American Lung Association.

Something in the Air

How Communities Are Tracking the Air They Breathe

A "State of the Air" Supplemental Report

At the Fenceline: Utilizing Data on Pollution from Stationary Sources

Index

Introduction

For decades, point-source pollution from refineries, petrochemical plants, metal fabrication operations, power plants and other heavy industrial facilities has been among the most persistent—and unevenly monitored—sources of hazardous air emissions in the United States. Although these facilities operate under federal and state permits, traditional ambient monitoring networks are not designed to capture the full, local scope of their impacts. Emissions can shift significantly with day-to-day operations, maintenance and unplanned emissions events, creating short-duration spikes—often involving hazardous air pollutants—leaving nearby neighborhoods exposed to pollution that is not represented in regional data.

As the "Something in the Air" series moves from broad, satellite-derived views of air pollution to conditions experienced at the neighborhood level, this report "At the Fenceline: Utilizing Data on Pollution from Stationary Sources" centers on point-source pollution as a distinct and persistent risk. Unlike diffuse or regional pollution, emissions from point source facilities originate in specific locations and often recur in the same communities over long periods of time. These impacts are localized, cumulative and frequently underrepresented in regional monitoring systems. In this context, fenceline and neighborhood-scale monitoring are essential for capturing site-specific variability, identifying recurring pollution trends and grounding regulatory oversight in the lived realities of communities located near major stationary sources.

Such sources present monitoring challenges common to other fixed emitters, where day-to-day operational variability and near-source conditions shape exposure patterns that broader regional systems are not designed to detect or fully characterize. Resolving these conditions requires monitoring approaches designed to capture proximity, persistence and variability—core dimensions of community experience. Fenceline communities—neighborhoods located immediately

Fenceline: A fenceline community lives immediately adjacent to highly polluting facilities and is directly affected by traffic and fuel sources (The Climate Reality Project, 2025) adjacent to polluting sites—face a distinct challenge: point-source pollution is highly localized, episodic and often most intense at the facility boundary where people live, work and go to school. These emissions are driven by operational cycles, flaring, maintenance activities and equipment failures, producing sharp, short-duration plumes. Because the nearest monitor may sit miles away and is often calibrated to reflect regional background levels, exposures experienced at the fenceline can be far more severe than what appears in official datasets. This creates important gaps in understanding how pollution is experienced at the community level. While certain industrial source categories are subject to facility-level fenceline monitoring under federal and state regulations, those programs typically target specific pollutants and defined permit requirements. They are not intended to assess cumulative neighborhood-scale conditions across multiple sources and variable operations. Localized monitoring therefore complements existing regulatory programs by providing finer-scale information that can inform health-protective decision-making and community engagement.

The case studies featured here—the Sensing Air Justice program in the Rubbertown industrial corridor in Louisville, Kentucky and the Cultivando AIRE initiative focused on the Suncor petroleum refinery in Commerce City, Colorado—demonstrate how community-led monitoring makes emissions visible at the scale of exposure, generating data that support enforcement, risk reduction and more effective responses to localized air quality impacts. While the case studies focus on specific industrial settings, the monitoring challenges they reveal extend across point-source sectors, including power generation, where emissions are similarly fixed in place yet highly variable over time.

Community-generated data can support enforcement actions, elevate local health concerns, guide industrial inspections, inform permitting decisions, strengthen emergency response and create shared governance structures between agencies and affected residents—all making air quality information more accessible and actionable where it is needed most. Even where sources operate under permits and meet regulatory requirements, emissions from fixed facilities can fluctuate with operational cycles, maintenance activities and unplanned events, producing localized exposure patterns that escape the reach of regional monitoring.

The case studies that follow build on this context and show how these efforts rely on clearly defined monitoring objectives, rigorous quality assurance, accessible data platforms and partnerships that link community knowledge with regulatory and technical expertise. Together, they illustrate how localized data can be translated into meaningful, health-protective action.

Point-Source Pollution Is a Persistent Public Health Threat

Point-source pollution poses a longstanding public health threat because it exposes nearby communities to concentrated mixtures of hazardous air pollutants that are emitted repeatedly and often unpredictably. National assessments show that industrial and manufacturing emissions account for a substantial share of the country's cancer risk from hazardous air pollutants, with the highest-risk census tracts often located next to large petrochemical or refinery complexes (U.S. Environmental Protection Agency [EPA], 2018).

National research reinforces this picture. Studies using EPA emissions inventories, hazardous air-pollutant risk assessments, and U.S. Census data consistently show that communities closest to refineries, power plants, petrochemical facilities and other major industrial sources have higher concentrations of low-income residents and larger proportions of Black and Latino households than the national average (U.S. EPA, 2023a). A 2024 study from the National Cancer Institute examined EPA emissions data and U.S. Census tract characteristics and found that industrial facilities released approximately 11 million pounds of known human carcinogens—including benzene, formaldehyde and 1,3-butadiene—into 1,763 census tracts in a single year, potentially affecting about seven million residents (Madrigal et al., 2024). Census tracts with the highest levels of these emissions were more likely to include higher proportions of Black, Hispanic and Latino residents, as well as households with lower income or educational attainment. Communities experiencing poverty were associated with up to 51% higher burdens of carcinogenic industrial air emissions, indicating measurable differences in where these pollutants are concentrated nationwide (Madrigal et al., 2024).

These findings point to a structural pattern in where pollution sources are sited. Industrial facilities and fossil fuel infrastructure are frequently located near communities of color and lower-income neighborhoods, concentrating exposure in the same places over time. One recent study estimates that 46.6 million Americans—more than 14% of the population—live within one mile of fossil fuel infrastructure, with exposure clustered in urban areas and communities of color (Gold, 2025). Taken together, this evidence reinforces why gaps in fenceline and real-time monitoring have greater consequences in communities already facing sustained and cumulative pollution burdens.

Point-Source Pollution

The EPA defines point source pollution as "any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack" (National Oceanic and Atmospheric Administration [NOAA], 2026). This definition encompasses a wide range of facilities, from individual industrial operations to dense clusters of major emitters operating within the same geographic area, each subject to distinct regulatory, operational and compliance requirements based on emissions and source characteristics.

Clean Air Act Title V Facilities

- Title V is the operating permit program created by the 1990 Clean Air Act Amendments.
- A Title V permit does not set new limits; it consolidates existing air requirements into a single, enforceable permit.
- Facilities covered under Title V must clearly document how they comply with all applicable air pollution requirements (U.S. EPA, 2025h).
- Facilities must obtain a Title V operating permit if they qualify as "major sources"—generally emitting 100 tons per year of a regulated pollutant, or 10 tons per year of a single hazardous air pollutant (U.S. EPA, 2025h).

The Clean Air Act (CAA) establishes a dual regulatory framework for addressing air pollution. At the population level, the CAA directs the EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants that are widespread and emitted by numerous sources, with the goal of protecting health. At the source level, it regulates emissions from individual facilities through permitting and performance standards that limit emissions at its point of release, regardless of whether an area currently meets ambient standards (U.S. EPA, 2020). Under this framework, the CAA regulates point sources as stationary sources, treating each facility as an individual, identifiable emitter subject to federal and state air pollution control requirements. Facilities regulated under the CAA include major stationary sources that emit criteria pollutants and hazardous air pollutants (HAPS) at levels requiring oversight through technology-based emission standards, operating permits and ambient air quality quality protections. Compliance is evaluated through permitting reviews, emissions testing and, in some cases, fenceline or near-facility monitoring. Oversight of industrial point sources is implemented through multiple, interrelated CAA programs. Technology-based emission limits are established through New Source Performance Standards (NSPS), which apply to new, reconstructed or modified emission units within defined industrial source categories. Emissions of HAPs are regulated separately at the source level through National Emission Standards for Hazardous Air Pollutants (NESHAP), which apply to specific industrial source categories and are enforced on a facility-by-facility basis, rather than through cumulative exposure conditions (U.S. EPA, 2025d).

Toxics Release Inventory (TRI)

- It is a public EPA database that requires certain industrial and federal facilities to report annual releases and waste management of listed toxic chemicals.
- Established under the Emergency Planning and Community Right-to-Know Act, TRI provides communities, agencies and researchers with facility-level data to track pollution trends, identify risks and support accountability and pollution reduction efforts (U.S. EPA, 2026a).

For major sources, these standards require the application of Maximum Achievable Control Technology (MACT), based on the performance of best-controlled facilities within each category (U.S. EPA, 2025d). State and local air agencies implement and enforce these requirements through federally approved State Implementation Plans (SIPs), which translate CAA requirements into facility-specific permits, standards and compliance (U.S. EPA, 2020). Through this structure, the CAA regulates point source pollution by holding each individual facility accountable for its emissions while relying on national standards to protect public health. Additional transparency regarding facility-level releases of toxic chemicals is provided through the Toxic Release Inventory (TRI), a public disclosure program administered by the EPA.

How Point Sources Differ

Across the country, many communities, agencies and organizations are generating their own air quality data to better understand emissions from the sources that shape local exposure. However, the types of facilities being monitored—and the regulatory frameworks that govern them—vary widely, meaning data needs, monitoring approaches and policy pathways differ by facility type.

The chart on the next two pages summarizes major air pollution source categories, the regulatory frameworks that apply to them and the primary pollutants they emit. Distinguishing among power plants, petroleum refineries and industrial corridors dominated by CAA Title V facilities is essential, as each category operates under different regulatory structures, produces distinct pollutant mixtures and presents different monitoring needs. These distinctions help explain why community-led monitoring efforts have evolved differently across source types and why tailored data approaches are critical for capturing real-world exposure conditions.

	Power Plants
	• Fossil-fuel electricity-generating units—such as coal-, natural gas– or oil-firedpower plants—sell electricity to the grid and operate major boilers, turbines or combined-cycle systems. These facilities generate electricity by burning large quantities of fuel, producing primarily combustion-related air pollutants (U.S. EPA, 2025a). • Emissions vary by fuel source but are primarily combustion-related and often occur for long operating periods, though rates vary with load and cycling (U.S. EPA, 2025e). • The electric power sector accounted for roughly 24–25% of total U.S. greenhouse gas emissions in 2022, making it the second-largest emitting sector (U.S. EPA, 2025b). • Power plants are regulated under CAA programs that set sector-specific performance standards and require standardized continuousemissions monitoring systems (CEMS) that apply to specific regulated pollutants and source categories, in addition to holding Title V operating permits (U.S. EPA, 2025h).
Pollutants	• "Primarily combustion pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon dioxide (CO_2), particulate matter, formaldehyde and mercury.
Select EPA Rules	• 40 CFR Part 75: federal rule requiring monitoring and reporting of SO_2, NO_x, CO_2, and flow, while most of these emissions are measured with CEMS (U.S. EPA, 2025e). • Mercury and Air Toxics Standards (MATS): national emission standards for HAPs from coal- and oil-fired electric utility steam generating units, including mercury, acid gases, and other toxic metals (U.S. EPA, 2026c). • NSPS: Emission standards for newly constructed, modified, or reconstructed power plants. (U.S. EPA, 2025d). • Greenhouse Gas Performance Standards (GHG): emission limits for new and certain existing fossil fuel-fired power plants (U.S. EPA, 2025b). • Acid Rain Program, Regional Haze Program, and Cross-State Air Pollution Rule (CSAPR): federal and interstate programs reducing SO_2 and NO_x emissions from power plants to address acid deposition, interstate transport and visibility impairment (U.S. EPA, 2024a).
	Other Title V Facilities
	• Includes chemical plants, metal fabrication facilities, cement plants, plastics manufacturing, and other large stationary sources.

	• Industrial facilities are often located near other chemical and manufacturing operations, creating overlapping and cumulative exposure patterns even outside formally defined corridors. When these areas contain multiple CAA Title V facilities, they can produce especially varied mixtures of pollutants that combine across a shared airshed.
Pollutants	• Benzene, 1,3-butadiene, vinyl chloride, ethylene oxide, formaldehyde, volatile organic compounds (VOCs), particulate matter ($PM_{2.5}$ and PM_{10}), SO_2, NO_x, CO, acid gases; as well as fugitive releases of these pollutants.
Select EPA Rules	• Required to obtain and maintain a Title V operating permit if classified as a major stationary source or otherwise subject to Title V under the CAA. • Title V permits (40 CFR Parts 70 and 71) compile all applicable CAA requirements and include monitoring sufficient to assure compliance. Monitoring may include periodic stack testing, parametric monitoring, recordkeeping, and, where required by underlying standards, CEMS. • Some facilities report annual emissions to the TRI if they meet applicable sector and chemical threshold criteria, and most major sources report emissions to state or federal inventories; however, continuous monitoring is not required for all pollutants and varies on applicable regulatory standards (with oversight focused on compliance with permitted limits rather than real-time exposure) (U.S. EPA, 2026a). • Facilities with covered chemical processes above regulatory threshold quantities must develop and maintain CAA Risk Management Programs (RMP) and plans under CAA. • Includes emission limits and standards from applicable programs, such as: · NESHAP/MACT, · NSPS, · New Source Review (NSR), a CAA preconstruction permitting program, and · Prevention of Significant Deterioration (PSD) which applies to new major sources or major modifications in areas that are in attainment or unclassifiable under the NAAQS (U.S. EPA, 2023b).

As shown in the chart above, the chemical makeup of emissions varies across power plants, refineries and other industrial facilities, but each source releases hazardous pollutants that pose significant risks to nearby neighborhoods. While pollutant mixtures vary by facility type—ranging from combustion-related gases to complex petrochemical hazardous air pollutants—they can all contribute to elevated exposure risks for nearby fenceline communities. Large industrial facilities are typically subject to multiple CAA programs simultaneously, including permitting requirements, technology-based standards, and preconstruction review. However, these programs regulate emissions by source category and pollutant rather than by cumulative neighborhood impact. Community-generated monitoring can therefore help illuminate how emissions from different regulated sources combine at the local level, providing additional context for interpreting pollutant patterns and translating data into meaningful public health insight.

This distinction between regulatory compliance and cumulative neighborhood impact makes it essential to examine how point source emissions are actually monitored at the fenceline. Recognizing the gap between source-based regulation and community-level exposure shifts the focus to whether existing monitoring systems capture—or fail to capture—real-world conditions. The following section examines how industrial air pollution is monitored in practice and where those systems leave critical gaps for fenceline communities.

At the Fenceline: Monitoring

Understanding how industrial air pollution is monitored begins with how it is regulated. EPA's Air Quality System (AQS) data show that regulatory monitors are limited in number and unevenly distributed, and because NAAQS monitors are sited to reflect regional air quality and long-term compliance, they are not designed to capture short-term spikes, facility-level gradients or many hazardous air pollutants common in refinery and chemical corridors—gaps that communities increasingly address through localized monitoring.

For refineries and chemical manufacturing corridors, the CAA relies on a layered system of permitting, hazardous-air-pollutant standards and ambient air-quality protections—each designed to address different risks, pollutants and time scales. The mixture of combustion byproducts, chemical-process emissions and episodic releases creates complex exposure patterns that cannot be captured by single-pollutant or regional monitoring alone. Together, these conditions illustrate why localized monitoring and real-time data are essential for understanding how industrial emissions translate into health risks at the fence line. Fenceline monitoring is the practice of measuring air pollutants at or near the property boundary of an industrial facility, rather than only at distant or regional regulatory monitors. For communities living adjacent to these facilities, conditions at the fenceline often differ substantially from what is reflected at regional regulatory monitoring sites.

At the federal level, the monitoring landscape differs by source category. Power plants are subject to standardized continuous emissions monitoring requirements for certain pollutants under programs such as 40 CFR Part 75, as reflected in the chart above. In contrast, most other Title V facilities—including refineries, chemical manufacturers, cement plants and metal processors—are not uniformly required to conduct continuous, perimeter-level monitoring. While more than 16,000 facilities operate under Title V permits nationwide, only a limited subset, most notably petroleum refineries subject to benzene fenceline requirements and certain chemical manufacturing sectors regulated under specific NESHAP standards, must conduct fenceline monitoring (U.S. EPA, 2025e). For many industrial corridors, regulatory oversight instead relies on periodic stack testing, emissions inventories, parametric monitoring and compliance reporting rather than continuous, location-specific measurements at the neighborhood scale. Monitoring obligations therefore vary significantly across Title V facilities depending on the underlying regulatory standards that apply.

The Suncor Refinery and the Rubbertown Industrial Corridor represent two settings where criteria pollutants, air toxics and process-specific compounds are released through both continuous operations and episodic events. Looking closely at these pollutant categories—and how they are monitored—helps explain why exposure patterns near industrial facilities can vary sharply over space and time, and why community-scale data are often needed to complement existing monitoring systems.

	Petroleum Refineries	Other Title V Industrial Facilities
Monitoring	• Refineries subject to CAA requirements, including CEMS, stack testing, Leak Detection and Repair (LDAR) programs, flare monitoring requirements, and HAPs monitoring under applicable NESHAP standards. • NESHAP benzene fenceline monitoring: facilities required to conduct benzene fenceline monitoring under the Refinery MACT rule. • Refineries are subject to applicable NSPS subparts, which establish emission limits and associated monitoring, testing, recordkeeping and reporting requirements. • In certain states, additional fenceline or community-scale monitoring requirements apply to specific industrial sectors beyond federal mandates.	• Title V does not automatically require CEMS, it requires monitoring adequate to demonstrate compliance with applicable CAA requirements. • Many facilities require periodic stack testing, control-device monitoring and tracking of hazardous air pollutants, most do not have mandatory fenceline monitoring requirements. • Title V permits must include periodic monitoring sufficient to assure compliance where underlying standards do not specify monitoring requirements (EPA Title V Periodic Monitoring Guidance) (U.S. EPA, 2025h). • Certain emission units are subject to Compliance Assurance Monitoring (CAM), which requires monitoring of control device performance to ensure compliance with emission limits.
Local Impacts	• Complex and variable exposure patterns, including episodic releases of benzene, sulfur compounds, VOCs, and flaring events that can cause rapid short-term spikes not always captured by regional monitors. (Colorado Department of Public Health and Environment [CDPHE], 2005).	• Impacts vary by facility type and emission profile and may include continuous process emissions or intermittent releases of HAPs.
	Suncor Refinery	**Rubbertown Industrial Corridor**
Criteria Pollutants Regulated under the Clean Air Act & monitored for public health impacts	• SO_2, NO_x, CO, $PM_{2.5}$ and PM_{10}. • Ozone precursors (NO_x + VOCs reacting in the atmosphere) (CDPHE, 2025).	• Chemical, plastics, polymer, and synthetic rubber facilities emit a mix of combustion-related pollutants (NO_x, SO_2, CO, PM), process-related VOCs that contribute to ozone formation, and trace metals from certain catalyst systems.

Hazardous Air Pollutants (HAP) & Other Air Toxics Are of particular concern because of their toxicity and potential long-term health impacts	• Benzene, 1,3-Butadiene, Toluene, Xylenes, Ethylbenzene, Formaldehyde, Acetaldehyde, Naphthalene, Polycyclic aromatic hydrocarbons (PAHs), Ammonia (NH_3), Hexane and other alkanes. • Hydrogen sulfide (H_2S), and episodic emissions from flares and storage systems.	• Chlorodifluoromethane (HCFC-22) – emitted primarily by Chemours. • Toluene – emitted primarily by American Synthetic Rubber Company. • Ammonia – emitted primarily by Clariant Corporation and Bakelite Synthetics (Louisville Metro Air Pollution Control District, 2026).

These differences in monitoring scope shape how—and where—federal oversight has focused efforts to strengthen fenceline data collection. Rather than applying uniformly across industrial sectors, EPA has concentrated on a limited subset of high-risk facilities where emissions profiles and exposure concerns warrant enhanced monitoring requirements. EPA has expanded fenceline monitoring requirements for specific source categories, including petroleum refineries and certain chemical manufacturing operations, but coverage remains narrow and sector-specific (South Coast Air Quality Management District, 2025). EPA's benzene fenceline monitoring requirements now play a major role in identifying refinery emissions and triggering corrective actions when pollution levels remain elevated, a point underscored in EPA's 2025 Enforcement Alert on nationwide refinery noncompliance. The alert highlighted that many exceedances originate from storage tanks, marine loading operations and wastewater systems, and reinforced that facilities must investigate exceedances quickly, identify true root causes and implement timely corrective actions to bring concentrations back below the 9 $\mu g/m^3$ action limit (U.S. EPA, 2025b).

This federal focus signals a targeted shift toward using fenceline data as an enforcement and accountability mechanism for select high-impact industrial sectors—not a comprehensive monitoring expansion across all Title V facilities. In this context, fenceline monitoring has become a critical tool for tightening oversight of refinery emissions and elevating the role of reliable, community-scale data in identifying persistent or episodic exposure risks near major point sources. In response to these gaps, communities living near refineries and chemical facilities have increasingly deployed their own monitoring approaches to better understand and document local conditions. Community-led efforts commonly use low-cost sensors, passive samplers and portable monitoring equipment to measure criteria pollutants and, in some cases, specific HAPs associated with nearby facilities. These tools are often placed along facility boundaries, near schools and homes, or in areas where residents report odors, flaring events or health symptoms—areas not consistently captured existing regulatory monitoring networks. This context frames the case studies that follow, which focus on industrial settings where monitoring requirements vary across source categories, real-time data are limited and exposure risks are concentrated in adjacent neighborhoods. In refinery and chemical-corridor settings, pollutants can disperse through stacks, flares, storage systems and equipment leaks in ways that do not always align with how regulatory monitoring networks are designed. As a result, localized community monitoring plays a critical role in capturing on-the-ground conditions and revealing exposure patterns that may otherwise remain invisible within compliance-based reporting frameworks.

> "Different communities face different sources and different pollutants. Monitoring needs to be tailored to those realities—that's why community networks are so important."
>
> — Michael Olgetree, Senior Director of State Air Quality Programs, CDPHE

At the same time, these efforts underscore an important reality: while community monitoring can reveal exposure patterns and gaps in oversight, it cannot replace durable, enforceable regulatory frameworks. Meaningful emissions reductions depend on strong federal and state standards, protective permit conditions and consistent enforcement. In the absence of comprehensive fenceline monitoring requirements across industrial sectors, many communities remain reliant on their own data to surface risks that regulatory systems do not consistently measure. Understanding this regulatory and monitoring landscape is essential to interpreting health impacts at the fenceline. The health risks discussed below are shaped not only by what pollutants are emitted, but by how those pollutants are measured, reported and enforced.

Health at the Fenceline

The pollutants and health impacts discussed in this section reflect the distinct emission profiles of the primary industrial point-source contexts examined in this report: large petroleum refineries and multi-facility chemical and manufacturing corridors. These case studies center on sectors characterized by complex mixtures of hazardous air pollutants and documented fenceline exposure concerns. Together, these industrial contexts illustrate a critical point: health risks at the fenceline are shaped not only by proximity to major emission sources, but by the type, toxicity and persistence of the pollutants released. The following section outlines the pollutants most consistently identified in each case-study area and summarizes the associated health impacts, drawing from state monitoring networks, regulatory reporting and community-generated data.

Power plants, while not the central case-study focus, remain part of the broader point-source landscape considered throughout this report, as they are included to contextualize the broader health burden from combustion-related air pollution, which differs in composition but remains consequential for communities living near major stationary sources.

Power Plants

Power plants referenced throughout the report provide broader regulatory and policy context. Understanding how power plants fit within the broader point-source landscape is especially important in the current regulatory context, as changes to federal air quality standards, enforcement approaches and monitoring expectations continue to shape how risks are assessed and managed. Power plants are among the largest emitters of criteria pollutants regulated through NAAQS, particularly $PM_{2.5}$, ozone-forming pollutants such as NOx and SO2, making them a critical point of comparison for understanding how ambient-based regulation differs from facility-specific controls applied to refineries and other industrial sources. Because these emissions contribute to regional $PM_{2.5}$ concentrations and ground-level ozone formation and disperse across wide geographic areas, associated health impacts are often population-wide rather than confined to immediate fenceline exposure, with well-established links to asthma exacerbation, cardiovascular disease and premature mortality (U.S. EPA, 2025a).

Although this report does not examine power plants in depth, their central role in NAAQS implementation provides important context for how risks from power generation are assessed, controlled and communicated (U.S. EPA, 2025a). This context explains why community monitoring efforts—many of which already focus on power generation and combustion-related sources nationwide—are essential for capturing real-world exposure patterns and informing policy decisions across different point-source categories.

Petroleum Refineries

Petroleum refineries represent a distinct category of industrial point source, characterized by the scale and complexity of emissions from a single facility, yet they are often located near or within broader industrial areas and in close proximity to residential communities. Petroleum refineries—approximately 130 nationwide, processing more than 18 million barrels of crude oil each day—play a central role in the nation's energy infrastructure and are among the most complex and emission-intensive industrial sources in the U.S. (Environmental and Energy Law Program, 2025). Refineries produce gasoline, diesel, jet and marine fuel through complex processes that emit a wide range of pollutants, including petroleum-derived VOCs, benzene, sulfur compounds and combustion byproducts.

Unlike single-stack emissions sources, refineries are comprised of interconnected process units such as catalytic crackers, heaters and boilers, storage tanks and wastewater systems. Many of these refining operations emit a wide range of pollutants through multiple pathways, including fugitive leaks, tank vents, pressure-relief devices and intermittent flaring rather than a single exhaust point—releasing hazardous air pollutants during routine operations as well as malfunctions. As mentioned in the chart above, these sources create highly variable emissions that differ significantly from those of non-refinery industrial facilities.

Petrochemical facilities produce a range of products, including rubber, chemicals and plastics. These facilities also emit a wide range of harmful pollutants linked to serious and chronic health risks. Key pollutants include $PM_{2.5}$, which reaches deep into the lungs and bloodstream and is associated with asthma exacerbation, cardiovascular disease, and premature death. These facilities also release NO_2 and SO_2, gases that irritate the respiratory system and contribute to ground-level ozone ("smog") formation. VOCs—including benzene, toluene, and 1,3-butadiene—are common byproducts of combustion and refining; many are carcinogenic or mutagenic and pose significant risks even at low concentrations (U.S. Energy Information Agency, 2010).

Benzene—a hazardous air pollutant linked to anemia, immune suppression, nervous system damage and increased leukemia risk—regularly appears at elevated levels near U.S. refineries. The Environmental Integrity Project's (2022) analysis shows that nearly half of all refineries reported long-term fenceline benzene concentrations above health-based thresholds.

Other Title V Industrial Facilities

Across the United States, non-refinery Title V industrial facilities emit pollutant mixtures that differ from those of petroleum refineries because their emissions reflect the specific processes used in each sector. These facilities rely on multiple emission points—such as boilers, curing ovens, reaction vessels, kilns, solvent operations or material-handling equipment—producing combinations of combustion byproducts, process chemicals and mechanical emissions. As a result, exposure patterns vary widely across facilities. In corridor settings, many industrial facilities operate in close proximity—such as chemical manufacturers, plastics and rubber producers, metals processors and hazardous waste facilities—collectively creating persistent, cumulative exposure conditions for nearby communities (U.S. EPA, 2025h).

Industrial facilities in Louisville's Rubbertown corridor release a complex mix of hazardous air pollutants and criteria pollutants that contribute to severe and chronic health burdens for nearby residents. Key toxics—including HCFC-22, 22, toluene and ammonia—cause airway irritation, central nervous system effects, cardiovascular impacts and, in some cases, carcinogenic risks, with additional pollutants such as 1,3-butadiene, vinyl chloride, formaldehyde, dioxin, benzene and multiple heavy metals further elevating cancer and respiratory risks (U.S. EPA, 2025g).

These facilities also emit criteria pollutants such as $PM_{2.5}$, PM_{10}, NO_x, SO_2 and CO. Burning sulfur-containing feedstocks produces SO_2, a gas that can trigger bronchoconstriction and acute breathing difficulties, especially for people with asthma (U.S. EPA, 2025g). NO_x and CO can aggravate respiratory conditions and strain cardiovascular function. High-temperature operations emit PM_{10} and $PM_{2.5}$—fine particles strongly linked to respiratory and cardiovascular disease, and premature mortality (Centers for Disease Control and Prevention [CDC], 2024). Combined, NO_x and VOC emissions also drive ground-level ozone formation, contributing to airway inflammation and increased asthma attacks. Although Lead (Pb) emissions are typically low, metal-catalyst processes may still release trace amounts, and even low-level exposure is associated with neurological and developmental harm (U.S. EPA, 2025g). Together, these pollutants create persistent and compounding public health hazards in the communities surrounding Rubbertown.

Stationary sources release complex mixtures of harmful pollutants that can accumulate in the environment and are linked to severe neurological, developmental and reproductive harms. Many of these compounds interact synergistically, amplifying their health effects, especially in communities already facing multiple environmental and socioeconomic stressors. These risks are compounded in industrial corridors, where clustered facilities produce overlapping emission plumes and cumulative exposure patterns within a shared geographic area. EPA risk assessments show that these chemical and petrochemical regions represent some of the highest cancer risks in the nation. EPA's AirToxScreen shows that census tracts closest to refineries, chemical plants and other major HAP sources bear higher cumulative cancer risk, and long-term exposure contributes to chronic disease and increased emergency-room visits (U.S. EPA, 2018). Specifically, fenceline communities experience 20–30% higher average HAP-related cancer risk than non-fenceline areas (The Climate Reality Project, 2025).

Consequently, emissions profiles are highly variable, and exposure patterns can shift sharply over short distances and time periods, making community-level impacts difficult to capture through regional monitoring alone (U.S. EPA, 2010). For fenceline communities, multi-point emissions, operational variability and limited continuous monitoring create persistent uncertainty about harmful exposures, reinforcing the need for fenceline monitoring and real-time community air data. These distinctions help frame the complex emission landscape of point sources nationwide.

Across these sectors—from combustion-dominated power plants to chemically complex refineries and multi-facility industrial corridors—a consistent pattern emerges: the nature of health risk is shaped by both pollutant composition and regulatory design. What distinguishes fenceline communities is not simply proximity to industry, but proximity to variability—fluctuating emissions, intermittent releases, fugitive leaks and chemical mixtures that may not be fully captured in routine compliance reporting. Health risk at the fenceline is therefore dynamic rather than static, influenced by operational patterns, regulatory coverage and the limitations of traditional monitoring systems.

Understanding these differences is essential before turning to the lived reality of communities navigating them. The case studies that follow move beyond pollutant lists and regulatory frameworks to examine how community-driven monitoring initiatives are redefining what it means to document exposure. These projects do more than measure air quality; they surface patterns that reshape local decision-making, inform enforcement conversations and shift the narrative from abstract compliance metrics to tangible public health outcomes—offering a model for how ongoing, community-scale evidence can transform how industrial risk is understood and addressed (Sarr et al., 2021).

Case Studies

Cultivando AIRE Project: Commerce City, Colorado

The Suncor Energy oil refinery in Commerce City is Colorado's only petroleum refinery and the state's largest industrial source of criteria pollutants and hazardous air emissions. Located in Adams County just northeast of Denver, the refinery sits within an industrial corridor immediately adjacent to predominantly Latino and Indigenous communities that experience higher rates of poverty, cumulative environmental burdens and adverse health outcomes compared to state averages (CDPHE, 2020). Commerce City is home to approximately 70,000 residents as of July 1, 2024, nearly half of whom identify as Hispanic or Latino—a proportion that exceeds the statewide average (U.S. Census Bureau, 2024).

The facility operates under state air and water permits and has faced enforcement actions related to air quality compliance, resulting in expanded monitoring, reporting and performance review requirements. As the dominant industrial emitter in the region, communities around Suncor are exposed to both criteria pollutants (such as NO_x, SO_2, PM, and CO) and hazardous air pollutants including benzene, H_2S, formaldehyde and other VOCs—pollutants strongly linked to respiratory disease, cardiovascular harm, cancer risk and other serious health outcomes (CDPHE, 2025). In Commerce City, concerns about refinery emissions have persisted for years, particularly given the facility's close proximity to homes, schools and community spaces. Residents have documented recurring smoke and odor events linked to flaring and operational upsets, as well as chemical releases and strong odors. Community members have also reported health symptoms consistent with refinery-related exposure, including asthma exacerbations and other respiratory effects. Suncor's history of permit violations and enforcement actions has further heightened concern about whether traditional regulatory monitoring alone is sufficient to protect nearby communities (CDPHE, 2020).

The CDPHE, primarily through its Air Pollution Control Division (APCD), oversees the facility's compliance with state and federal air quality requirements. Because of its emissions levels, the refinery is classified as a "major source" under the CAA and must maintain Title V operating permits. Although legally considered one facility, Suncor operates under two Title V permits due to historic ownership structure (CDPHE, 2025). CDPHE conducts continuous oversight of the refinery, including comprehensive annual inspections and formal enforcement when violations occur. Air monitoring near the refinery occurs at multiple levels. CDPHE operates five permanent monitoring stations in the surrounding area with hourly data publicly available.

Although CDPHE maintains continuous oversight and operates multiple monitoring stations, questions remained about how well existing systems captured neighborhood-level conditions. In response, Cultivando, a Latino-led non-profit in Colorado, helped implement a community-driven air monitoring effort designed to characterize real-world exposures near the refinery. The Cultivando Air Quality Investigation and Research for Equity [AIRE] project emerged following a 2020 enforcement settlement between Colorado regulators and Suncor that addressed multiple air quality violations. As part of that settlement, a portion of the penalty funds were allocated to support community-based environmental projects in Commerce City and North Denver (CDPHE, 2025). Cultivando received the largest share of this funding and used it to build an independent monitoring network. The organization partnered with Boulder A.I.R. to design, deploy and operate the monitoring system.

Between November 2022 and June 2023, Cultivando's air monitoring initiative employed five distinct sampling strategies and identified a total of 129 chemicals, including PM, CO, CO2, SO2, Nox, Methane, VOCs, ethane, propane, benzene, hexane, toluene, H_2S and hydrogen cyanide. Across sampling methods, the network detected a broad range of pollutants: weekly integrated samples identified 16 chemicals, 15-minute canister samples detected 21 chemicals and year-long continuous monitoring captured 22 chemicals (Cultivando, 2024a). Additional data from the CDPHE and the U.S. EPA expanded the analysis to include 14 carbonyl compounds and 58 ozone precursor chemicals. The assessment also incorporated hourly meteorological data and radon measurements to better understand dispersion patterns and background conditions.

Approximately 20–30 sensors were strategically placed near schools, parks and residential areas to capture conditions where people live and gather—measuring at minute-to-hour resolution and reported publicly in near real time (Cultivando, 2024a). Cultivando trained local residents as promotoras—community health workers—to help deploy these sensors. These promotoras assisted with installation, maintenance and community outreach, helping ensure the equipment functioned properly while building local understanding of the data. The approach combined technical monitoring with on-the-ground engagement, creating a system where residents were not just data subjects but active participants in tracking and interpreting neighborhood air quality conditions.

Study Components

- Acquired, fabricated, equipped, and installed the Commerce City Fixed Site (CCF) monitoring trailer.
- Acquired, fabricated, equipped, installed, and later relocated the Commerce City Mobile Site (CCM) monitoring trailer.
- Developed and shared public dispersion modeling of Suncor emissions.
- Implemented residential PM2.5 monitoring using PurpleAir sensors.
- Built, launched and maintained a public website portal with real-time data reporting.
- Integrated CCF and CCM data into the Interactive Data Analysis Tool (IDAT).
- Implemented and operated a 9-month passive sampling program for VOCs.
- Conducted whole air sampling for residential VOC monitoring.
- Implemented the nation's first real-time, high time-resolution monitoring of gases, particles and associated radioactivity.
- Developed and provided preliminary data analyses and interpretation to project members and the public.

(Helmig, 2023).

Findings

1. Monitoring results revealed sharp spatial and temporal variability in pollutant concentrations, frequent short-duration spikes that are masked by longer-term averages, and pollutant levels consistently higher than those observed at regional comparison sites.
2. Multiple pollutants were detected simultaneously, with elevated concentrations occurring more frequently at night and during winter months, highlighting distinct exposure patterns not captured by traditional monitoring approaches (Cultivando, 2023). High variability in pollutant concentrations with time; day-night and seasonal behavior.
3. Pollutant concentrations were seen to be higher at night, and also higher in winter.
4. Pollutant concentrations are much higher in Commerce City than at comparison sites.
5. Airborne radioactivity was detected during the monitoring period.

(Cultivando, 2023).

	Threshold	Number of Exceedances past 6 Months								Sampling average	Criterion
		CCF	CCM	BNP	BSE	BRZ	ECC	LLG	LUR		
Benzene	> 0.9 ppb	**316**	233	3	0	1	75		5	*10 minutes (once/hour)*	*CA chronic lifetime no effects*
H_2S	> 8 ppb	**3895**			0					*Every minute*	*Odor threshold*
Methane	> 5000 ppb	**4337**	118	101		0	487	0	15	*Every minute*	*2.5 times ambient background*
Ethane	> 50 ppb	218	**320**	37	22	2	48		93	*10 minutes (once/hour)*	*25 times usual background*
Propane	> 50 ppb	**174**	7	3	1	0	2		24	*10 minutes (once/hour)*	*25 times usual background*
PM 2.5	> 35 µg/m³	**14820**			389		954		378	*Every minute*	*NAAQS 24-hours*
PM 10	> 54 µg/m³	**62685**			2225		9251		3484	*Every minute*	*PM 10 safe level* Slide 17 of 35
NO_x	> 53 ppb	**65203**	33199		3315	113			10375	*Every minute*	*NAAQS 24-hours*

Figure 1: Multiple Pollutant Exceedances (Helmig, 2023).

Figure 1 describes monitoring sites that include BRZ (Boulder Reservoir), LLG (Longmont Lykins Gulch), LUR (Longmont Union Reservoir), ECC (Erie Community Center), BSE (Broomfield Soaring Eagle), BNP (Broomfield North Pecos), CCF (Commerce City Fixed Site) and CCM (Commerce City Mobile Site). This highlights the diverse range of pollutants that were captured from the sensors over the course of the study. Ozone is not emitted directly from a single source but forms in the atmosphere when NOx and VOCs react in sunlight. These findings indicate that the community is influenced by regional and local pollution sources that contribute to ozone formation. from a single source but forms in the atmosphere when NOx and VOCs react in sunlight. These findings indicate that the community is influenced by regional and local pollution sources that contribute to ozone formation. These high-level occurrences from the study are shown below in **Figure 2. Figure 3** shows benzene levels measured once per week over one year, resulting in about 50 data points per site, reported as weekly averages. Mean benzene concentrations varied by more than 50% between monitoring sites. In 2022, the number of one-minute readings above 35 μg/m^3 — the EPA's 24-hour health standard for PM2.5—was calculated for two monitoring sites. At Broomfield (BSE), pollution exceeded that level for 380 minutes (about 6 hours total). At Commerce City (CCF), it exceeded that level for 12,800 minutes (nearly 9 full days). This means CCF experienced about 40 times more high-pollution minutes than BSE, indicating far more frequent spikes above the daily health benchmark (Helmig, 2023). This is shown on the next page on **Figure 4**.

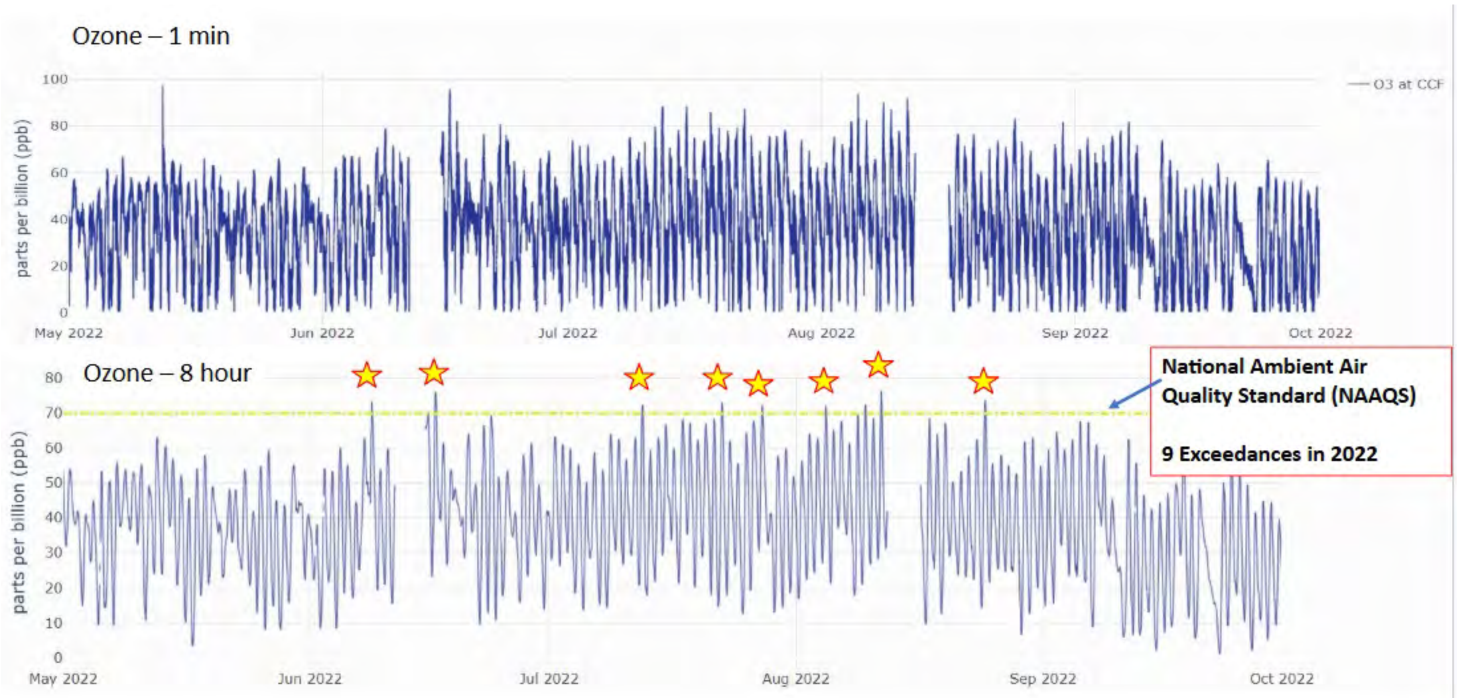

Figure 2: Ozone High Level Occurrences (Helmig, 2023).

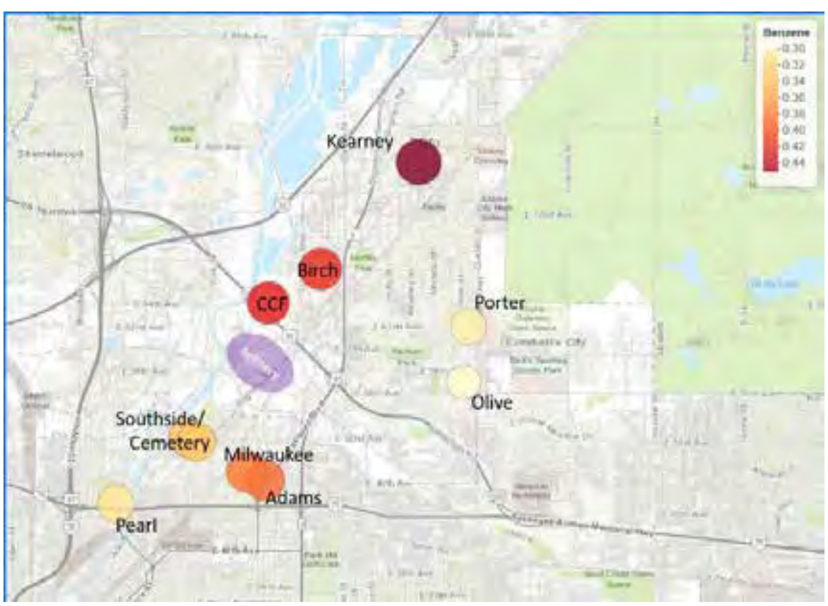

Figure 3: Benzene Levels (Helmig, 2023)..

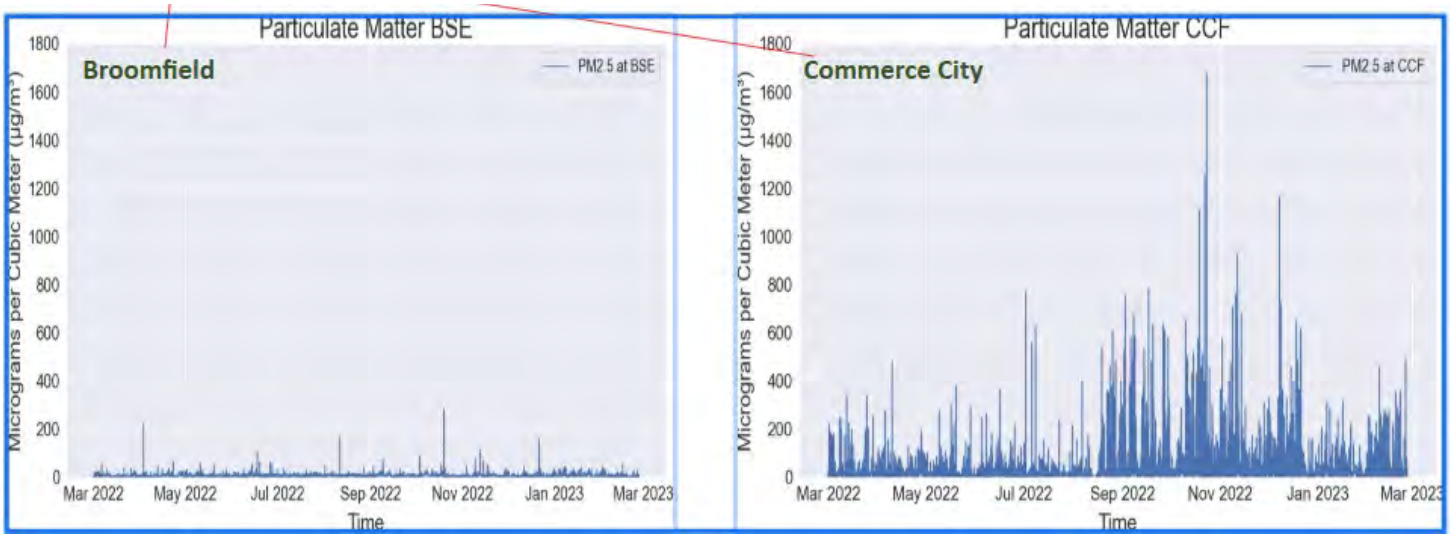

Figure 4: Comparison of Particulate Matter (Helmig,

Figure 5 highlights Methane, Propane and H_2S levels that were monitored near Suncore. Each map shows pollutant concentrations displayed using a color gradient, where dark blue represents lower concentrations and colors transition through green and yellow to red, which indicates the highest measured levels. The circular patterns reflect wind-directional analysis centered on the monitoring site, illustrating how concentrations vary depending on wind speed and direction. Warmer colors clustered in specific directional sectors suggest elevated pollutant levels when winds originate from those areas. Monitoring results documented refinery-related pollutants beyond the facility boundary. The detection of these compounds in community air samples reinforced concerns that emissions associated with refinery operations may be extending into nearby residential areas.

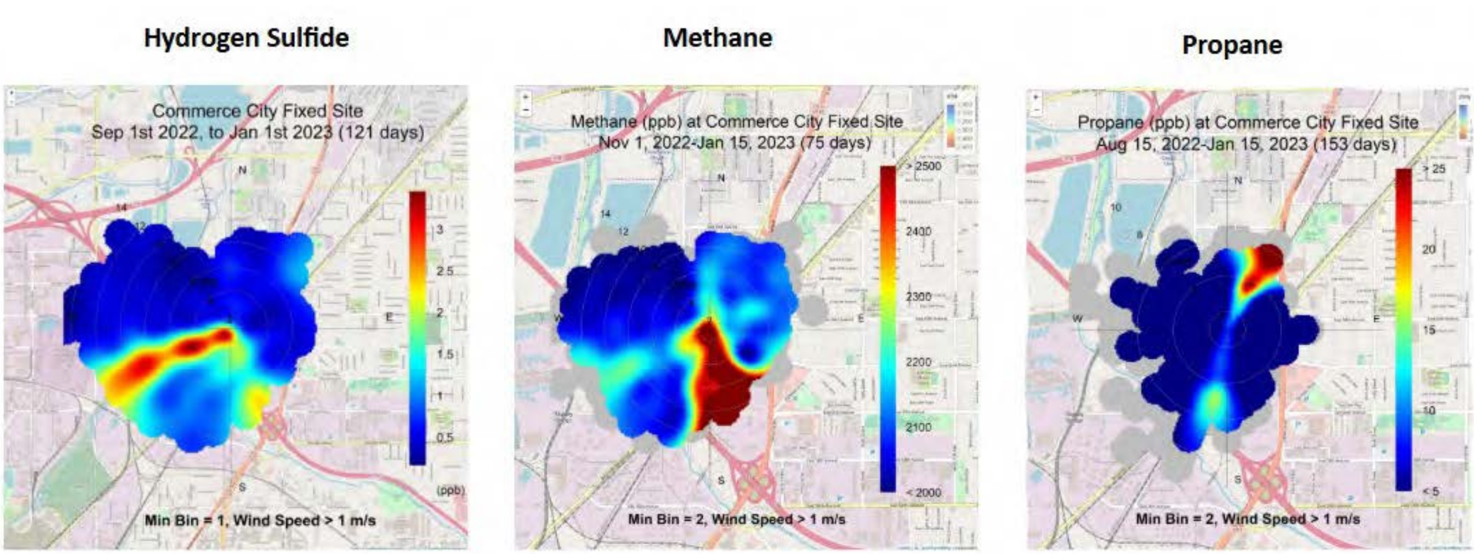

Figure 5: Commerce City Measurements (Helmig, 2023).

Today, CDPHE operates a combined fenceline and community air toxics monitoring program that requires certain industrial facilities to continuously measure pollutants such as benzene, H_2S and hydrogen cyanide at their perimeters, while also conducting mobile and fixed-site monitoring in surrounding neighborhoods. Cultivando's work has also contributed to ongoing policy conversations around emergency notification and rapid response protocols in Commerce City. Their advocacy has supported efforts to strengthen community alert systems, improve transparency around industrial upsets and advance clearer protocols for notifying residents during chemical releases or operational malfunctions at Suncor.

These efforts generate publicly accessible data designed to improve transparency, support rapid response to emissions events and strengthen health protections for communities living near major point sources of industrial pollution (CDPHE, 2025). When paired with resident testimony describing health symptoms, the resulting data has provided critical evidence to inform advocacy and regulatory engagement (CDPHE, 2025).

Suncor Air Pollution Monitoring

The Commerce City–North Denver (CCND) Air Monitoring Program was developed by Suncor Energy (U.S.A.) Inc. in response to community feedback received in late 2020. Designed in coordination with existing regional monitoring networks, the program was shaped through engagement with regulators and local governments, including the CDPHE, Commerce City, the City and County of Denver, Adams County and Tri-County Health Department, as well as public meetings held in May 2021. Suncor selected Montrose Air Quality Services to deploy, operate and maintain the monitoring network (Commerce City–North Denver Air Monitoring, 2026).

The CCND program operates multiple fixed stations that provide continuous public reporting of key pollutants. A mobile monitoring van is periodically deployed to detect additional VOCs and hydrogen cyanide. In 2026, the system was updated to align with Suncor's Title V permit and now includes six stations equipped with FEM instruments (Suncor Energy, 2025).

Permitting, Rulemaking and Regulatory Accountability

Cultivando's AIRE monitoring and community research helped strengthen the evidence base supporting expanded air toxics oversight in Colorado. By pairing high-resolution community data with formal regulatory engagement, the organization contributed to policy discussions that coincided with concrete state and federal actions affecting the Suncor refinery and other major point sources. Under Colorado's 2021 Regulate Air Toxics Act, certain industrial facilities, including Suncor, became subject to required fenceline monitoring for priority pollutants, with partial operation of its fenceline system in 2023, and full system operation by the end of 2024, along with strengthened public notification provisions (CDPHE, 2025). Together, these state and federal actions illustrate a shift in how regulatory systems respond to industrial pollution, as shown here. For point source monitoring projects, aligning neighborhood-scale data with state datasets and regulatory standards can make findings more actionable in rulemaking, permit review and enforcement processes. Community monitoring adds another layer — real-world exposure data that can reveal patterns not fully captured in permit documents or annual inventories. When integrated into enforcement reviews, settlement agreements and air toxics rulemaking, this data strengthens oversight, improves transparency and accelerates corrective action.

> "Community monitoring gave residents something they never had before—independent data that validated their lived experience and strengthened their voice in state rulemaking." — Olga Gonzalez, Executive Director, Cultivando

For residents living near the facility, these developments matter in practical terms. Expanded fenceline monitoring, strengthened public notification requirements and enhanced enforcement mechanisms increase the likelihood that emissions events are detected, documented and addressed promptly — reinforcing risk management and emergency response planning for residents living near industrial facilities. They create clearer pathways for public engagement and regulatory response. More broadly, they signal that environmental protection is not solely a technical exercise conducted within agency walls, but a shared process in which community evidence can shape how permits are written, how compliance is evaluated and how health protections are defined. When regulatory authority and community-generated data operate in tandem, monitoring shifts from a passive record of pollution to an active instrument of governance.

> "Community-collected data has directly informed state rulemaking in Colorado. These datasets have been used to support testimony and shape air-quality regulations adopted by the Air Quality Control Commission." — Michael Olgetree, Senior Director of State Air Quality Programs, CDPHE

Data-to-Decision Pathways

Cultivando advanced a data-driven advocacy strategy by pairing rigorous air quality monitoring with structured regulatory engagement. By generating time-resolved and location-specific data, the organization created an evidence base that could be introduced into public hearings, agency meetings and rulemaking processes. The study underscored major gaps in environmental health tracking. Cancer and other health indicators are typically reported at the county level, which can mask neighborhood-scale disparities in communities such as Commerce City. Researchers at the University of Colorado Denver worked with Cultivando to align community-collected monitoring data with state datasets to identify localized pollution hotspots and strengthen analysis at the census tract and neighborhood scale (Cultivando, 2024a). This alignment helped translate community data into formats compatible with state regulatory frameworks, making it more actionable within formal decision-making processes. Monitoring findings were used to inform testimony, support comments on rulemakings and engage regulators under Colorado's Regulate Air Toxics Act, which requires the identification and control of priority air toxics. Community-generated data, when combined with resident documentation of symptoms and exposure events, strengthened calls for expanded fenceline monitoring, improved notification requirements and enhanced oversight.

> "Fenceline monitors revealed pollution patterns the community had reported for years. Data made those stories impossible to dismiss."
> — Olga Gonzalez, Executive Director, Cultivando

Durability Through Collaboration

Local engagement was central to how data was used. Cultivando invested in community capacity-building by hosting workshops, distributing educational materials and training residents on the health risks associated with air pollution. Promotoras played a central role in the model, supporting sensor deployment and maintenance, translating technical findings into accessible information, documenting odors, flaring events and related health symptoms and serving as trusted messengers within the community. Community-generated data and lived experience were brought into public meetings, press events and regulatory discussions, strengthening advocacy and informing recommendations to state decision-makers. These efforts equipped residents with the tools to interpret air quality data, engage in public processes and advocate effectively for stronger environmental protections (Cultivando, 2024b).

As part of a Latino-led organization, Cultivando prioritized culturally relevant outreach and multilingual materials, ensuring that air quality information was available and understandable to Spanish-speaking residents and families. This approach strengthened trust, built local expertise and supported long-term engagement, enabling community members to use air quality data to inform decisions and participate effectively in public processes over time. Cultivando also strengthened the durability of its monitoring and advocacy efforts through sustained collaboration with grassroots residents, technical experts and cross-sector partners. By working alongside organizations such as GreenLatinos and Earthjustice, the initiative combined community-generated data with legal expertise and policy advocacy, reinforcing that durable environmental health protections often require coordinated action across community, scientific and legal spheres (Cultivando, 2023).

Sensing Air Justice in Rubbertown: Louisville, Kentucky

Rubbertown is a historic industrial corridor along the Ohio River in West and Southwest Louisville, located in Jefferson County, Kentucky. Developed during World War II to support synthetic rubber and chemical production, the area now contains a dense concentration of large-scale chemical, plastics, refrigerant, ammonia and waste treatment facilities. According to Louisville's Air Pollution Control District, 12 Title V facilities operate in Rubbertown, with a total of 31 Title V facilities operating across the Louisville Metro (Air Justice Louisville, 2025). The EPA's TRI identifies 57 hazardous waste treatments, storage and disposal facilities in the metropolitan region as well, with many located directly adjacent to residential neighborhoods (Air Justice Louisville, 2025). This proximity creates complex, overlapping mixtures of hazardous air pollutants at the fenceline, where homes, schools and community gathering spaces often sit with little to no buffer from industrial activity. Rubbertown is home to approximately 5,000 residents, and the surrounding neighborhoods include a high proportion of low-income households, with over 75% of residents in West and Southwest Louisville identifying as Black (Sarr et al., 2021). These patterns reflect broader conditions across these areas, where poverty rates are elevated and average life expectancy is seven years shorter in West and Southwest Louisville than in East Louisville (Air Justice Louisville, 2025). These neighborhoods have long experienced disproportionate exposures to industrial pollution due to the concentration of chemical plants, waste facilities and power generation infrastructure located directly adjacent to residential areas (Sarr et al., 2021).

Image of Rubbertown Facilities (Louisville Metro Air Pollution Control District [APCD], 2026).

There have long been community complaints about air pollution in neighborhoods bordering Rubbertown, and federal and local assessments have documented elevated concentrations of carcinogenic pollutants in these areas. According to the American Lung Association's "State of the Air" 2025 report, Louisville was ranked the 29th worst metropolitan area in the nation for ground-level ozone pollution and second worst in its region for ozone pollution. Louisville also ranked 88th worst for short-term particle pollution out of 225 metropolitan areas and ranked the worst 15% of metropolitan areas for annual particle pollution.

As a result of increasing pollution concerns, Rubbertown Emergency ACTion (REACT) was established in April 2003 by residents living near the fenceline of the plants that make up Louisville's Rubbertown industrial area. Originally formed as a campaign of the Justice Resource Center, REACT became an independent grassroots organization later that year (Environmental Justice for All, 2024). Through collaboration with REACT, University of Louisville researchers and the Environmental Health Literacy Coalition, the Sensing Air Justice monitoring project began in 2021. Former University of Louisville faculty members Dr. Megan Poole and Professor Shavonnie Carthens partnered with community advocate Eboni Neal Cochran to engage scholars, students, local residents and community partners in developing research-informed solutions. The project focused on reducing toxic emissions and advancing legislative change in neighborhoods bordering Rubbertown.

A core element of community-driven monitoring is starting with the questions residents want answered. Instead of relying solely on technical assumptions, this project began with extensive in-person surveys across West and Southwest Louisville, reaching nearly 2,000 residents. An overwhelming 92% identified air pollution as a high-priority concern, with 50% of respondents reporting asthma or other lung conditions and 16% reporting cancer (Air Justice Louisville, 2025). In Louisville, 62% of young patients hospitalized for asthma are Black children, while asthma is more prevalent and severe in zip codes that border Rubbertown.

Health assessments further show the West and Southwest corridor residents are three to four times more likely to develop cancer than those in East Louisville, alongside elevated rates of asthma and heart disease. **Figure 6** highlights rates of asthma from the Sensing Air Justice report. **Figure 7** displays modeled cancer risk from industrial air pollution across Louisville using EPA's 2020 AirToxScreen data, averaged by Council District. The color gradient represents average industrial source cancer risk per million residents, with darker purple and blue areas indicating higher estimated risk and lighter green to yellow areas indicating lower estimated risk. Red dots mark the locations of Title V industrial facilities.

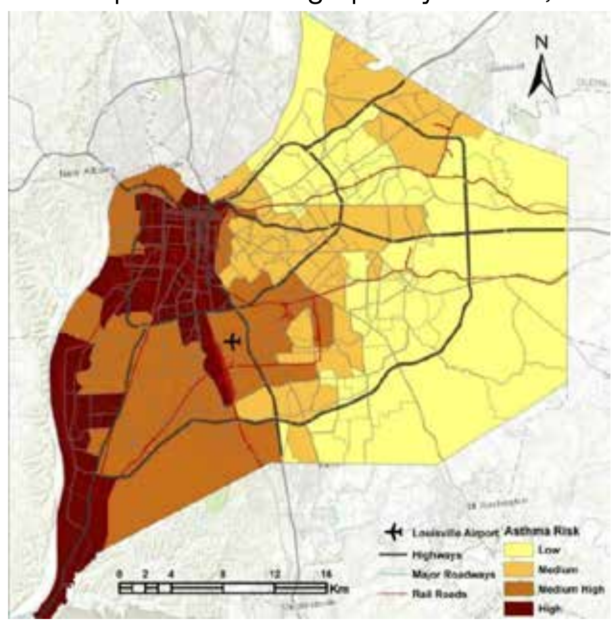

Figure 6: Louisville Asthma Rates (created by Air Louisville) (Air Justice Louisville, 2025).

> "Public health and environmental harms are not just scientific issues—they are legal and policy issues. Law and policy tools can elevate these harms and make them visible in decision-making spaces."
>
> — Shavonnie Carthens, JD, Assistant Professor of Law, University of Kentucky, J. David Rosenberg College of Law

Residents consistently raised air quality concerns and the questions below represent a deliberate effort by residents to examine the gaps between regulatory reporting and on-the-ground exposure conditions. Residents consistently identified air pollution as a top concern and raised specific questions that existing regulatory monitoring could not answer:

Were particulate matter exposures near Rubbertown higher than reported by official sources?	Whether pollution varied block by block rather than uniformly across neighborhoods?	How do community-collected data compare with measurements from the local Air Pollution Control District (APCD) and the EPA?

The program deployed 11 PurpleAir sensors across West and Southwest Louisville to provide real-time neighborhood-level PM data. Eight were placed in Parkland and Park DuValle based on survey findings, with three in Shively as a comparison site. Sensors were co-located with EPA monitors at Bowman Field for validation, and data collected from October 2023 to April 2024 was reviewed by a panel of residents, students and independent experts (Air Justice Louisville, 2025). The sensors continuously measured $PM_{2.5}$ and identified consistent early-morning spikes in West and Southwest Louisville that did not align with traffic patterns. Compared to East Louisville, these areas recorded higher average $PM_{2.5}$ levels, with several sensors reaching or exceeding health-based Air Quality Index (AQI) thresholds. Heat map analysis revealed repeated daily spikes and localized exposure disparities not visible in weekly trends.

Figure 8 on the next page shows daily average $PM_{2.5}$ concentrations from multiple PurpleAir monitors in Louisville between November 2023 and March 2024. Each line represents an individual sensor, grouped by east and west locations. The data show frequent short-term spikes in fine particle pollution throughout the monitoring period, with concentrations regularly fluctuating between low levels and peaks approaching 25–30 μg/m^3. Although pollution levels vary day to day, the overall pattern indicates recurring episodes of elevated $PM_{2.5}$ across multiple sensors simultaneously, suggesting area-wide influences rather than isolated site-specific events. Seasonal variation is also visible, with higher variability during winter months, when colder temperatures and atmospheric stagnation can trap fine particles near the ground.

These findings do more than document episodic spikes; they demonstrate how distributed, neighborhood-scale monitoring can reveal patterns that regional networks may overlook. The themes that emerged from this project offer a practical framework for other communities seeking to translate localized air quality data into stronger public health insight and accountability.

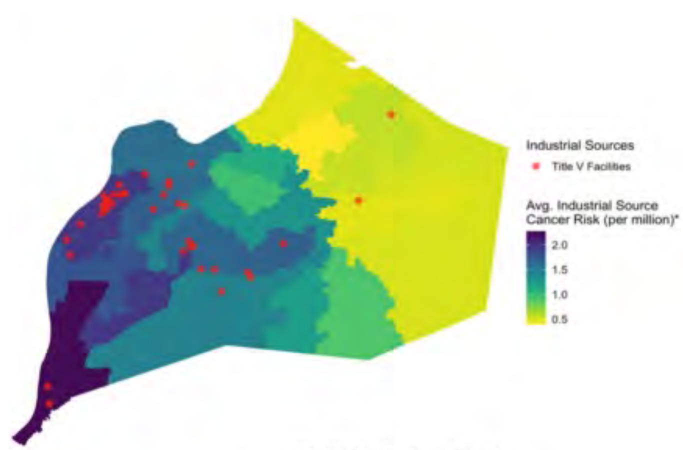

Figure 7: Title V facilities in the Louisville Metro area over AirToxScreen data.

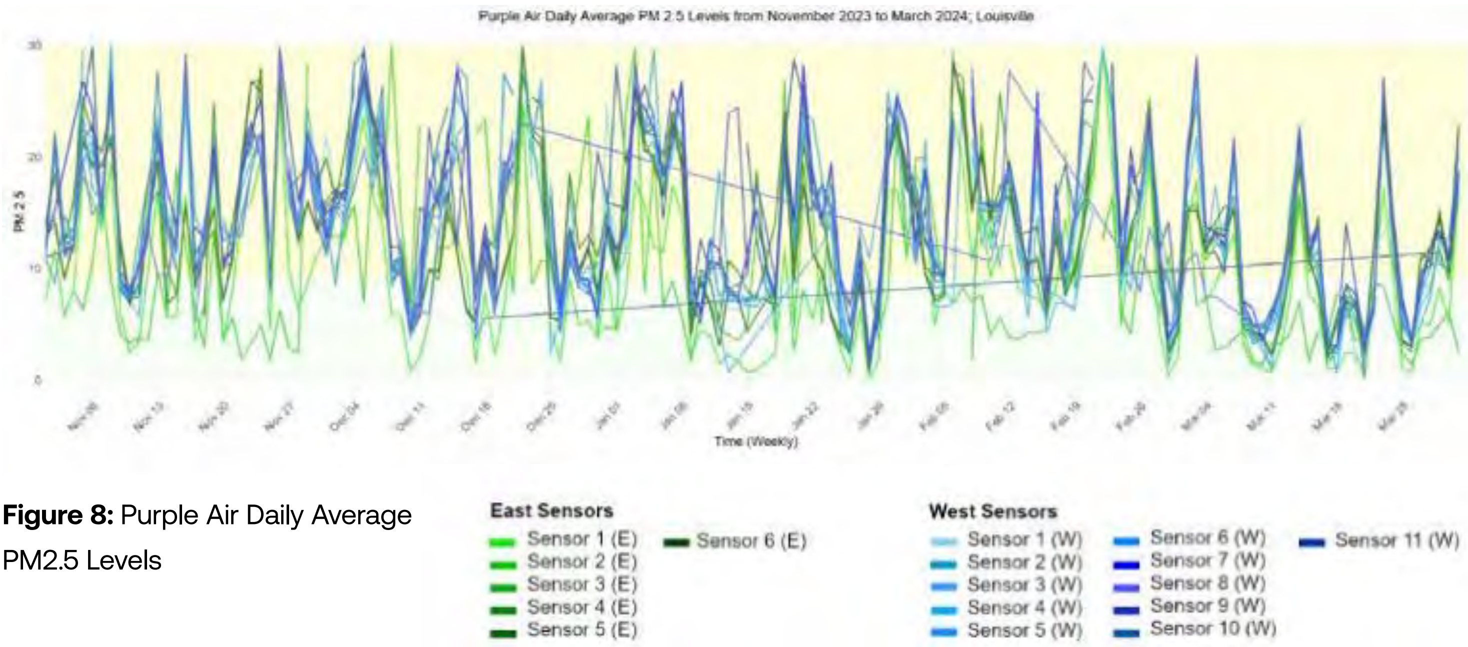

Figure 8: Purple Air Daily Average PM2.5 Levels

Strengthening Public Process

Public participation in environmental decision-making depends on more than the availability of technical documents. It depends on whether residents can understand, access and act on the information that shapes regulatory outcomes. In many industrial communities, pollution data and permitting materials are technically public but practically inaccessible — buried in complex language, lengthy applications or poorly publicized comment periods. Health information is also inaccessible when distributed only through channels that many residents do not regularly use, limiting awareness of comment opportunities and hearings.

Through the Air Justice work, monitoring data became a bridge between lived experience and regulatory systems. Community-generated air measurements were translated into plain language summaries, visual tools and workshop discussions that helped residents understand what pollutants were present, how they related to refinery operations and where those findings intersected with permit conditions or rulemaking processes (Air Justice Louisville, 2025). Rather than positioning data as an endpoint, the program used it as a participation tool— equipping residents to submit informed public comments, ask targeted questions during hearings and engage more confidently with regulators. The research also identified practical steps to strengthen participation more broadly, including improving the readability of permit materials, using plain-language standards and translation checklists, extending public comment periods to allow adequate review time and expanding distribution of public notices beyond traditional channels to reach a wider audience.

By connecting monitoring results to permitting timelines and emergency notification systems, the effort helped shift public engagement from reactive testimony to evidence-based participation. In this model, transparency is not just disclosure. It is the ability of community members to interpret data, connect it to regulatory mechanisms and influence decisions before permits are finalized or rules are adopted.

Data-to-Decision Pathways

The monitoring effort did not end with data collection. Results were intentionally connected to regulatory, permitting and emergency preparedness systems to create actionable pathways for change. Community-generated air data informed public comments during permit review processes, strengthening resident participation with site-specific evidence. Findings were shared with local regulators to support calls for improved odor investigations, expanded toxic air studies and stronger enforcement practices. The documented presence of refinery-related pollutants beyond facility boundaries also reinforced recommendations for permanent, independent monitoring rather than reliance on self-reported industry data. Monitoring results were further used to advocate for structural improvements in regulatory systems, including extending public comment periods, increasing accessibility of permit materials and expanding distribution of public notices. In this way, data moved beyond awareness and into process reform.

> "Data has to be digestible at a glance—otherwise people can't use it to advocate for stronger permits, better monitoring, or safer operations." — Megan Poole, Ph.D., Assistant Professor of Rhetoric & Writing, University of Texas at Austin & co-creator of Air Justice

Air Justice also advances emergency response and notification efforts by advocating for more transparent, timely communication during industrial incidents and linking residents to Louisville Metro Emergency Services alerts for chemical spills and releases. The project's findings supported broader emergency preparedness discussions, highlighting the need for clearer communication protocols, updated risk management planning and collaborative preparedness strategies for communities living near industrial facilities.

Finally, the data contributed to broader accountability conversations around enforcement. By pairing measured air conditions with patterns in regulatory response, the effort highlighted gaps between compliance on paper and exposure in practice, strengthening calls for more effective oversight and enforcement that discourages future violations. In this model, monitoring served as both documentation and leverage — connecting lived experience to regulatory decision points and creating clearer pathways from data to policy action.

Permitting, Rulemaking and Regulatory Accountability

The Air Justice project used monitoring results to engage directly in permitting and regulatory processes affecting refinery operations. By documenting the presence of refinery-related pollutants beyond the facility boundary, the data provided concrete evidence that could be referenced during Title V permit reviews, public comment periods and discussions with local regulators. This shifted community participation from general concern to evidence-based engagement tied to specific regulatory decisions. The project also identified structural barriers within the permitting system — including technical permit language, limited public notice distribution and constrained comment timelines that made meaningful participation difficult. In response, monitoring findings were translated into plain-language summaries and shared through community workshops to help residents understand how measured pollutants intersected with permit conditions, reporting requirements and enforcement mechanisms. Beyond individual permits, the findings supported broader discussions about regulatory reform. Results reinforced calls for permanent, independent toxic air monitoring rather than reliance on self-reported industry data, more transparent enforcement practices and regulatory systems that respond to documented exposure patterns. By connecting community-generated data to concrete regulatory touchpoints, Air Justice demonstrated how monitoring can inform both immediate permit decisions and longer-term rulemaking discussions.

> "There is often a gap between community concerns and the government's response. A response does not always meet the needs expressed by the community." — Megan Poole, Ph.D., Assistant Professor of Rhetoric & Writing, University of Texas at Austin & co-creator of Air Justice

The data also informed conversations about emergency management. The project reinforced calls for stronger coordination between regulators and residents during incidents and for preparedness planning that accounts for those living closest to facilities, especially updating risk management plans at the local facilities.

In this model, permitting, rulemaking and emergency response were not distant administrative processes. They became accessible pathways for accountability—where measured air conditions, public participation and oversight intersect.

Conclusions

Point-source pollution remains one of the most persistent and unevenly addressed air-quality challenges in the United States, particularly for communities living at the fenceline of refineries and chemical manufacturing corridors. The case studies of Commerce City, Colorado and Louisville's Rubbertown demonstrate that meaningful change often begins at the fenceline, where residents confront emissions firsthand and where conventional monitoring systems are least capable of capturing short-term spikes and facility-specific impacts.

Across both cases, industrial exposure is experienced at the neighborhood level — uneven, episodic and deeply felt by those living closest to major facilities. Community-led monitoring did not simply confirm what residents already suspected; it documented patterns and intensity in ways that regional systems could not resolve. By situating monitors within residential blocks and along facility boundaries, these initiatives transformed localized concern into concrete evidence, grounding policy conversations in measurable community conditions rather than distant compliance summaries.

The case studies demonstrate that community-generated monitoring is most effective when supported by rigorous technical design and embedded within durable partnerships. Clearly defined objectives, strong quality-assurance protocols, transparent data platforms and collaboration with state agencies, academic institutions and technical experts were critical to ensuring findings were credible, actionable and trusted. When these elements were in place, localized monitoring informed rulemaking, strengthened enforcement conversations, guided inspections and supported more responsive emergency planning.

At the same time, these efforts underscore a broader truth: while community monitoring can expose gaps in oversight and reveal when and where emissions occur, it cannot replace strong, enforceable regulatory frameworks. Only robust federal and state standards, permit conditions and enforcement mechanisms can reduce emissions at their source. In the absence of comprehensive fenceline monitoring requirements across industrial sectors, many communities remain reliant on their own systems to understand and expose risks that regulatory networks do not consistently track. Embedded within collaborative governance structures, these partnerships reframed monitoring from a compliance exercise into a shared public-health tool—one that strengthens accountability while respecting community knowledge and leadership. Point-source emissions are not only chronic but episodic, and these characteristics make emergency preparedness a central concern. Short-duration releases of hazardous air pollutants can pose acute risks, particularly when residents lack timely alerts, clear response guidance or confidence that agencies are aware of conditions on the ground. The experiences documented here show how localized monitoring can support faster detection, more informed emergency response and clearer communication during industrial incidents—but only when data systems are designed with emergency management in mind.

As point-source corridors continue to overlap with densely populated neighborhoods—often communities of color and low-income households—the need for both localized monitoring and systemic regulatory reform becomes increasingly urgent. The combined approach reflected in these case studies recognizes lived experience, addresses long-standing monitoring inequities and strengthens the ability of communities to participate meaningfully in decisions that affect their health and safety (Madrigal et al., 2024).

Looking Forward

The recommendations above are already taking shape in several regions through next-generation monitoring frameworks and public-facing data tools that show how community data, regulatory oversight and transparency can function together at scale, with fenceline and community monitoring evolving beyond pilot efforts into standardized, enforceable systems that provide real-time data, clear accountability and independent verification.

Next-Generation Facility Monitoring

Across the country, refinery fenceline and community-monitoring programs are evolving toward real-time, publicly accessible data systems, and one of the clearest examples is South Coast Air Quality Management District's (AQMD) Rules 1180 and 1180.1 in Southern California. In the South Coast Air Basin, covering Los Angeles, Orange, and parts of Riverside and San Bernardino counties, refineries are now required to operate continuous air-monitoring systems at their fencelines and in surrounding neighborhoods. The air district also runs its own community monitoring network through a Community Air Monitoring Plan (CAMP) and a Quality Assurance Project Plan (QAPP), documents that describe how monitors are sited, how data is validated and how results are communicated. Together, these systems provide real-time detection of emission changes, public alerts when pollutants exceed thresholds and clear expectations for facility response. AQMD is also developing an Independent Audit Protocol to ensure that refinery-reported data are independently verified and consistent with regulatory and public-health standards (South Coast Air Quality Management District, 2025).

This protocol represents a shift in how community monitoring is being built across the country. It introduces regular third-party audits, detailed document and data reviews, on-site verification tests and formal corrective action plans that reinforce accuracy, transparency and continuous improvement. Key priorities include clear roles among refineries, auditors and regulators; consistent QA/QC procedures tied to public dashboards; strong data-management systems; and a repeatable process for identifying and resolving issues. As more regions adopt similar approaches, community monitoring will increasingly rely on independently validated, high-frequency networks that give residents trustworthy information, support health-protective decision-making and strengthen accountability for point-source emissions.

Together, these elements show how fenceline monitoring can evolve into a durable regulatory and public-health tool—one that aligns facility responsibility, agency oversight and community trust through validated, real-time data. In parallel with advances in facility-level monitoring, new public-facing data platforms are reshaping how industrial air pollution information is accessed, understood and acted upon by communities and decision-makers. These tools demonstrate how transparent, map-based dashboards can complement regulatory monitoring by making localized risks visible, contextualizing health impacts and revealing where monitoring coverage remains insufficient. The recommendations and examples in this report reflect approaches already underway across the country.

Public-Facing Air Quality Data Tools

Recent tools point toward a shift in industrial air-quality monitoring toward integrated, public-facing dashboards that link facility locations, emissions, health-risk indicators and monitoring coverage. In 2025, the Environmental Defense Fund (EDF) launched the Petrochemical Air Pollution Map, an interactive tool that shows where petrochemical facilities operate, which nearby communities face the highest modeled health risks and where monitoring gaps persist. Tools like this illustrate how transparent, map-based dashboards can complement regulatory monitoring and improve visibility into localized risks near industrial corridors (EDF, 2025).

Recommendations

Communities living near point-source facilities are already generating the data needed to understand and respond to local emissions, but the durability of these efforts depends on stronger policy frameworks, sustained funding, clear emergency-response pathways and consistent integration of community data into regulatory systems. To ensure that localized monitoring translates into meaningful public-health protection, the American Lung Association offers the following calls to action.

Federal Government

- Implement and enforce science-based, health-protective NAAQS, including the 2024 updated $PM_{2.5}$ standard.
- Strengthen hazardous air pollutant standards and enforcement. Expand fenceline monitoring requirements to more stationary sources of hazardous air pollutants.
- Adequately fund state, local and tribal air agencies to sustain robust regulatory monitoring networks, including staffing, data platforms and infrastructure.
- Invest in dedicated, multi-year funding for community-led monitoring, supported across federal agencies (e.g., EPA, FEMA, USDA and others). Include investments in technical assistance hubs that provide calibration and collocation support, QA/QC protocols, quality assurance and data interpretation guidance. Support ongoing research into best practices.
- Develop guidance on minimum performance, documentation and transparency standards to integrate validated, community monitoring data into federal air quality decisions, including enforcement, inspections, permitting, compliance and rulemaking.
- Establish frameworks to utilize community-scale data for public health communications, emergency response and preparedness, and post-event evaluations.
- Building on the success of the EPA U.S. Fire and Smoke Map, improve and modernize federal data platforms to display validated and corrected community monitoring data alongside regulatory measurements. Permanently fund and expand federal wildfire smoke monitoring programs, including EPA's WSMART.
- Support cross-agency coordination among air agencies, transportation authorities, port and freight authorities and land-use and zoning regulators to integrate community monitoring into decision-making.

States

- Ensure stable, state-level funding streams, beyond short-term grants and projects, for community monitoring. Sustain cross-agency partnerships that build local expertise and tailor to local needs.
- Partner with universities, air agencies and research institutions to provide technical support – including sensor deployment, data hosting, calibration and validation, assessment and maintenance, data useability and hands-on training—for community, school and tribal monitoring programs.
- Integrate properly corrected community sensor data into dashboards, maps, public advisories and communication platforms that support incident-response systems, neighborhood-level messaging, school and outdoor activity guidance, emergency response decisions, post-event assessments and inclusion in state resilience planning.

- Establish frameworks that formalize community participation and transparency in air quality decision-making, including defining how community input informs agency actions and ensuring feedback loops between residents and decision-makers. Ensure a pathway for community-generated data to be used to identify high exposure areas.
- Use quality-assured community data to inform state permitting decisions, cumulative-impact analyses and targeted inspections, and formalize how neighborhood-scale monitoring feeds into state air quality programs to support enforcement screening, mitigation prioritization, emergency monitoring plans, transportation planning and land-use strategies. SIPs can remain anchored to regulatory monitoring for NAAQS compliance while using quality-assured community data to identify hotspots and better target where emission reductions can be applied.
- Support Tribal sovereignty in air monitoring by strengthening EPA State and Tribal Assistance Grant (STAG) support for tribal air programs, including sustained funding for staff, operations and data ownership and use.

Local Governments

- Commit sustained funding to support the full lifecycle of community air monitoring, including sensor maintenance and replacement, staff capacity and training, partnerships, public data platforms and ongoing engagement that links monitoring to public health and emergency response.
- Coordinate across cities, counties, regional agencies, public health and emergency planners and neighboring jurisdictions to align monitoring with pollution patterns, enabling residents and agencies to co-develop priorities, review data and guide mitigation strategies.
- Embed air quality monitoring into local emergency management and hazard-mitigation plans by establishing formal cross-department protocols that define how community sensor networks are used in public communications, emergency operations, recovery planning and future preparedness, require agencies to use real-time data to guide coordinated response during major pollution events, and document lessons learned to improve future decision making.
  - Wildfire smoke: Use data to guide decisions on outdoor activities, worker safety, school and childcare operations, ventilation and clean-air shelter activation.
  - Heavy-duty trucks: Apply data to inform truck routing, idling enforcement, curb management, port operations and roadway design.
  - Point-source pollution: Integrate data into investigations, permitting review, public comment processes and facility-level mitigation actions.
- Regularly review monitoring data to identify areas of elevated concentrations, dominant sources and exposure trends, and conduct after-action reviews following major events to refine communication, sensor placement, outreach and resource deployment.
- Preserve quality-assured community data for public comment and, when needed, legal review, strengthening the administrative record with real-world exposure evidence.
- Support community events and volunteer networks—including schools, faith-based organizations and health clinics—to engage residents as sensor hosts and data stewards.
- Use transparent, plain-language and multilingual reporting tools with visuals and maps to support public understanding and informed participation in policy discussions.

Individuals/Community Groups

- Collaborate with academic entities, public health organizations, government agencies and commercial vendors to secure multi-year grant funding support for deploying monitoring projects and sustaining staffing, data infrastructure and stewardship.
- Bolster community capacity and support through coordination with local schools, tribal, faith-based and neighborhood organizations in under-resourced or rural areas.
- Use publicly accessible air quality data, supported by cross-sector partnerships, to deliver clear findings, actionable requests and health-protective protocols to local municipal boards, school boards, commissions and decision-making bodies.
- Apply neighborhood-scale data to advocate for health-protective actions, including emergency alerts, clean-air shelter activation and smoke-day school and work adjustments, truck rerouting, idling restrictions, buffer zones near homes and schools, and stronger fenceline monitoring, permit modifications, targeted inspections, health symptom tracking and enforceable mitigation during permit renewals or expansions.
- Build data literacy by training local staff, volunteers, leaders and residents to interpret corrected data, document pollution events and communicate findings effectively, while establishing clear governance structures over roles, authority and data ownerships.
- Plan for the full data lifecycle and continuous improvement—from defining monitoring questions and selecting sensors to placement, calibration and maintenance; data collection, backup and useability; to quality assurance and sustained use of results.
- Document and apply lessons learned to improve communication strategies, locally tailored data models, resource deployment and long-term operation and sustainability.
- Maintain public-facing dashboards that integrate sensor data and forecasts with plain-language health guidance, designed to be mobile-friendly, multilingual and accessible to non-experts.
- Educate residents on local emergency preparedness and response protocols, including the communication channels used to deliver rapid public alerts during pollution events.

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Something in the Air

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A “State of the Air” Supplemental Report

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