

MEMORANDUM

TO: Roadmap to Reduce Air Toxics Team, California Air Resources Board
FROM: Joshua S. Apte, PhD. For identification purposes only: Associate Professor of Environmental Health and Environmental Engineering, University of California, Berkeley.
DATE: September 11, 2026
RE: Comments on the Draft 2026 Roadmap to Reduce Air Toxics (August 2026)

Thank you for the opportunity to review the draft Roadmap. This roadmap correctly outlines many of the crucial science, research, and policy needs related to reducing the emissions, exposures, disparities, and health risks associated with air toxics in California. I support its direction and congratulate CARB on taking this crucial step. Furthermore, **I strongly support the allocation of the necessary resources to make this roadmap a reality.** First, I wish to highlight several strengths of the roadmap, including:

- **Diagnosis.** California clearly needs a new generation of strategies and policies to address the cumulative health risks from air toxics, especially in disadvantaged communities.
- **Equity and cumulative risk.** The roadmap correctly highlights that a key policy goal must be to address the disparate risk of air toxics for disadvantaged communities.¹ The focus on an integrative approach to addressing the cumulative risk from this multi-pollutant problem is appropriate and necessary.
- **Integration of measurements, models and inventories.** Appropriate identification, quantification, and management of air toxics will inherently require a multi-pronged, multi-method approach that integrates multimodal, hyperlocal measurements; refined inventories; and next-generation exposure/risk-assessment models.
- **Partnership.** The roadmap correctly identifies the need for partnership. The air toxics challenge will require unprecedented collaboration between CARB, air districts, communities, academia, and industry.

Key suggestions. My comments identify strengths the final version should keep and four areas where more specific commitments would (i) increase the efficacy of the proposed program, and (ii) help CARB and the public track progress.

1. **Quantitative tracking of risks and disparities.** I suggest that the roadmap should be revised to incorporate a clear strategy for *quantitatively* tracking progress over time. Critically, the roadmap should articulate a commitment to regularly (e.g., biennially) quantifying how the **relative and absolute disparities** in air toxic exposures and risks are evolving over time in response to emissions reductions. This tracking and reporting is critical to many key goals: (i) strengthening accountability and transparency; (ii) building trust and support of communities, and (iii) providing an effective set of metrics to allow policies to respond dynamically to lessons that are learned in the years to come.
2. **Rely on recent CalEPA-funded science to inform metrics and policy design.** CARB and OEHHA have already funded an **extensive body of peer-reviewed research** that provides actionable metrics for quantifying how relative and absolute disparities respond to emissions control measures.²⁻⁴ These metrics are now widely adopted in the air pollution and environmental justice literature, and are well-suited to the goal of tracking how exposure and disparities evolve over time.
3. **Ensure that spatial scale of analysis tools matches the problem.** Available evidence suggests that the distribution of risks from many (but not all) air toxics has a strongly **hyperlocal** character – areas of sharply elevated risk at the neighborhood and finer spatial scale (~ 100 m – 1 km).^{5,6} While technically challenging, it is essential that analysis methods for quantifying risks and designing interventions

match the spatial scale of the problem at hand. Traditional ambient monitoring excels at tracking long-term trends but can struggle to represent the relevant spatial resolution that drives much exposure and disparity.

Thankfully, CARB, air districts, academic partners, and community air monitoring efforts have collaborated to produce many of the fundamental methodological innovations that would enable assessment at this scale. It will take skill and creativity to cost-effectively implement these techniques, but this is a challenge that is worth tackling, because it lies at the cornerstone of a successful strategy for addressing the air toxics problem.

4. Integrate measurements, models, and inventories into a unified, coherent and multi-scale data strategy. The draft roadmap correctly highlights how measurements, modeling, and inventory development play mutually reinforcing roles. I would go further. For CARB's new efforts around toxics to be successful, it is imperative that these traditionally fragmented/"siloed" functions be tightly integrated into a single shared data infrastructure. Done right, an integrated "observing and modeling ecosystem"⁷ for air toxics could prove to be far greater than the sum of its parts while delivering substantial cost efficiencies by reserving measurements for where they add the most valuable new information. Here are several considerations and recommendations to contemplate in developing this system.

- a. **Leverage the unique strengths of diverse measurement approaches.** Over the past 15 years, there has been an explosion in the range of available monitoring technologies and measurement paradigms. These diverse approaches have unique but complementary strengths.⁹ An effective integrated monitoring strategy would harness these complementarities to ensure that the full range of monitoring functions is met, even when no single approach does so on its own. These functions could include:
 - i. long-term trend tracking, including for regulatory compliance
 - ii. assessing the impact of control policies
 - iii. representation of hyperlocal gradients and community hotspots
 - iv. source profiling and identification, including the discovery of unexpected/unknown sources⁸
 - v. detection of episodic/accidental releases and transiently hazardous conditions
 - vi. model and inventory evaluation⁶
 - vii. estimation of population exposures
 - viii. providing community information, especially for priority receptor locations
- b. **Models can help generalize and explain measurements.** Given that it will be cost-prohibitive to continuously measure all air toxics everywhere, models are a necessity. A crucial, underappreciated role of modeling is to assimilate diverse multimodal measurements to fill in the gaps in space and time that inevitably exist in individual measurement datasets.⁹⁻¹⁰ Moreover, it is possible to use assimilated measurements in an inverse modeling framework¹¹ to characterize emissions sources and estimate emissions rates in ways that produce updated, observationally-constrained, and generalizable emissions inventories.
- c. **Ensure open and interpretable data.** Community groups, local governments, and researchers should retain ready access to the data this infrastructure produces, with documented detection limits, averaging times, and uncertainties. For air toxics, documentation carries unusual weight, because method detection limits frequently sit above health-relevant

benchmarks. CARB should devote staff time to publishing plain-language summaries alongside the underlying data. Access should also run inward: tiered QA/QC protocols that let community-collected measurements enter the shared infrastructure could widen the observational base while giving communities a stake in a system they help populate.¹²

- d. **Harness California expertise.** Between state/local agencies, academia, industry, and community groups, California has extensive expertise in each of these data functions, and has pioneered state-of-the-art research in how to integrate measurements, models, and inventories to maximum effect. CARB could consider convening a technically-oriented “air toxics data consultation group” that could provide recommendations on strategies for cost effectively integrating these diverse approaches.

Closing

These recommendations depend on one another. Disparity metrics require measurements and inventories that agree. A next-generation air toxics data infrastructure that marries models and measurements can help provide the data to guide this decision making. I would welcome the chance to discuss these comments with staff.

References

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