeling for ozone pollution is challenging?

Ms. Austin. I would be happy to get back to you on the cost related to regional airshed modeling. I do not have that information before me now, but I would be happy to get it to you

after the hearing.

I would say that some of the general challenges related to regional air modeling and the State of Arizona's, State of Colorado, most western States, for something like ozone, do present unique challenges, given the seasons in which ozone are traditionally higher. Your topography and geography can play significant roles in how that modeling is done and how it is captured, and ultimately, how that is reflected in the data.

An ozone challenge in the eastern part of the United States, say, down in the Carolinas or even Virginia, which is right next door, will present probably very differently than it would out in the west. Those are important considerations for EPA to be able to take into consideration when it is promulgating policy, when it is recommending changes, when it is reviewing State implementation plans.

So, I definitely think that those are the types of issues that EPA endeavors to in a way accordingly and appropriately and consider recognizing that a one-size-fits-all approach, especially with something like ozone, is not appropriate, just given the chemistry.

Senator Kelly. Thank you. Thank you, Mr. Chairman.

Senator Carper. You are quite welcome. Thank you for joining us.

I have a question for Ms. Austin, but I am going to delay

it until we have heard from Senator Sullivan. Welcome. Good to see you.

Senator Sullivan. Thank you, Mr. Chairman.

Senator Carper. You bet.

Senator Sullivan. I want to thank the witnesses. I appreciate your focus on this important issue.

I wanted to kind of get to the PM 2.5, particulate matter, issue. We have a real challenge in the interior part of Alaska. We have a nonattainment area in interior Alaska, the Fairbanks area.

But the challenge there is 60 to 80 percent of the pollution putting Fairbanks over the standard comes from wood-burning stoves in people's homes. We have a unique environment, winter environment, there. Fairbanks is kind of in a bowl, and if you have been to interior Alaska, it is really cold, 50 below zero in the winter. You have this kind of inversion challenge.

The community has been working really hard to reduce emissions, really hard. But the EPA in back-to-back actions in 2023 has started to initiate sanctions against the community for its inability to meet the existing PM 2.5 standard and has concurrently proposed to lower emissions.

Then, really badly, in my view, worked with an outside environmental group, I think it was the Sierra Club, without coordinating with the State or the Congressional delegation to

get an agreement with some far-left environmental group on what Alaskans should do. Really bad approach from the EPA that myself and my Congressional colleagues have written them about, like hey, you have to check in with the people who are in charge of the State.

I would like any and all, why don't we start with you, Ms. Austin, to discuss how a one-size-fits-all approach to monitoring PM 2.5 can be very challenging but fail community-specific needs. Like I said, the extreme winter environment, the use of woodstoves to address sub-zero climate conditions, these kind of create a real challenging situation where, in Alaska, a lot of times, one-size-fits-all approaches from D.C. just don't work. They don't fit, and we end up spending an enormous amount of time trying to address that.

Do you have any thoughts? I will just go to each of the witnesses. It is really my only big question, but it is a really important one. This is just a specific example where we have been putting an enormous amount of work and effort into trying to reduce these emissions. We understand the importance of doing that, and yet, the unique elements of what goes on in Alaska, particularly in the winter, make it a challenge.

Ms. Austin. Senator Sullivan, thank you very much for the question. I think your characterization of a one-size approach fits all is unfortunately but understandably, to some degree.

EPA is there to set national standards, but you look back to the Clean Air Act, which has that cooperative federalism approach deliberately embedded in it.

Senator Sullivan. A lot of times, EPA forgets about that cooperative federalism approach, right, where the States are in the lead. A lot of people don't know that that is the law.

Ms. Austin. What I would say to that is, I think one area where EPA has striven to really do more and should continue to do and probably up the ante a bit is engage with States. Engage, engage, engage.

Senator Sullivan. So when they like, with a national environmental group, and do a consent decree without bringing the State of Alaska or the Congressional delegation in, you would call that a foul in terms of engaging with the States?

Ms. Austin. I would posit that that is not the way to move forward and actually find a path forward to environmental improvement to benefit public health.

Senator Sullivan. Yes, I agree with that. Thank you.

Mr. Obermann, do you have a view on this, in general?

Mr. Obermann. Sure, thank you for the question. Yes, I am not just familiar with the context in Alaska, but I can say PM 2.5 pollution due to wood-burning stoves is an issue in Denver, too.

Senator Sullivan. Yes. You guys have kind of the

inversion thing with the mountain.

Mr. Obermann. Yes, Salt Lake City, where I grew up, actually does as well.

So, there are State rules, and there may be in Alaska as well, I am not familiar with the regulatory context there, that require certain types of stoves that are EPA-certified to be burned.

The air pollution sensor network that we have in Denver can be a great complement to the public health that those individuals are experiencing in your community. They can look at their property's air pollution level and say, what does that mean for my health today? If I am asthmatic, or if my grandmother is asthmatic, what does that mean?

Honestly, in the context from my perspective, what we hear is people need to know what the air pollution is in those communities and why they potentially feel off that day. Programs like ours can help people just get quicker information and understand what that means for their health and even have resources to understand more about air pollution and health, if say, they go to our website or other means of communication.

Senator Sullivan. Good. Thank you.

Mr. Hammad, do you have a view on this, given your CRS perch?

Mr. Hammad. Yes, thank you, Senator Sullivan.

First, the State of Alaska and Fairbanks in particular have made strides in their Change Out Program, and that is where they change out the wood-burning stoves, and they have developed the program, been leaders across the Nation in developing that program.

Senator Sullivan. You know, the EPA is supposed to be certifying those stoves, and they haven't done a very good job at that. I don't know what the issues in Denver are, but in Alaska, they haven't done a good job on certifying the stoves.

Mr. Hammad. So, the certification program works for the manufacturers and the retailers of the stoves, and Alaska joined the northeast States in their recent litigation action against EPA for their certification program. They just have some disagreements about the way, the method, that EPA is completing those certifications.

Senator Sullivan. Would you agree that the EPA is kind of failing in that certification process, just from the CRS perspective?

Mr. Hammad. I will say that the States feel that EPA is failing them. Alaska and the northeast States did file suit. CRS is going to give you the facts on that, and that is what we will give you. The States do feel that EPA needs to update their certification methods for that Change Out Program.

It is the method in which the wood is burned in the oven

that they disagree on, and the organization real-world applications versus a test location are not the same. That is where the disagreement and discord happens.

Senator Sullivan. Good. Well, I appreciate that.

Thank you, Mr. Chairman. I am sorry I went over time there, but it is an important issue particularly in interior Alaska.

Senator Carper. It is okay. Yes, we are glad you could join us.

Senator Sullivan. Thank you.

Senator Carper. Ms. Austin, I promise we are not going to forget you here. I am going to have at least one question just for you.

I think you agreed that sensor technology is improving fairly rapidly. Do you support even more work by EPA to improve the integration of sensor data into EPA's work?

Ms. Austin. Yes, I do, but with the caveat that those resources not be diverted from otherwise maintaining, updating, and correcting the reference monitor network.

Senator Carper. Would any of our other witnesses want to comment as well on that issue? Anything you want to add, take away?

Mr. Obermann. Yes, the air pollution monitoring technologies for our criteria air pollutants like Mr. Hammad

mentioned earlier, the six criteria air pollutants, are actually more affordable than ever. I believe there is a path to help States continue their regulatory monitoring efforts, as well as also help local communities and governments implement air sensor programs on the ground. I think there is space for both.

Senator Carper. Okay, thank you.

Mr. Hammad?

Mr. Hammad. So, the potential future uses of low-cost air sensors and where it goes from here depends, I think, on a range of factors, including the state of the technology, whether the improvements have been made and such. The leaps in the technology that we have seen in the last few years have shown that there have been a lot of advancements.

In addition, their continued or expanded use may depend on any changes in EPA assessment regarding their capabilities and whether EPA can determine certain devices would meet any regulatory standards for monitoring. I think that would change the landscape for low-cost air sensors and where they go from here.

Senator Carper. Okay, thank you. I have another question, Mr. Hammad, for you. It is one that deals with funding from Congress.

As you know, Congress has provided funding for EPA to administer community air quality monitoring grants through the

American Rescue Plan and through the Inflation Reduction Act. In November of, I think it was 2022, EPA selected over 100, maybe a 130-some air monitoring projects across some 37 States to receive this funding.

My question is, in your testimony, you discuss how low-cost air sensor projects that have received funding or will receive Federal funding, how can federally funded sensor projects ensure a high quality of data? I will say that again: how can federally funded sensor projects ensure a high quality of data?

If you would, just please elaborate on the process for projects to undergo quality assurance. In your answers, just, if you would, please also describe the type of entities that received this funding and for what types of projects.

Mr. Hammad. Thank you, Chairman Carper. According to GOA, there are 132 community air projects that will be conducted by groups including nonprofits, States, local air agencies, tribes, and more than half these projects plan to use sensors. I included that in my testimony, and the funding recipients conducting low-cost air sensor data collection would be required to submit a quality assurance project plan. EPA refers to these as QAPPS.

Senator Carper. As what?

Mr. Hammad. QAPPS.

Senator Carper. What does that stand for?

Mr. Hammad. Quality assurance project plan, QAPP.

Senator Carper. Thank you. An acronym for everything.

Mr. Hammad. That is the government.

Senator Carper. Thank you.

Mr. Hammad. So, per the requirements of the CFR, the quality assurance project plan is a written document that provides a blueprint for the entire project and each specific task to ensure that the project produces reliable data that can be used to meet the project's overall objectives and goals. It provides the who, what, when, where, why, and how of the project, and according to EPA, a quality assurance project plan, a QAPP, aims to ensure the credibility of information collected or used by the community air project itself.

Senator Carper. Okay. Thank you.

I have a question, one more question, that I think I will ask for all of you to respond to, if you would. Ms. Austin, if we could just start with you.

The question is, in closing, would each of you take a moment or two and tell us where you see common ground with your fellow witnesses? If the answer is that we are farther apart than we started, that would be too bad, but I hope you can identify maybe some areas where you already had some common ground and now it is maybe more or less, but just be really honest with us, and that will be helpful.

If you could go first?

Ms. Austin. Chairman Carper, thank you. I certainly see common ground where technology innovation is going to further reduce costs. Data quality will improve with respect to air sensors. I think that is a very exciting place to, frankly, be as a Country. We have seen it in various other technology applications that affect us and make our lives easier in everyday life. I think air sensors are certainly on that train and it is moving in the right direction.

I think we can also agree that when it comes to the reference and regulatory monitors, that more need to be done and that those should continue to serve as the backbone for any regulatory decision-making at State air agencies and at the Federal level.

Perhaps one day, the air sensors will catch up, they will get to a level where they are equally robust. I look forward to that day. I hope it gets there, but alas, I don't think today is that day. But I think there is a lot to look forward to in both contexts.

Senator Carper. Good. Thank you. I like that note of optimism. Thanks so much.

Mr. Obermann, please, same question, common ground.

Mr. Obermann. Thank you for the question, Mr. Chairman.

I agree that our reference air quality monitoring network

run by the EPA and the States needs a lot of support and help. It needs to innovate over time as these new technologies become available that are reference quality.

We know of several vendors in Colorado that have gotten that stamp of approval from EPA to use their monitors as reference-level monitors, and that is the same process that other makers like Teledyne have used for a long time. We know that there is a need, and I agree to support that monitoring network.

The reality is there are many, many areas in our Country where we will never be able to cover it with a regulatory-grade monitoring network. The sensors that are available on the market today help fill in those voids, and there are some big voids out there, especially in areas where they are prone to wildfires.

So, I think an area where we can agree is that that sensor network can absolutely help inform where some of our air pollution challenge is changing. So if in some of our more rural communities, air pollution is actually increasing due to things like wildfires, we can know that through the air sensor network so that perhaps we can bring regulatory air monitoring there in the future.

I believe there is a lot of agreement here on the panel about sensors broadening that awareness and perhaps for

attention with regulatory air monitoring in the future.

Senator Carper. Mr. Hammad?

Mr. Hammad. Thank you, Chairman Carper.

I think we do agree on the current state of our regulatory monitors and their importance and the information that they have been able to provide the Country for the past few decades has been invaluable.

Where low-cost air sensors are and how they fill these data gaps and help identify opportunities for regulatory agencies to direct their resources, I think we also agree on that.

Where the technology goes from now, again, depends on the level of investments and the capacity for EPA to review and continue to review these technologies and to provide further guidance on their use and the data collection and the handling and proper siting of them. Like my co-panelists, I think I agree in saying, you know, hopefully one day they do reach the capacity to be used in a regulatory purpose.

Senator Carper. Okay. Thank you.

I think we are going to close here. We had one or two other colleagues that are trying to get here, but there are a bunch of committees that are meeting at the same time, and it is, we got a pretty good bipartisan cross-section that was able to be here. I had hoped that we might get one or two more, but I don't think we are.

So, I am going to go ahead and begin to close this.

I just want to thank you all for coming today and for the time you put into actually coming here in person and really for the work you do with your lives and what you do for your own communities and for your States and our Country and our planet. We thank you for that.

I want to thank members of our staff for the very good work that they do week after week after week. I have always surrounded myself with people smarter than me. My wife says it is not hard to find them. We have some smart cookies behind me.

The other thing that we have going for us is they sort of like each other and they work well together. You all heard of something called "trickle-down theory." I believe in that. I think Senator Capito does, as well. We, for the most part, I think, work really well together, and I think that is a positive influence on the members of our staff.

I want to maybe mention one or two other things, but I think that we can all pretty much agree that folks in this day and age shouldn't have to worry about whether the air that they breathe is safe for them and for their families, whether young or old, yet far too many communities are exposed to harmful air pollution, even despite all of our efforts to reduce those threats.

Fortunately, as we have learned today, the advancements in

low-cost air quality sensors equip a lot of communities with knowledge about their air quality, and this knowledge is helping local policymakers make evidence-based decisions in order to improve public health further.

Before we adjourn, I am going to ask unanimous consent to submit for the record materials relating to today's hearing. This is my favorite part of the hearing, when I get to ask, make a unanimous consent request, and there is no one here to object, no other Senators. Hearing no objection, I am going to move on to some housekeeping.

[The referenced information follows:]

Senator Carper. Senators will be allowed to submit written questions for the record through the close of business on Wednesday, April 24th. We will compile those questions. We are going to send them to our witnesses, and we are going to ask you all to reply, if you would, by Wednesday, May the 8th.

With that, I think we will just declare this hearing adjourned. Thanks so much.

[Whereupon, at 11:48 a.m., the hearing was adjourned.]