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Ada E MÃ¡rquez Comments - CEQA Comment Letter Appendix A Ref (3 of 8)

Additional submitted attachment is included below.

Update on Particulate Matter (PM) Air District Work: Grants and Incentives

Karen Schkolnick
Director, Strategic Incentives, Bay Area Air Quality Management District

Main takeaway	**Since 1991, more than $1.2 billion has been invested through the Air District's grants and incentives programs, resulting in significant emissions reductions and accelerated adoption of cleaner and zero-emission technology. Because these initiatives are not subject to regulatory constraints, the Air District is able to use the great majority of funds to target mobile sources. However, programs are constrained by the requirements of the funder — for example, there is only one source of funding that can be used for VMT reduction.**

Ms. Schkolnick presented a summary of the Air District's grant revenue sources, current grants and incentive programs, and recent program results. She highlighted several key initiatives that incentivize the accelerated adoption of the cleanest commercially available technology and discussed how these programs connect to other Air District priorities including health risk reduction in communities disproportionately impacted by air pollution.

Current Air District Work

Prioritization Process

Because grants and incentive programs are not tied to regulatory constraints, the Air District is able focus almost all of its funding through these programs (90 to 95%) on reducing mobile-source emissions. Most of this funding goes toward accelerating the adoption of the cleanest commercially available technology. An additional priority is expediting emissions reductions in disproportionately impacted communities.

The cost effectiveness (CE) of nearly all programs is evaluated using the following formula (or a variant) from the Carl Moyer Program, established by the State of California and CARB:

$$CE = \frac{Funds\ Awarded}{Tons\ of\ NOx + ROG + (\boldsymbol{PM_{10}\ x\ 20})\ reduced}$$

Notably, this formula has changed over 20 years by incrementally increasing the weighting of PM from 1 to 20, reflecting the State's interest in health protection.

Current Funding Allocation

$97 million from grants and incentives in 2018 were allocated to:

- **On-road emissions reduction — $32 million (one third),** supporting both deployment and infrastructure for lower- or zero-emission light-, medium-, and heavy-duty vehicles (cars, trucks, and buses). Notably, pass-through programs also support this category, so the total amount of support is higher than this number.
- **Off-road mobile source emissions — $44.4 million (almost half),** from sources such as cargo handling equipment, agricultural equipment, marine and locomotive vehicles, and airport ground support. These are primarily diesel emissions and the cleanest commercially available technology in most cases is cleaner diesel, transitioning from Tier 0 or 1 to Tier 4 engines, although some electrification is now occurring such as Caltrain and lighter cargo handling and air ground-support equipment.
- **Vehicle Miles Traveled (VMT) reduction — $6.2 million (plus nearly $9 million in pass-through),** including shuttle and ride-share services connecting to mass transit, pilot services such as Bay Area Bike Share (now sponsored by Lyft), and expansion of bikeways and bike parking. The Spare the Air program is also funded in this category. For the Spare the Air program, funding is also supplied through pass-through programs, so the total amount of support is higher.
- **Household technology and local climate action — $5.1 million,** including lawn and garden equipment replacement, wood smoke reduction (now focused on reducing combustion through transition to heat pumps), and capacity-building for schools and local government.
- **Pass-through to county transportation agencies — $9.5 million,** primarily to implement trip reduction and on-road vehicle emissions reduction.

Notable Initiatives

Diesel Free by '33

This program focuses on introducing zero-emission technology in each category of vehicles and equipment as soon as it becomes commercially available. While the present focus is on the light-duty sector, the program is designed to incorporate categories such as marine, locomotive, and construction vehicles and equipment as technology evolves.

The **light-duty sector** demonstrates the expected pattern: While hybrid and natural gas vehicles were the best available technology 10 years ago, zero-emission vehicles have since emerged and become a focus for Air District grants and incentives funding. Currently:

- More than $15 million has been invested by the Air District, plus additional investments from the federal and state government and the private sector to help accelerate the adoption of light-duty zero-emissions vehicles
- Almost 8,000 electric vehicle charging ports are in place

- Renewables are included in 25% of Air District-supported charging ports
- Low-income residents are a focus for vehicle electrification programs
- 3% of Bay Area vehicles are electric
- 25% of all electric vehicles in the U.S. are in the Bay Area
- Goal: Five million vehicles by 2050
    - Presently ahead of schedule
    - Limitation is availability of vehicles

R&D advanced technology demonstration programs

The Air District also participates in advanced demonstration programs, which provide proof-of-concept for the deployment of improved technologies that are not yet commercially available. The Air District has recently been serving as the lead administrator for a $2.9 million project in partnership with Goodwill Industries, BYD (a manufacturer of heavy-duty battery electric vehicles and equipment) and CARB. This project will test and deploy 10 electric delivery trucks and one refuse hauler. Another $3 million project in partnership with Golden Gate Zero Emissions Marine and CARB will build, test, and deploy the first hydrogen-powered ferry for passenger service in mid-2020. Both of these projects are funded primarily through the California Climate Investments program from CARB's Low Carbon Transportation program.

Port of Oakland

Over the course of ten years, Air District grants have invested approximately $120 million in retrofitting and replacing vehicle technology and infrastructure at the Port of Oakland, including replacing approximately 2,000 drayage trucks and more than 1,000 on-road trucks, installing shore power at 14 berths, and updating harbor craft and cargo handling equipment.

Recent (since 2015) Results and Highlights

Significant reductions in regionwide emissions

- CO_2: nearly 600K tons
- NO_x: more than 3K tons
- Reactive organic gas: more than 1K tons
- PM_{10}: nearly 400 tons

Infrastructure and equipment implemented

- More than 1,000 electric vehicle charging stations
- Approximately 40 miles of bikeways
- More than 1,200 woodstoves and fireplaces replaced
- More than 100 zero-emissions transit and school buses

Supporting disproportionately impacted communities

Approximately 53% of funds went to programs in Community Air Risk Evaluation (CARE) areas.

More than $1.2 billion in total investments

Through 2020, clean air investments from Air District grants and incentives total over $1.2 billion. This figure represents significant growth since these programs were initiated in 1991 with approximately $5 million.

Forthcoming Air District Work

For 2020, an estimated $108 million will be invested through the Air District's Strategic Incentives programs. In addition to the continuation of the initiatives described above, including the expansion of eligible vehicles and equipment for Diesel Free by '33, the Air District will promote:

- expansion of **lawn and garden** equipment replacement programs,
- reducing **motorcycle** usage,
- funding **air filtration systems** and **clean air shelters**,
- funding **climate resilience** programs, and
- securing **new sources of funding** to expand eligibility of existing programs (such as VMT reduction) and initiate new efforts.

Post-Presentation Discussion

Successes. Chair Hayes and Council Member Rudolph commended the Air District's successes through its grants and incentives programs, particularly with regard to the Port of Oakland and other initiatives targeting diesel particulate matter.

VMT reduction. Council Member Rudolph asked why more funding had not been allocated to VMT reduction and inquired whether the Carl Moyer formula disincentivized VMT as a focus. Ms. Schkolnick explained that while VMT reduction is a priority for the Air District, efforts are limited by available funding sources. The only funding stream that allows for VMT reduction is the Transportation Fund for Clean Air. Annually, of that fund's approximately $25 million, $9 million is allocated as a pass-through to county transportation agencies and used primarily for VMT reduction. The Air District's remaining amount from that fund is split between light-duty emission reduction programs and reducing VMT. Additionally, the Air District partners with the Metropolitan Transportation Commission on regional efforts such as the Bay Area Carpool Program through 511.org and Spare the Air. Mr. Breen added that the new focus on VMT and reducing brake and tire wear and road dust comes as a result of the Air District's successes in reducing emissions from diesel particulate matter, which was previously the predominant source of PM and remains a significant health concern in disproportionately impacted communities. He noted that the science has not yet caught up to the change in priorities, and that the Air District can advocate for changes in legislation once that science is clear.

Retirement of diesel equipment. Council Member Lipman inquired whether the Diesel Free by '33 initiative is retiring diesel vehicles and equipment or only adding additional lower- and zero-emissions technologies to fleets. Ms. Schkolnick clarified that nearly all Diesel Free by '33 programs are replacement programs.

Evaluation formula. Chair Hayes asked for clarification on the use of the Carl Moyer guidelines for evaluating cost effectiveness. In response to Chair Hayes' question concerning the designation of PM_{10} as the focus of emissions reduction, Ms. Schkolnick affirmed that the formula does specify PM_{10} rather than $PM_{2.5}$. She added that there has been some discussion about converting the formula to $PM_{2.5}$, but it is not clear how the formula would need to be altered to result in an equivalent evaluation. She also clarified in response to Chair Hayes' question about sidebar calculations that the Air District does use additional and more complex calculations to further evaluate some programs, such as co-benefits, $PM_{2.5}$, brake and tire wear and road dust, and proximity to disproportionately impacted communities. Council Member Kleinman commented that the risk of specifying PM_{10} is that courser particles are easiest to remove and, due to their greater mass, will reflect a greater apparent reduction of emissions while potentially leaving in place all the $PM_{2.5}$. He noted that to ensure health protection it would be beneficial to apply an alternative formula that balances that risk. Mr. Breen clarified that while the Carl Moyer Program requires the application of the specified formula, the tools that the Air District uses (such as calculating Significant Emissions Rates and using diesel particulate matter filters) do capture $PM_{2.5}$. He acknowledged that the more difficult correlation to establish is the degree to which applying the Carl Moyer guidelines using Air District approaches succeeds in reducing ultrafine PM.

Renewable charging stations. Council Member Kleinman asked how many of the approximately 8,000 electrical vehicle charging stations use renewable energy. Ms. Schkolnick replied that while she did not have information about all of the charging stations in the area, approximately 25% of the stations that the Air District has funded use renewable energy (primary solar).

Update on Particulate Matter (PM) Work: CARB PM Research and Rules

Alvaro Alvarado
Manager, Health & Ecosystems Assessment, California Air Resources Board (CARB)

Main takeaway	**CARB is currently conducting research to better understand the air quality impact of wildfires, brake and tire wear, and ultrafine particles. New and forthcoming regulations will soon be implemented to further reduce emissions from mobile sources.**

Dr. Alvarado described the PM research currently being conducted at the California Air Resources Board and the emerging regulations designed to further decrease PM emissions. In line with the Advisory Council's requests, he focused on research concerning wildfires, brake and tire wear, and ultrafine particles. Several regulations are underway or forthcoming regarding trucks, cars, and trains.

Current CARB Research

Why PM? Dr. Alvarado began his presentation by highlighting the health impacts of PM including approximately 7,200 premature deaths each year in California. Although CARB regulations specifically track hospitalizations and emergency room visits as health outcomes of PM, CARB is also aware of and concerned with outcomes such as asthma attacks and other respiratory symptoms, adverse brain effects, and work loss days. He noted that regulations implemented over the past 25 years, particularly with respect to trucks, have contributed to substantial decreases in average $PM_{2.5}$ concentrations.

Wildfires

Millions of Californians — by some estimates, the entire State population — were exposed to wildfire smoke in 2018, and wildfires are expected to become more frequent and widespread as a result of climate change. Although the current assumption is that all PM is equally toxic, this may not be the case; as wildfires cause more extensive damage there will be more combustion of structures and vehicles that could cause more toxic smoke. Effects could be particularly pronounced for children and older adults. Current CARB research includes:

- **Monkey study at UC Davis.** As Office of Environmental Health Hazard (OEHHA) Director Lauren Zeise described during the first Air District PM symposium, UC Davis researchers are investigating the effects of the 2008 wildfires on an outdoor captive monkey colony. When compared to monkeys in the population born in 2009, monkeys that were infants in 2008 experienced impaired immune function, changes in lung structure, and reduced

lung function, which persisted into adulthood. Moreover, immune effects were passed on to the next generation.

- **Wildfire emissions research.** Researchers at UC Berkeley and UC Riverside are using mobile monitoring platforms to investigate in-home exposures to wildfire smoke, and CARB is partnering with NASA to use aircraft to collect wildfire data.

Brake and Tire Wear

As previously noted by other presenters, as tailpipe emissions are reduced, brake and tire wear become more predominant sources of mobile-source PM. These emissions are more localized; whereas tailpipe emissions are associated with secondary PM and downwind exposures, brake and tire wear primarily affect people living near roadways. Health effects from brake and tire wear may be distinct from tailpipe emissions due to the presence of metals and plastics in wear-based PM emissions. Current CARB research includes:

- **Laboratory studies** quantifying brake and tire wear emissions using dynamometers,
- **Community exposure** studies with UC Riverside, and
- **Health effects** studies with UCLA.

Ultrafine Particles

Dr. Alvarado reiterated that ultrafine particles are difficult to measure and study, that it travels from the lungs to other organs including the brain, and that concentrations vary by space and time with peaks near roadways and during traffic that taper off at a distance and at night. He noted that prior research, primarily in Europe, has limited utility as it tends to focus on short-term exposures (one to four days) measured at only one location and using the extreme outcomes of hospitalizations and premature death. If ultrafine particles are similar to $PM_{2.5}$, long-term exposures can be expected to be far more significant than short-term exposures and indexed to population proximity and vulnerability.

To begin closing these research gaps, current CARB research is 1) **modeling ultrafine particles** annual average concentrations and speciation throughout the state and 2) **associating mortality** with long-term exposures using the California Teachers Study cohort. Preliminary results suggest an increased risk of premature death with high exposure to ultrafine particles. Additionally, to better understand health effects of short-term exposures to UFP, CARB is working with Council Member Kleinman to identify gaps in available research and develop a research plan.

Forthcoming CARB Regulations

A number of regulations will soon be implemented to further reduce mobile source emissions.

Heavy-Duty Trucks

- Advanced Clean Truck Regulation will transition heavy-duty trucks to zero emissions starting in 2024.
- Heavy-duty vehicle inspection and maintenance will require trucks to pass an inspection similar to a smog check in order to register with the California Department of Motor Vehicles.
- Innovative Clean Transit will transition public transit buses to zero emissions.
- Airport shuttles will also be transitioned to zero-emission vehicles by 2035.
- The Heavy-Duty Low NO_x omnibus rule will reduce NO_x as well as PM from diesel trucks, thereby addressing both primary and secondary PM.

Warehouses

- CARB is developing a Freight Handbook outlining best practices for warehouses to reduce their contributions to emission levels.
- New regulations are being developed for:
    - Transport refrigeration units,
    - Drayage trucks, and
    - Cargo handling equipment.

Passenger Cars

- Advanced Clean Cars 2 will increase the number of zero-emission vehicles on the road and reduce tailpipe emission through 2026.
- Catalytic converter theft reduction is being implemented to ensure that converters are stamped by manufacturers and registered with cars.

Trains

CARB is currently working with railyards in southern California to reduce idling. Lessons from this effort will be applied statewide, potentially through regulation, to reduce emissions from trains.

Post-Presentation Discussion

Next steps? Chair Hayes asked for the presenter's opinion on the next steps to improve public health. Dr. Alvarado, who clarified that he was speaking on behalf of himself and not CARB, replied that his priority would be to utilize low-cost in-home monitors to better understand how short-term localized exposures are affecting people in disadvantaged communities. This information could be used to direct regulations and resources toward improving health among the most vulnerable Californians, in line with AB 617.

Addressing brake and tire wear and road dust. Noting that Dr. Martien's presentation revealed that the great majority of PM emissions experienced in West Oakland are from regional sources, Chair Hayes inquired whether brake and tire wear and road dust contribute to these regional-source exposures and whether these issues are under CARB's regulatory authority. Dr. Alvarado replied that he could not speak to CARB's authority on these matters, but that brake and tire wear and road dust are more localized issues. Council Member Kleinman commented that regenerative braking technology appears to reduce brake wear and could be a useful target for incentive structures. Council Member Lipman clarified that such technology can only be used with hybrid vehicles, but that it could be promising as an innovation that benefits both fuel efficiency and PM reduction.

Relative health impact of wildfires. Chair Hayes asked the presenter to characterize the relative contribution of wildfires to public health risk in comparison to day-to-day PM emissions from other sources. Dr. Alvarado responded that while there was not sufficient research to quantify the impact of wildfires at their newly intensified levels, it does appear that wildfire smoke has health effects similar to those of other types of PM exposure.

Defining premature death. Council Member Lipman asked for clarification on how premature death is defined in CARB's calculations. Dr. Alvarado, along with Council Members Kleinman and Rudolph, clarified that the calculation is a statistical analysis of population-level loss of life relative to life expectancy.

New technologies increasing UFP? Council Member Solomon recalled that when natural gas and diesel reduction technologies were first being developed for transportation, there was some concern that they could increase ultrafine particle emissions. She asked whether that prediction had been accurate. Dr. Alvarado responded that while he would need to check to be certain, he believed that an initial increase in ultrafine particles was seen in early natural gas vehicles, but the problem had since been addressed through controls.

Update on Particulate Matter (PM) Air District Work: PM Rules and Regulatory Development

Victor Douglas
Manager, Rule Development, Bay Area Air Quality Management District

Main takeaway	**The Air District continues to update its rules and regulations to further limit PM exposures. As its focus shifts from an exclusively regional perspective to reducing risks for disproportionately impacted local communities, the Air District is exploring the possibility of treating PM as a toxic air contaminant. Although the State of California does not presently recognize undifferentiated PM as an air toxic, it may be possible for the Air District to do so independently.**

Mr. Douglas presented a brief overview of the history, current efforts, and emerging directions for rule development in the Air District. He described how the Air District's emerging focus on health risks for local communities is prompting further consideration of rulemaking regarding stationary source emissions and potential treatment of undifferentiated PM as an air toxic.

Current Air District Work

Approaches

The Air District has approached PM regulation in three distinct ways:

1. As a **nuisance**, which was the initial approach in the first Air District regulations adopted in 1979 and 1980 regarding open burning and dust and aerosols.
2. As a **criteria pollutant**, which is the current, regional approach to undifferentiated PM governing attainment of ambient air quality standards. These regulations apply to both primary PM (filterable and condensable) and precursors of secondary PM (oxides of nitrogen and sulfur dioxide). With this approach, the Air District selects the most cost-effective strategies to achieve regional standards.
3. As an **air toxic**, which is the approach taken specifically to diesel PM to limit localized exposures. The air toxic approach can be either risk-based (utilizing modeling) or technology-based (limiting emissions from specific sources, such as dry-cleaning facilities or backup generators).

Mr. Douglas mentioned that a fourth potential approach would be to consider climate impacts.

Regulations and Rules

There are 57 Air District rules that directly or indirectly address PM, housed within a range of regulations including those governing permits, open burning, inorganic gaseous pollutants,

hazardous pollutants, and miscellaneous standards of performance. Several PM regulations and rules have been updated since 2012, including a new Regulation 6 on Particulate Matter established in 2018.

Mr. Douglas specifically highlighted **Air District Rule 11-18: Reduction of risk from air toxic emissions at existing facilities.** Recent revisions to this rule reduced the threshold limit on toxic air contaminants by an order of magnitude (from 100 per million to 10 per million), requiring approximately 80 existing permitted facilities to develop plans to reduce their emissions or install best available control technologies. This rule is one example of the Air District's emerging focus on localized, community-specific exposures and health risk. Another example he mentioned is **Rule 6-5: Particulate emissions from refinery fluidized catalytic cracking units**, which was recently revised to further reduce localized PM emissions from refineries.

Forthcoming Air District Work

Localized Sources

As the Air District turns increasing attention to localized health impacts of PM for disproportionately impacted communities, it is exploring further regulation regarding:

- **Restaurants**,
- **Wood smoke**, and
- **Indirect or magnet sources** (e.g. warehouses, which do not directly emit PM, but attract PM-producing traffic such as diesel trucks).

PM as an Air Toxic

The Air District is also engaged in exploring the possibility of approaching undifferentiated PM as an air toxic. The present constraint is that the Air District has relied on the State of California's list of toxic air contaminants, which does not include undifferentiated PM. Air District rulemaking that treats PM as a toxic could potentially be developed, independent of state-level air toxics regulations, if the Air District is able to identify appropriate methodology to perform health risk assessments.

Post-Presentation Discussion

Shifting focus to greenhouse gas emissions and global warming? Council Member Rudolph asked how a hypothetical emphasis on climate impacts would shift the Air District's approach to PM regulation. Mr. Douglas responded that reducing climate impacts is a co-benefit of the other three approaches to PM (as a nuisance, criteria pollutant, and air toxic). Mr. Nudd added that an emphasis on climate impacts could shift the Air District's focus more heavily toward black carbon, but that he was uncertain of the effect such a shift would have on health risks.

Council Member Rudolph commented that climate change presents the greatest health risk to the population.

Toxics framework. Chair Hayes asked for clarification on the process by which undifferentiated PM could be introduced into the regulatory framework as a toxic air contaminant. Mr. Bunger explained that the first option was for OEHHA to add undifferentiated PM to its list of air toxics, which would immediately trigger its inclusion in several existing Air District rules including 11-18 (existing facilities) and 2-5 (new source review). The Air District has requested this action from OEHHA, and analysis is underway at the state level, but the Air District does not have the power to compel such action by the State. However, in theory, the Air District does have the ability to independently classify undifferentiated PM as a toxic air contaminant and treat it accordingly. To do so, the Air District would need to identify appropriate methodology to use for health risk assessment. Chair Hayes noted that the Air District already concerns itself with controlling source-specific PM emissions in its modeling regarding attainment of ambient air quality standards. Mr. Bunger clarified that such analysis does not presently apply to every source of PM emissions, as it would if PM were classified as an air toxic. Board Member Sinks asked whether OEHHA has committed to a schedule for evaluating undifferentiated PM for potential inclusion on its air toxics list. Mr. Nudd responded that he does not observe a willingness on the part of OEHHA to enact statewide recognition of undifferentiated PM as an air toxic in the near term, likely due to present challenges in some parts of the state with meeting existing federal air quality standards. However, he explained that OEHHA is assisting the Air District with its PM analyses, and does appear willing to support the Air District (at least through peer review) if it moves toward independently recognizing undifferentiated PM as a toxic. Mr. Bunger noted that the Air District is also exploring other distinct PM species (besides diesel PM) as air toxics.

Discussion of Draft October PM Symposium Report and Advisory Council Q&A Document

The Advisory Council discussed the draft report on the October PM Symposium prepared by consulting technical writer Elisabeth Andrews on behalf of the Air District, available online at https://www.baaqmd.gov/news-and-events/conferences/pm-conference.

The Advisory Council briefly considered potential updates such as revising the "topics for further exploration" identified in the draft report into Advisory Council findings and creating further content for the "Next Steps" section. Chair Hayes also introduced the prospect of incorporating an additional document into the report. That document, which he initiated, provides responses to the questions originally posed by the Advisory Council and the Air District to the October PM Symposium panelists (see Appendix for the list of questions). His aim was to distill the information shared by the panelists into concise answers to each of the questions. Ultimately, the Advisory Council determined that because the purpose of the October PM Symposium report was to serve as a record of the October PM Symposium, it was appropriate to limit that report's contents to what had been shared during that event.

Edits to Draft October PM Symposium Report. Three clarifying edits were made to the October PM Symposium report draft, all within the section on "Advisory Council Deliberation." The Advisory Council agreed to release the draft report for public comment following these edits.

Progress of Q&A document. Council Member Solomon volunteered to assist Chair Hayes in further developing the question-and-answer document. Several Advisory Council members made suggestions regarding the draft Q&A:

- Council Members Solomon and Kleinman supported recommending the treatment of PM as a non-threshold toxic. Council Member Kleinman noted that the dose-response relationship appears to be curvilinear rather than linear.
- Council Member Solomon argued for incorporating information from the forthcoming March PM Symposium (focused on community organizations) into the Q&A.
- Council Member Rudolph stated the need to emphasize new evidence for likely causal relationships between PM and specific health effects and the greater sensitivity of vulnerable populations. She also noted the importance of reducing ambient PM levels as much as possible in the presence of events such as wildfires that cannot be placed into a regulatory framework.

Public Comment

Three opportunities were provided for public comment: prior to presentations from Air District staff, following presentations from Air District staff, and toward the close of the meeting following Advisory Council deliberation on the October PM Symposium Summary draft report. A list of the commenters follows; their comments are categorized by topic and summarized below.

List of Commenters

Dr. Ashley McClure, primary care physician, Oakland
Jed Holtzman, 350 Bay Area
Greg Karas, Communities for a Better Environment
Richard Grey, 350 Bay Area

Comments

Structure of public comment. Dr. McClure suggested that comment on agenda items should take place after the agenda items had been discussed by presenters and the Advisory Council. Mr. Holtzman requested that the Advisory Council determine and publicize the timing of public comment periods in advance of Advisory Council meetings. Council Member Borenstein concurred with Mr. Holtzman's suggestion, and Chair Hayes indicated that the Advisory Council would implement this suggestion by formally determining public comment periods in advance so that people who wish to comment can plan when to be present at Advisory Council meetings.

Urgency. Dr. McClure stated that the October PM Symposium left little ambiguity regarding the health impacts of PM and asked why further symposia were necessary prior to rulemaking. Mr. Holtzman also questioned the pace of progress and the duration of time between meetings. Council Member Borenstein stated that while the Advisory Council was interested in recommending the Air District move toward stricter PM controls, it was not yet clear precisely what the targets should be. He emphasized the importance of measured and deliberative action, as rulemaking is likely to be challenged in court.

Strong statements. Addressing the need to establish a public record to support rulemaking, Mr. Holtzman urged Advisory Council members to "be very fierce in your statements" regarding the implications of the science.

Zero-carbon economy. All four commenters spoke of a need to phase out fossil fuel combustion and transition to a zero-carbon economy. Tying fossil fuel combustion to the climate conditions that have led to increased wildfires, commenters emphasized that reducing

risks from wildfires can only be achieved by reducing the greenhouse gas emissions that ultimately contribute to their frequency.

Air District actions. Commenters recommended specific actions for the Air District:

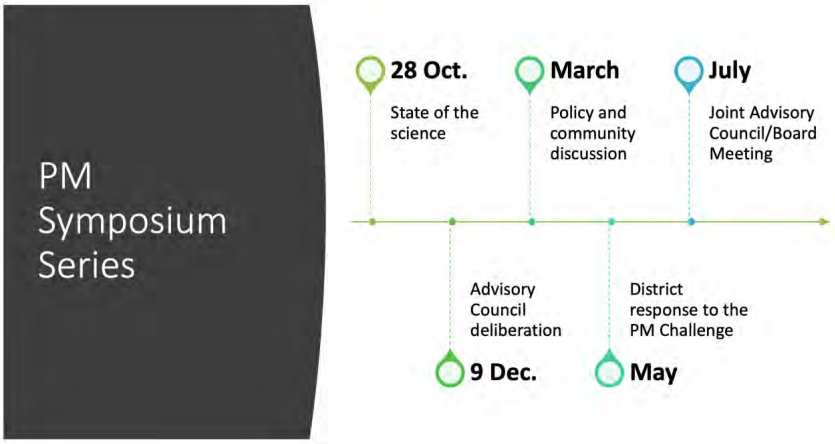
- Set PM threshold levels based on sensitive populations (Holtzman)
- Focus separately on top local and regional sources of PM (Holtzman)
- Update modeling approaches for brake and tire wear and road dust (Holtzman)
- Address agriculture as a source of NH_3 emissions (Holtzman)
- Use fees on PM emitters to support increased instrumentation for speciation (Holtzman)
- Increase attention to black carbon, which has both health and climate impacts (Holtzman)
- Verify low-cost sensors and utilize their data once verified (Holtzman)
- Tighten controls on ultrafine particles, exposure to which is an environmental justice issue as risks are closely associated with proximity to sources (Karas)
- Utilize findings from the California Household Exposure Study, which measured indoor and outdoor $PM_{2.5}$ concentration levels and found both to be higher near refineries (Karas)
- Focus attention on refineries and the oil industry, particularly fluid cracking units (Grey)
- Develop messaging campaigns to help the public recognize the connection between sources of air pollution and health outcomes (McClure)
- Emphasize, possibly at the March PM Symposium, the meaning and values driving the pursuit of tighter air quality controls; “Give us all something to believe in” (McClure)

Partner actions. Commenters also recommended actions that are outside Air District jurisdiction:

- Pursue a tighter state standard for PM (Holtzman)
- Offer free public transit, either on Spare the Air days or at all times (McClure)

Next Steps

The PM Symposium Series continues as depicted in the timeline below. The next symposium will take place on March 24, 2020, in Oakland, focused on presentations from community organizations and leaders. Planning is currently underway.



Following the March symposium, the May event is expected to focus on formulating potential Air District plans to further reduce Bay Area health risks from PM, particularly for disproportionately impacted communities.

The July event brings together the Advisory Council and the Board of Directors to discuss the information and suggestions shared throughout the PM Symposium Series. During this final meeting in the series, the Advisory Council is expected to present its findings to the Board of Directors regarding particulate matter and health in the Bay Area.

Appendix — Questions from the Advisory Council and Air District sent to October PM Symposium Panelists

GENERAL

- What is bullseye in clean air target? How clean is clean enough?
- How will we know when we get to target? What metrics should we use to track progress?
- How do we combine criteria pollutants and toxics? Cancer and non-cancer health endpoints? Short- and long-term effects?
- How can we make sure everyone is treated fairly?
- How can we ensure that everyone breathes clean air?
- What are most important actions that can be taken now? And, in future?

HEALTH EFFECTS PANEL

- Are current PM standards sufficiently health protective?
- Are some species of PM more dangerous than others?
- What is role of ultrafine particles (UFPs)?
- Should form of target expand to account for more than just mass?
- How should we include draft PM ISA's new "likely-causal" health endpoints (nervous system effects, cancer) and new more sensitive populations (children, lower socio-economic status)?
- What are health impacts of high-concentration acute events (e.g., wildfires)? How should we compare them to day-to-day PM impacts?

EXPOSURE AND RISK PANEL

- What are major sources of PM in the Bay Area?
- What PM levels exist in Bay Area? What health risks do they pose?
- How much additional health benefit can be achieved?
- How should we account for spatial scale of effects (i.e., regional versus local-scale impacts, including proximity to major sources)?
- How should we determine which measures would most move public health needle?

PM Health Protection Symposium
(Advisory Council Meeting of October 28, 2019)

Chair Stan Hayes
Advisory Council
December 9, 2019

PM Focus:
Context

- Following three years of intense wildfire smoke, focus on reducing diesel PM emissions, and conclusion that PM is overwhelming health risk driver in Bay Area air
- Air District asked Advisory Council to focus on PM
- Provide Advisory Council's take on latest and best science, in science-affirming way
- Assist Air District to identify those further PM measures that would most move public health needle, especially in most impacted communities

PM Symposia:
Overview

- Convened by Advisory Council as series of meetings
- Engage nationally-recognized experts, including leading experts previously engaged at the Federal level
- Support Air District in identifying health-focused “target” guidelines based on latest science, beyond standards already in effect
- Facilitate Advisory Council feedback on Air District planning
- Include local stakeholders
- Provide national leadership

Key Points

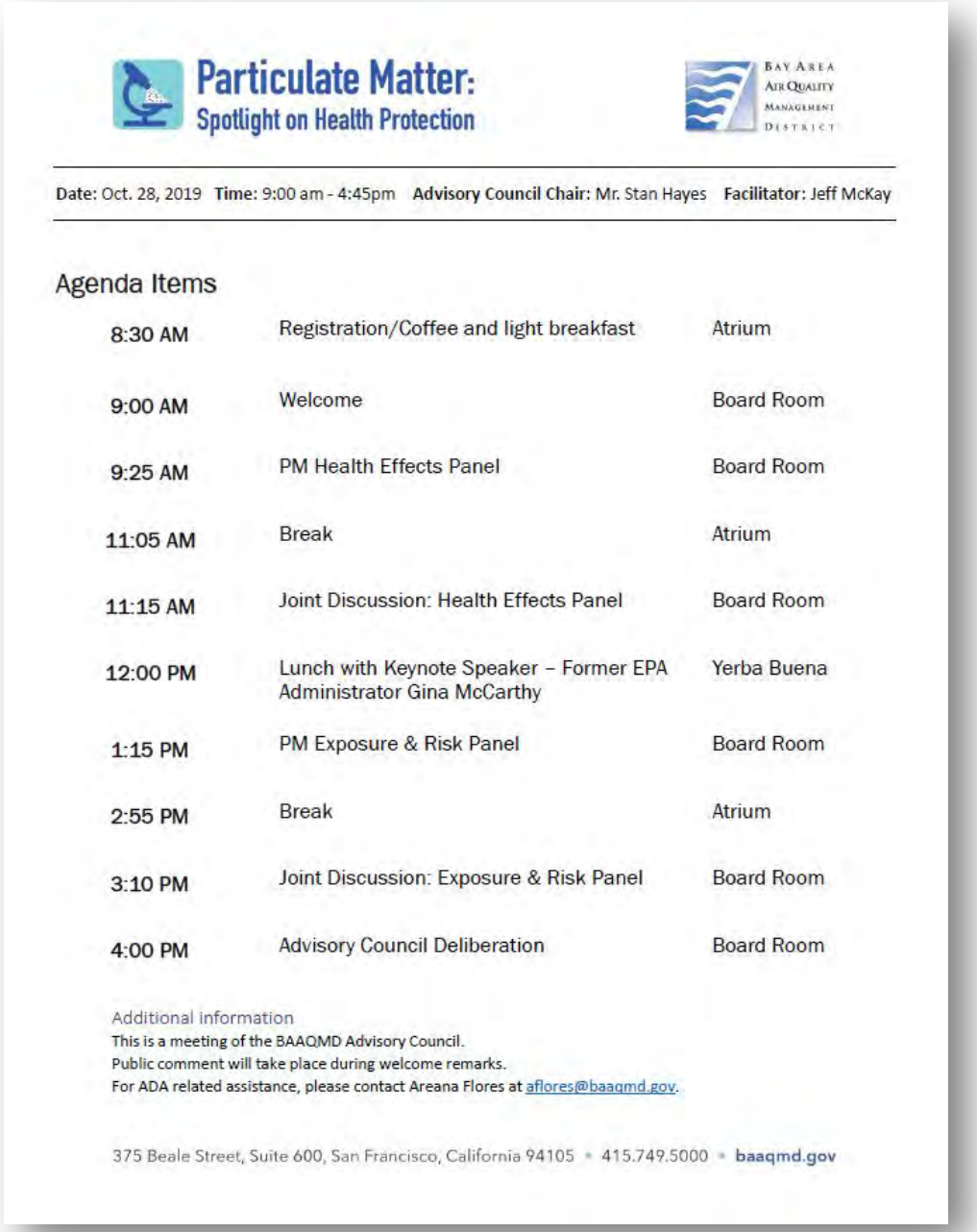
- The National Ambient Air Quality Standard (NAAQS) Science Review Process Worked Well Until 2017
- EPA Administrators Pruitt and Wheeler Have **Broken the Process**
- Particulate Matter Science Review By the EPA Clean Air Scientific Advisory Committee (CASAC) is Highly Deficient: **Appropriate to Look Elsewhere**
- Disbanded CASAC PM Review Panel Reconvened Itself
- Key Findings of the Independent Particulate Matter Review Panel

C276

Particulate Matter:
Spotlight on Health Protection

Bay Area Air Quality Management District

C277



Particulate Matter:
Spotlight on Health Protection

Bay Area Air Quality Management District

Date: Oct. 28, 2019 **Time:** 9:00 am - 4:45pm **Advisory Council Chair:** Mr. Stan Hayes **Facilitator:** Jeff McKay

Agenda Items

8:30 AM	Registration/Coffee and light breakfast	Atrium
9:00 AM	Welcome	Board Room
9:25 AM	PM Health Effects Panel	Board Room
11:05 AM	Break	Atrium
11:15 AM	Joint Discussion: Health Effects Panel	Board Room
12:00 PM	Lunch with Keynote Speaker – Former EPA Administrator Gina McCarthy	Yerba Buena
1:15 PM	PM Exposure & Risk Panel	Board Room
2:55 PM	Break	Atrium
3:10 PM	Joint Discussion: Exposure & Risk Panel	Board Room
4:00 PM	Advisory Council Deliberation	Board Room

Additional information
This is a meeting of the BAAQMD Advisory Council.
Public comment will take place during welcome remarks.
For ADA related assistance, please contact Areana Flores at aflores@baaqmd.gov.

375 Beale Street, Suite 600, San Francisco, California 94105 • 415.749.5000 • baaqmd.gov

Particulate Matter:
Spotlight on Health Protection

- ~160 registrants
- 2 panels
  - PM Health Effects
  - PM Exposure & Risk
- 9 leading experts

Gina McCarthy

- **Former EPA Administrator**
- Finalized the Clean Power Plan and the Clean Water Rule
- Professor of the Practice of Public Health in the Department of Environmental Health at Harvard T.H. Chan School of Public Health
- Director of the Center for Climate, Health, and the Global Environmental
- Member of the Board of Directors of the Energy Foundation and Ceres
- M.Sc. in Environmental Health Engineering, Planning and Policy from Tuft's University

Jason Sacks, M.P.H.

- Senior Epidemiologist in the Center for Public Health & Environmental Assessment within U.S. EPA's Office of Research and Development
- **Assessment lead for the Particulate Matter Integrated Science Assessment (Draft PM ISA)**
- Key leadership roles in synthesizing the health effects evidence of air pollution for various National Ambient Air Quality Standards reviews
- International training on U.S. EPA's Environmental Benefits Mapping and Analysis Program – Community Edition
- M.P.H. from Johns Hopkins University in 2003

Michael Kleinman, Ph.D.

- UC Irvine Professor of Environmental Toxicology
- Co-Director of the Air Pollution Health Effects Laboratory in the Department of Community and Environmental Medicine
- Adjunct Professor in College of Medicine
- **Serves on the Air District Advisory Council**
- Ph.D. in Environmental Health Sciences from New York University
- **CA Scientific Review Panel on Toxic Air Contaminants; CA Air Quality Advisory Committee**

John R. Balmes, M.D.

- Professor of Medicine at UC San Francisco
- Professor of Environmental Health Sciences in the School of Public Health at UC Berkeley
- Director of the Northern California Center for Occupational and Environmental Health
- Authored over 300 papers on occupational and environmental health-related topics
- **Physician Member of the California Air Resources Board**

H. Christopher Frey, Ph.D., F. A&WMA, F. SRA

- Glenn E. Futrell Distinguished University Professor of Environmental Engineering in the Department of Civil, Construction, and Environmental Engineering at North Carolina State University
- Adjunct professor in the Division of the Environment and Sustainability at the Hong Kong University of Science and Technology
- Fellow of the Air & Waste Management Association and of the Society for Risk Analysis
- Ph.D. in Engineering and Public Policy from Carnegie Mellon
- **Former Chair/Member, EPA Clean Air Scientific Advisory Committee (CASAC)**
- **Former Chair/Member, 10 different CASAC NAAQS Review Panels**
- **Chair, Independent PM Review Panel**

Lauren Zeise, Ph.D.

- **Appointed by Gov. Brown as Director of the California Office of Environmental Health Hazard Assessment in December 2016**
- Former Chief of the cancer unit at the California Department of Health Services
- Leading role in OEHHA's development of CalEnviroScreen
- Co-led the team that developed the hazard trait regulation for California's Safer Consumer Products program
- Member, fellow, former editor, and former councilor of the Society for Risk Analysis
- 2008 recipient of the Society's Outstanding Risk Practitioner Award
- Ph.D. from Harvard University

C284

Julian Marshall, Ph.D.

- **Kiely Endowed Professor of Environmental Engineering at University of Washington with a focus on air quality management**
- Founded and runs the Grand Challenges Impact Lab, a UW study abroad program in Bangalore, India
- Associate Editor for Environmental Health Perspectives and Development Engineering
- Published over 100 peer-reviewed journal articles
- Ph.D. in Energy and Resources from UC Berkeley

Scott Jenkins, Ph.D.

- Senior Environmental Health Scientist in EPA's Office of Air Quality Planning and Standards (OAQPS)
- **Currently leading EPA's review of the National Ambient Air Quality Standards (NAAQS) for Particulate Matter (PM)**
- Howard Hughes Postdoctoral Research Fellow in the Department of Cell Biology at Duke University
- Ph.D. in Behavioral Neuroscience from the University of Alabama at Birmingham

Phil Martien, Ph.D.

- **Director of the Assessment, Inventory, & Modeling Division at the Bay Area Air Quality Management District**
- Leading role in the Technical Assessment of AB617's West Oakland Community Action Plan
- Leading role in the Technical Assessment of the Air District's 2017 Clean Air Plan: Spare the Air, Cool the Climate
- Leading role in the Air District's Community Air Risk Evaluation Program
- Ph.D. from UC Berkeley

C287

PM Health Effects Panel

PM Exposure & Risk Panel

Advisory Council Discussion with Experts

BAAQMD's Questions

Example Response

- Are current PM standards sufficiently protective? **Emphatic NO – definitely not for $PM_{2.5}$.**
- How has the PM health evidence been strengthened? **Better "exposure" models, much larger study populations at much lower levels than before.**
- What new health effects are now recognized? **Strengthening of some causality determinations, but largely the focus is still premature mortality, respiratory morbidity, and cardiovascular morbidity.**
- New endpoints like cancer and central nervous system effects? **Opinions differ.**
- New sensitive groups, like children and lower socioeconomic status, SES, populations? **Growing recognition of "at risk" groups.**
- Are all types of PM equal? **Probably not.** Or, are some more dangerous than others? **Probably. But, more work needed. No components are as yet 'exonerated.'**
- How severe are PM health risks? **Premature mortality is severe.**
- What additional health benefits can be achieved by further reducing PM to below current standards? **Difficult to quantify with certainty but on the order of tens of thousands of deaths nationally.**

C289

Discussion Questions (EXAMPLE, DO NOT CITE)

Are current PM standards sufficiently health protective?

NOT PROTECTIVE, STANDARDS SHOULD BE LOWERED

Are some species of PM more dangerous than others?

QUITE POSSIBLY BUT NOT ENOUGH INFORMATION, NO PM COMPONENTS "EXONERATED"

What is role of ultrafine particles (UFPs)?

NOT YET CLEAR, TOX STUDIES OF CONCERN, NEED UFP FEDERAL REFERENCE METHOD, MORE MONITORING, EPI STUDIES

Should PM "target" expand to account for more than just mass?

IN RESEARCH ABSOLUTELY, IN REGULATION TOO SOON, UNLESS HIGHLY RISK-AVERSE

How should we include draft PM ISA's new "likely-causal" health endpoints (nervous system effects, cancer) and new more sensitive populations (children, lower socio-economic status)?

NEW HEALTH EFFECTS AND GROWING RECOGNITION OF "AT RISK" GROUPS IMPORTANT (SUCH AS CHILDREN AND LOW SES), NEED TO CONSIDER

What are health impacts of high-concentration acute events (e.g., wildfires)? How should we compare them to day-to-day PM impacts?

NOT WELL-KNOWN SCIENTIFICALLY BUT OF CONCERN, DATA ON SUB-DAILY EXPOSURES TOO LIMITED AS YET, POTENTIALLY SERIOUS EFFECTS IN EARLY STUDIES, OTHER STUDIES ONGOING, MORE RESEARCH NEEDED

Advisory Council:
Initial Deliberation

Sense of the Council

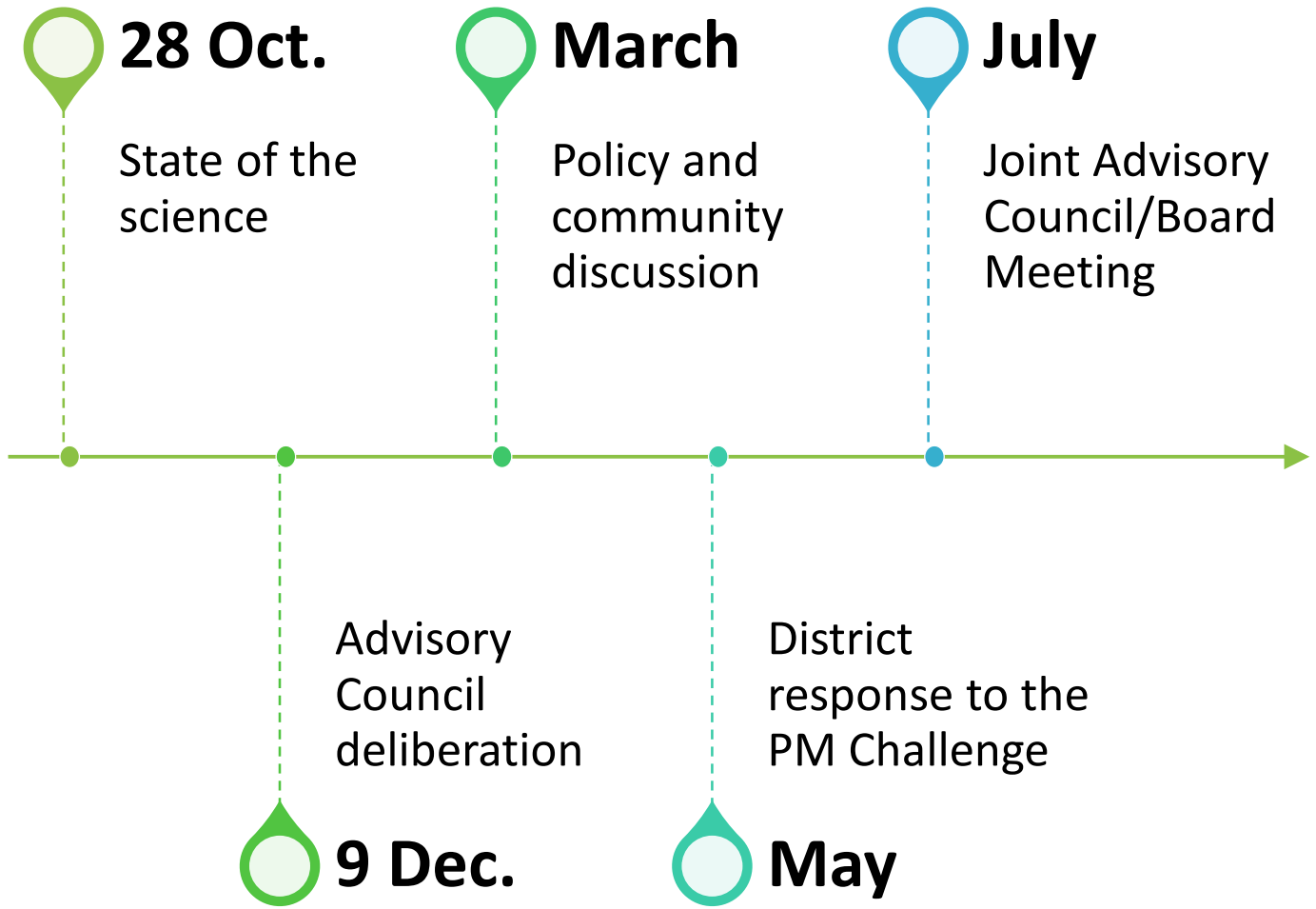
- The current standards are not adequately health protective.
- Further reductions in PM will realize significant additional health benefits.
- We need more science, *and* we should act now.

Further Exploration

- Treating PM as an air toxic
- Expanded monitoring of UFP
- Health effects of acute PM exposures, e.g., wildfire smoke
- Identifying PM species that are particularly dangerous
- Assisting District in identifying strategies having "highest bang for buck" for health protection
- Pursuing strategies that have climate and other co-benefits

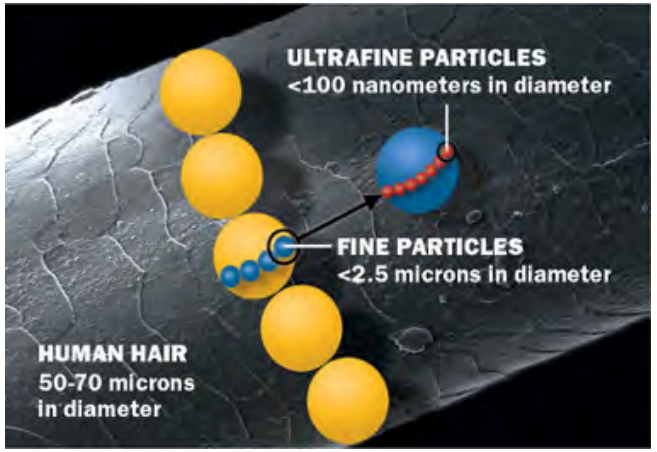
C291

PM Symposium Series



Ambient Particulate Matter (PM)

- PM is a mixture, including particles of differing origin (combustion, crustal, biological) and varying size.
- Multiple sources



Mortality – Long-term $PM_{2.5}$ Exposure

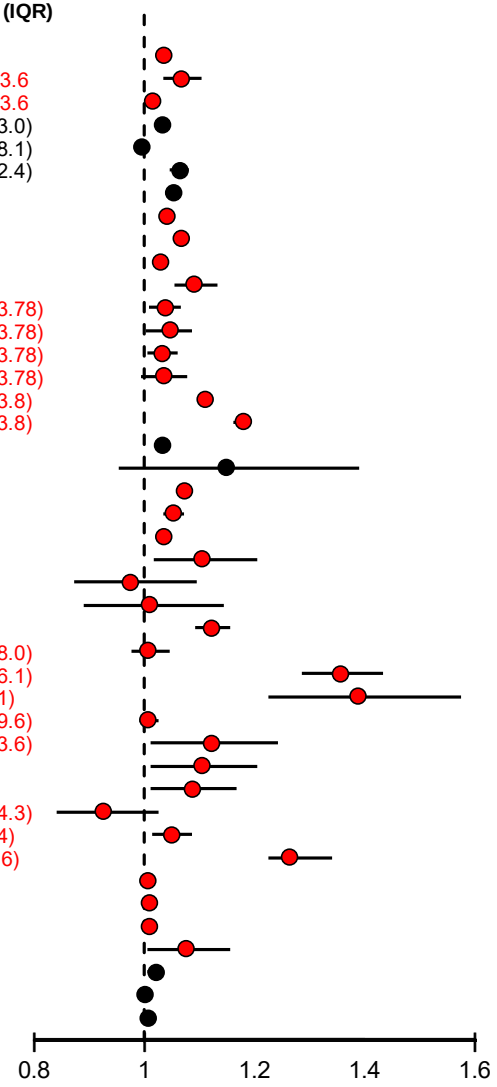
Recent evidence supports and extends the conclusions of the 2009 PM ISA that there is a causal relationship between long-term $PM_{2.5}$ exposure and mortality

Figure 11-18. Associations between long-term $PM_{2.5}$ and total (nonaccidental) mortality in recent North American cohorts.

Note: Associations are presented per 5 μg/m^3 increase in pollutant concentration.

Red = recent studies;
Black = studies evaluated in the 2009 PM ISA

Reference	Cohort	Notes	Years	Mean (IQR)
†Pope et al. 2014	ACS		1982-2004	12.6
†Lepeule et al. 2012	Harvard Six Cities		1974-2009	11.4-23.6
†Thurston et al. 2015	NIH-AARP		2000-2009	10.2-13.6
Zeger et al. 2008	MCAPS	Eastern	2000-2005	14.0 (3.0)
Zeger et al. 2008	MCAPS	Western	2000-2005	13.1 (8.1)
Zeger et al. 2008	MCAPS	Central	2000-2005	10.7 (2.4)
Eftim et al. 2008	ACS-Medicare		2000-2002	13.6
†Di et al. 2017	Medicare		2000-2012	11.5
†Di et al. 2017	Medicare	exp<12	2000-2012	11.5
†Di et al. 2017	Medicare	nearest monitor	2000-2012	11.5
†Kioumourtzoglou et al. 2016	Medicare		2000-2010	12
†Shi et al. 2015	Medicare	mutual adj	2003-2008	8.12 (3.78)
†Shi et al. 2015	Medicare	exp <10, mutual adj	2003-2008	8.12 (3.78)
†Shi et al. 2015	Medicare	no mutual adj	2003-2008	8.12 (3.78)
†Shi et al. 2015	Medicare	exp <10, no mutual adj	2003-2008	8.12 (3.78)
†Wang et al. 2017	Medicare		2000-2013	10.7 (3.8)
†Wang et al. 2017	Medicare	exp<12	2000-2013	10.7 (3.8)
Lipfert et al. 2006	Veterans Cohort		1997-2001	14.34
Goss et al. 2004	U.S. Cystic Fibrosis		1999-2000	13.7
†Crouse et al. 2012	CanCHEC	Satellite data	1991-2001	8.9
†Crouse et al. 2012	CanCHEC	Monitor data	1991-2001	11.2
†Crouse et al. 2015	CanCHEC		1991-2006	8.9
†Chen et al. 2016	EFFECT		1999-2011	10.7
†Weichenthal et al. 2014	Ag Health		1993-2009	8.84
†Weichenthal et al. 2014	Ag Health	more precise exp	1993-2009	8.84
†Pinault et al. 2016	CCHS		1998-2011	6.3
†Lipsett et al. 2011	CA Teachers		2000-2005	15.6 (8.0)
†Ostro et al. 2010	CA Teachers	within 30 km	2002-2007	17.5 (6.1)
†Ostro et al. 2010	CA Teachers	within 8 km	2002-2007	17 (6.1)
†Ostro et al. 2015	CA Teachers		2001-2007	17.9 (9.6)
†Puett et al. 2009	Nurses Health		1992-2002	13.9 (3.6)
†Hart et al. 2015	Nurses Health	nearest monitor	2000-2006	12.7
†Hart et al. 2015	Nurses Health	spatio-temp. model	2000-2006	12
†Puett et al. 2011	Health Prof	full model	1989-2003	17.8 (4.3)
†Hart et al. 2011	TrIPS		1985-2000	14.1 (4)
†Kloog et al. 2013	MA cohort	CVD+Resp	2000-2008	9.9 (1.6)
†Garcia et al. 2015	CA cohort	Kriging	2006	13.06
†Garcia et al. 2015	CA cohort	IDW	2006	12.94
†Garcia et al. 2015	CA cohort	closest monitor	2006	12.68
†Wang et al. 2016	NJ Cohort		2004-2009	11.3
Enstrom 2005	CA Cancer Prev		1973-1982	23.4
Enstrom 2005	CA Cancer Prev		1983-2002	23.4
Enstrom 2005	CA Cancer Prev		1973-2002	23.4

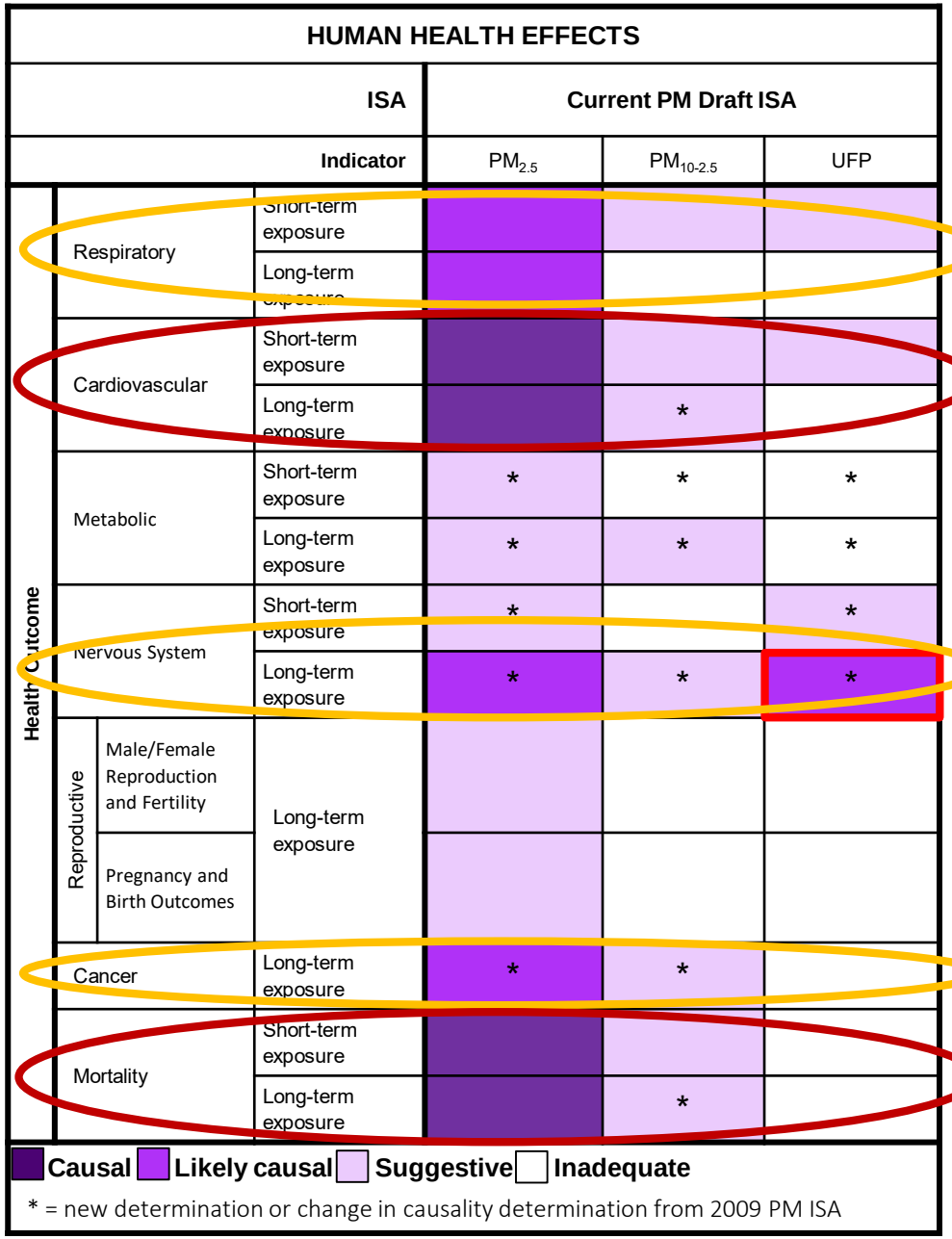


Draft PM ISA Health Effects: Causality Determinations

Table 1-5. Summary of causality determinations for health effect categories for the draft PM ISA.

Draft PM ISA:

- **1,879 pages**
- **2,647 references**



Respiratory (LIKELY CAUSAL)

Cardiovascular (CAUSAL)

Nervous System (LIKELY CAUSAL)

Cancer (LIKELY CAUSAL)

Mortality (CAUSAL)

Populations Potentially at Increased Risk of a PM-related Health Effect

- The NAAQS are intended to protect both the population as a whole and those potentially at increased risk for health effects in response to exposure to criteria air pollutants
  - *Are there specific populations and lifestages at increased risk of a PM-related health effect, compared to a reference population?*
- The ISA identified and evaluated evidence for factors that may increase the risk of $PM_{2.5}$-related health effects in a population or lifestage, classifying the evidence into four categories:
  - Adequate evidence; suggestive evidence; inadequate evidence; evidence of no effect
- Conclusions:
  - **Adequate: children and nonwhite populations**
  - Suggestive: pre-existing cardiovascular and respiratory disease, overweight/obese, genetic variants glutathione transferase pathways, low SES
  - Inadequate: pre-existing diabetes, older adults, residential location, sex, diet, and physical activity

Summary of Risk Estimates

Estimates of $PM_{2.5}$-associated deaths in the full set of 47 study areas

Endpoint	Study	Air quality simulation approach*	Current Standad Absolute Risk (12/35 µg/m³)	CS (12/35) % of baseline**	Alternative Standard Absolute Risk	
					Alternative Annual (10 µg/m³)	Alternative 24-hr (30 µg/m³)
Long-term exposure related mortality						
Ischemic Heart Disease	Jerrett 2016	Pri-PM	16,500 (12,600-20,300)	14.1	14,400 (11,000-17,700)	16,400 (12,500-20,000)
		Sec-PM	16,800 (12,800-20,500)	14.3	14,200 (10,900-17,500)	16,500 (12,600-20,200)
	Pope 2015	Pri-PM	15,600 (11,600-19,400)	13.3	13,600 (10,100-17,000)	15,400 (11,500-19,200)
		Sec-PM	15,800 (11,800-19,600)	13.4	13,400 (9,970-16,700)	15,600 (11,600-19,400)
All-cause	Di 2017	Pri-PM	46,200 (45,000-47,500)	8.4	40,300 (39,200-41,400)	45,700 (44,500-47,000)
		Sec-PM	46,900 (45,600-48,200)	8.5	39,700 (38,600-40,800)	46,200 (44,900-47,500)
	Pope 2015	Pri-PM	51,300 (41,000-61,400)	7.1	44,700 (35,700-53,500)	50,700 (40,500-60,700)
		Sec-PM	52,100 (41,600-62,300)	7.2	44,000 (35,100-52,700)	51,300 (41,000-61,400)
	Thurston 2015	Pri-PM	13,500 (2,360-24,200)	3.2	11,700 (2,050-21,100)	13,300 (2,330-24,000)
		Sec-PM	13,700 (2,400-24,600)	3.2	11,500 (2,010-20,700)	13,500 (2,360-24,200)
Lung cancer	Turner 2016	Pri-PM	3,890 (1,240-6,360)	8.9	3,390 (1,080-5,560)	3,850 (1,230-6,300)
		Sec-PM	3,950 (1,260-6,460)	9.1	3,330 (1,060-5,470)	3,890 (1,240-6,370)
Short-term exposure related mortality						
All cause	Baxter 2017	Pri-PM	2,490 (983-4,000)	0.4	2,160 (850-3,460)	2,460 (970-3,950)
		Sec-PM	2,530 (998-4,060)	0.4	2,120 (837-3,400)	2,490 (982-3,990)
	Ito 2013	Pri-PM	1,180 (-16-2,370)	0.2	1,020 (-14-2,050)	1,160 (-16-2,340)
		Sec-PM	1,200 (-16-2,400)	0.2	1,000 (-14-2,020)	1,180 (-16-2,370)
	Zanobetti 2014	Pri-PM	3,810 (2,530-5,080)	0.7	3,300 (2,190-4,400)	3,760 (2,500-5,020)
		Sec-PM	3,870 (2,570-5,160)	0.7	3,250 (2,160-4,330)	3,810 (2,530-5,070)

* Pri-PM (primary PM-based modeling approach), Sec-PM (secondary PM-based modeling approach)

** CS denotes the current standard.

Current annual standard of 12 ug/m3 = ~ 47 thousand deaths per year

Lower annual standard from 12 to 10 ug/m3 = ~ 6-7 thousand fewer deaths per year (13-15%)

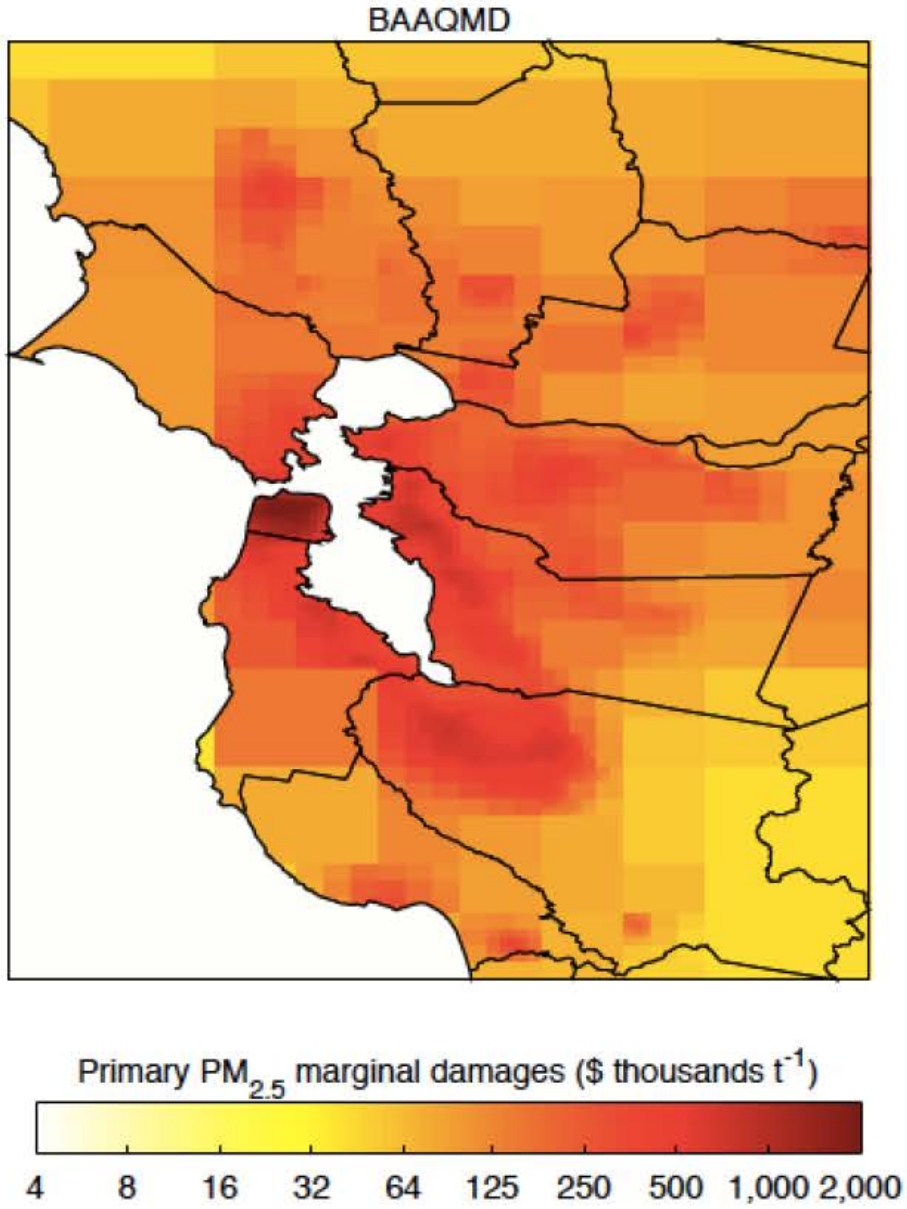
Preliminary Conclusions on the Current Primary $PM_{2.5}$ Standards

- The available scientific information can reasonably be viewed as calling into question the adequacy of the public health protection afforded by the current annual and 24-hour primary $PM_{2.5}$ standards

Draft EPA PM Policy Assessment (PA)

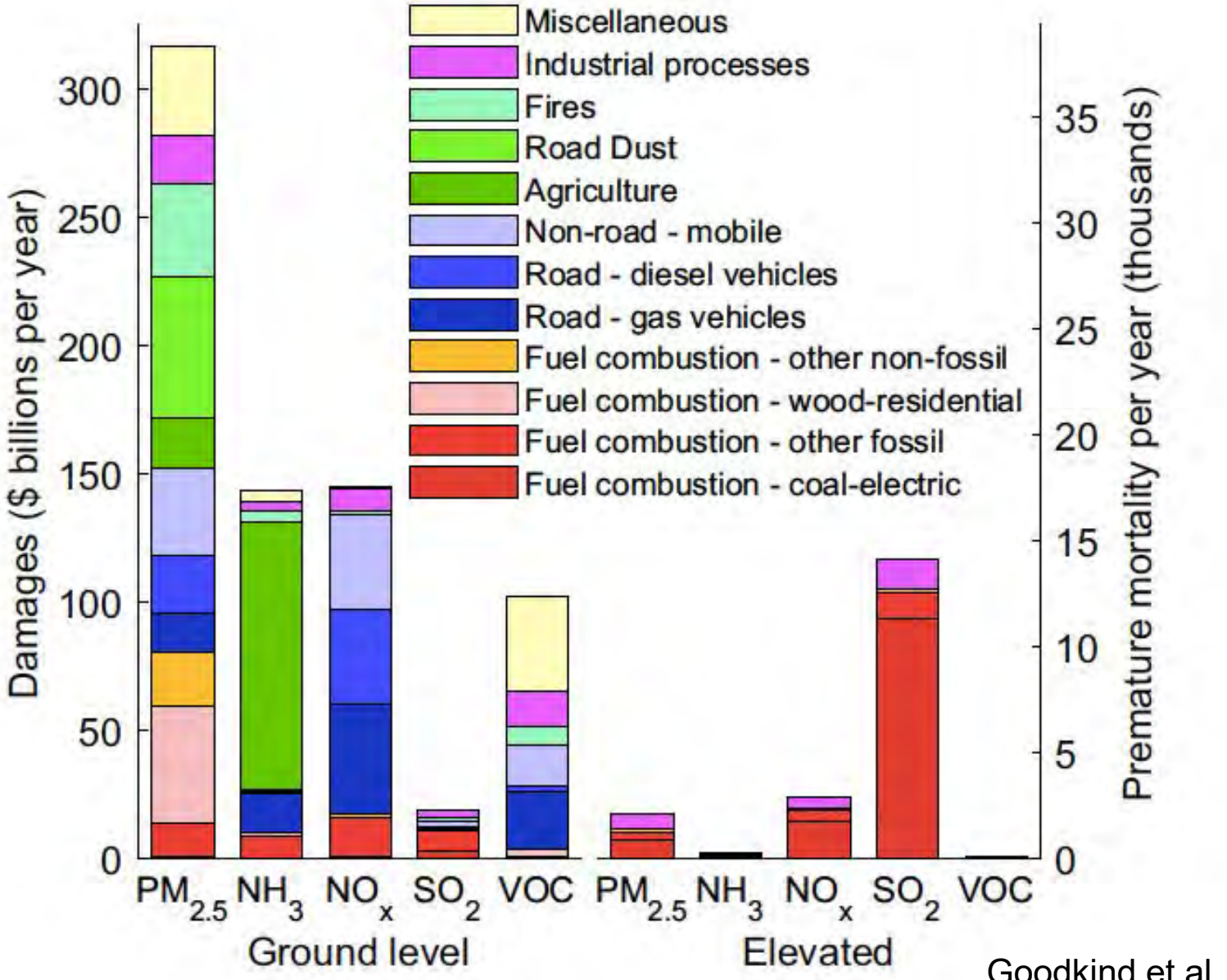
- Basis for this preliminary conclusion:
  - Long-standing body of health evidence, strengthened in this review, supporting relationships between $PM_{2.5}$ exposures and various outcomes, including mortality and serious morbidity effects
  - Recent U.S. and Canadian epidemiologic studies reporting positive and statistically significant health effect associations for $PM_{2.5}$ air quality likely to be allowed by the current standards
  - Analyses of pseudo-design values indicating substantial portions of study area health events/populations in locations with air quality likely to have met the current $PM_{2.5}$ standards
  - Risk assessment estimates that the current primary standards could allow thousands of $PM_{2.5}$-associated deaths per year – most at annual average $PM_{2.5}$ concentrations from 10 to 12 $\mu g/m^3$ (well within the range of overall mean concentrations in key epidemiologic studies)

Primary $PM_{2.5}$ Marginal Damages



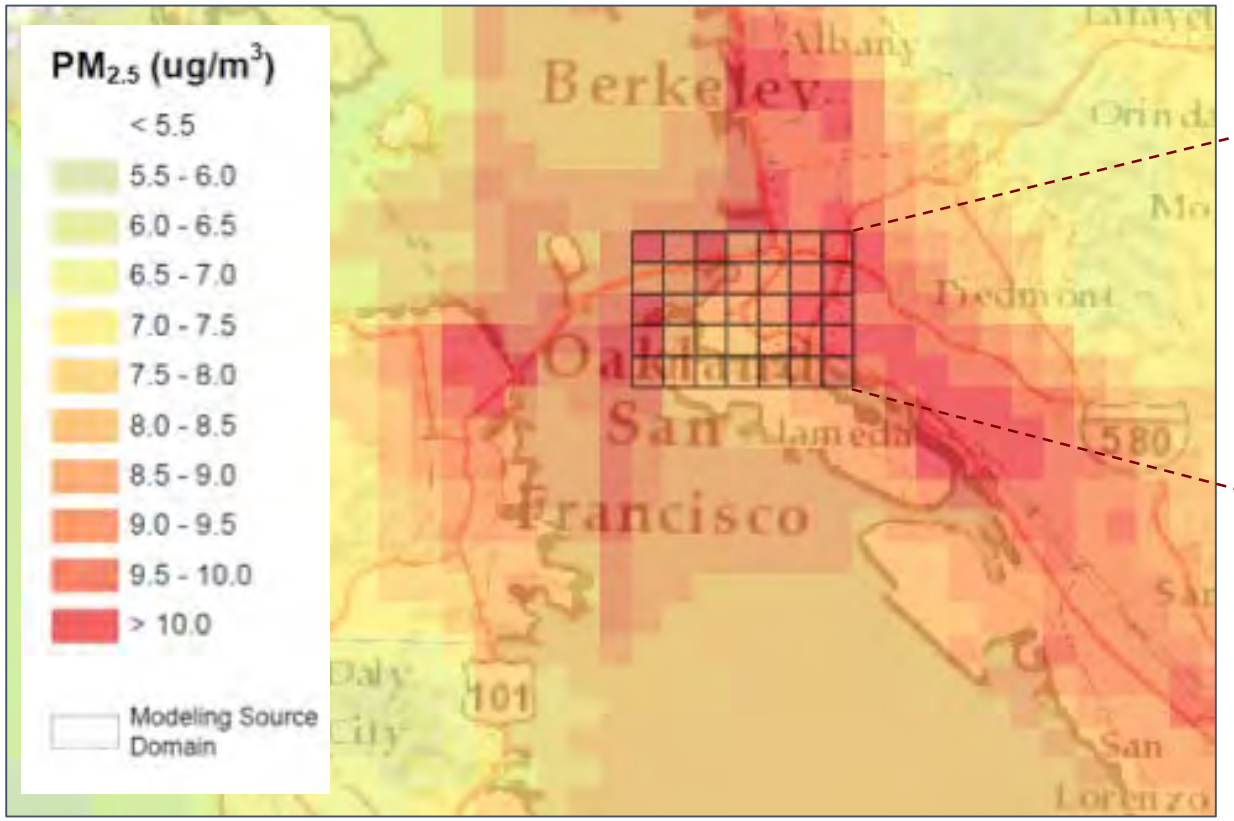
Goodkind et al., *PNAS*, 2019

Damages and Premature Mortality

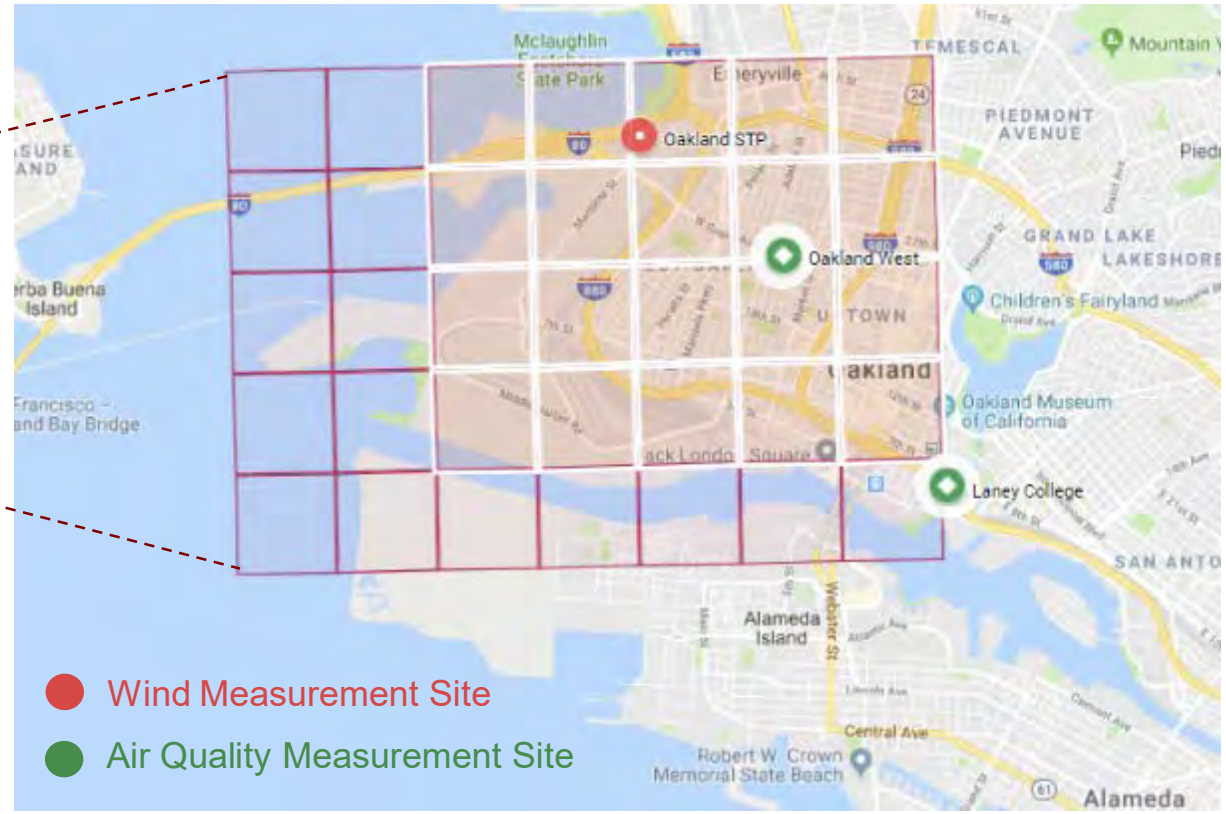


Goodkind et al., *PNAS*, 2019

Regional-Scale and Community-Scale Modeling (2017)



Regional-scale modeling: covers the Bay Area



Local-scale modeling: covers West Oakland, including impacts in receptor area (white) from sources in source area (red)

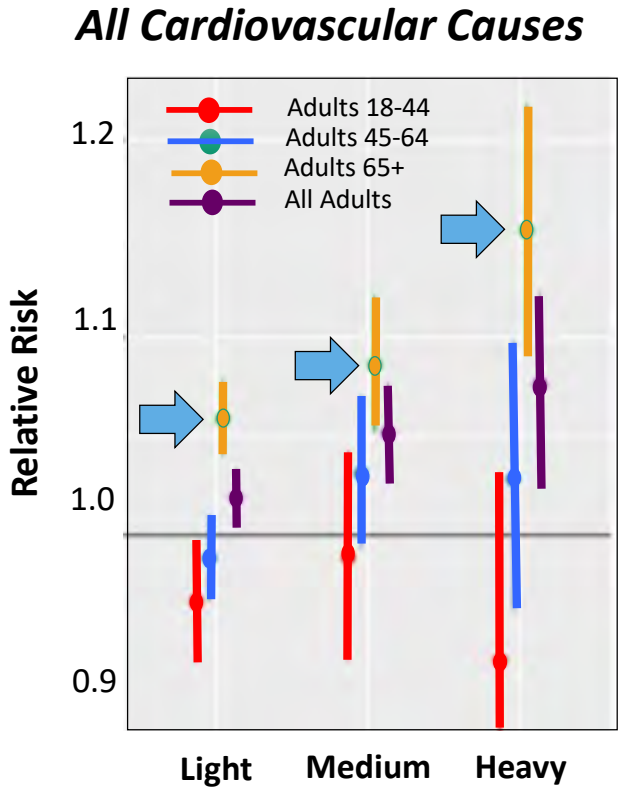
C301

Clear evidence of an association between wildfire smoke and respiratory health

- Asthma exacerbations significantly associated with higher wildfire smoke ***in nearly every study***
- Exacerbations of chronic obstructive pulmonary disease (COPD) significantly associated with higher wildfire smoke in most studies
- Growing evidence of a link between wildfire smoke and respiratory infections (pneumonia, bronchitis)

Wildfire-$PM_{2.5}$ Increases Heart Attack & Stroke

- ***Wildfire-$PM_{2.5}$ associated with heart attacks and strokes for all adults, particularly for those over 65 years old***
- ***Increase in risk the day after exposure:***
  - All cardiovascular, 12%
  - Heart attack, 42%
  - Heart failure, 16%
  - Stroke, 22%
  - All respiratory causes, 18%
  - Abnormal heart rhythm, 24%
    (on the same day as exposure)



31

Wettstein Z, Hoshiko S, Cascio WE, Rappold AG et al. JAHA April 11, 2018

Slide credit: Wayne Cascio

AGENDA: 5A

Update on Particulate Matter (PM) Air District Work:

Regional-and Local-Scale $PM_{2.5}$ Source Apportionment

Phil Martien, PhD
Director of Assessment, Inventory, and Modeling

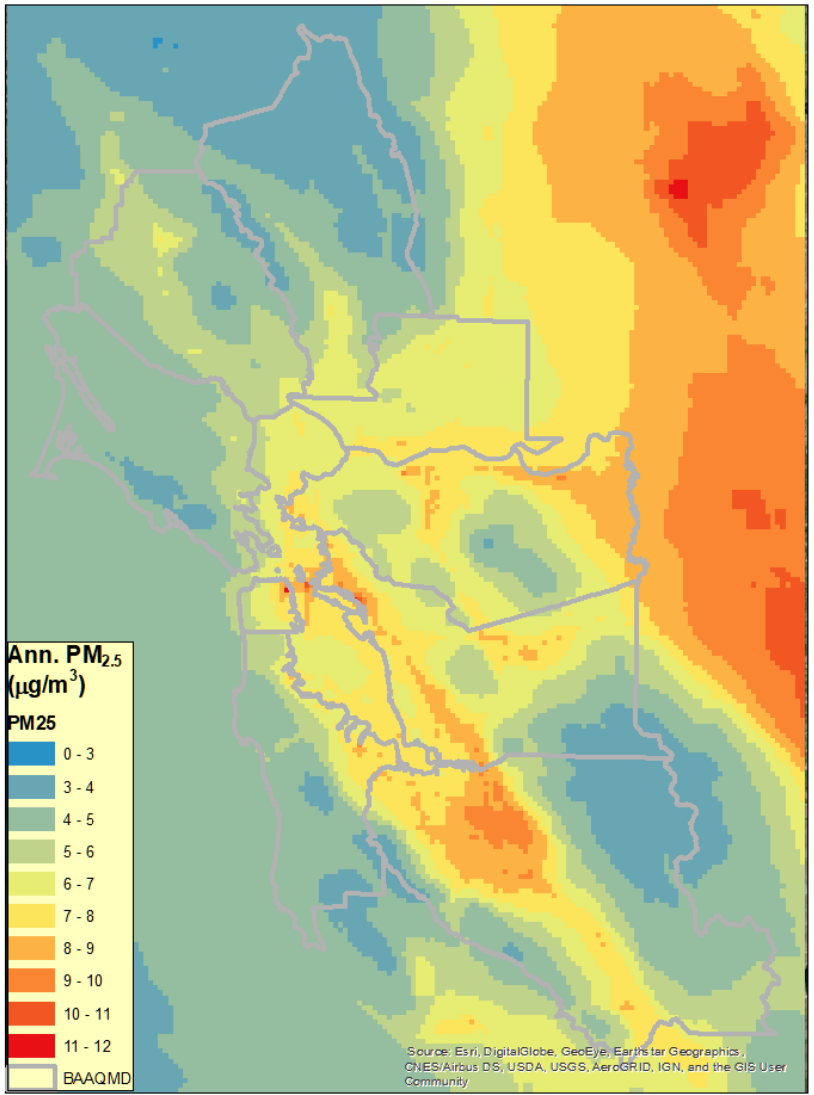
Advisory Council Meeting
December 9, 2019

Overview

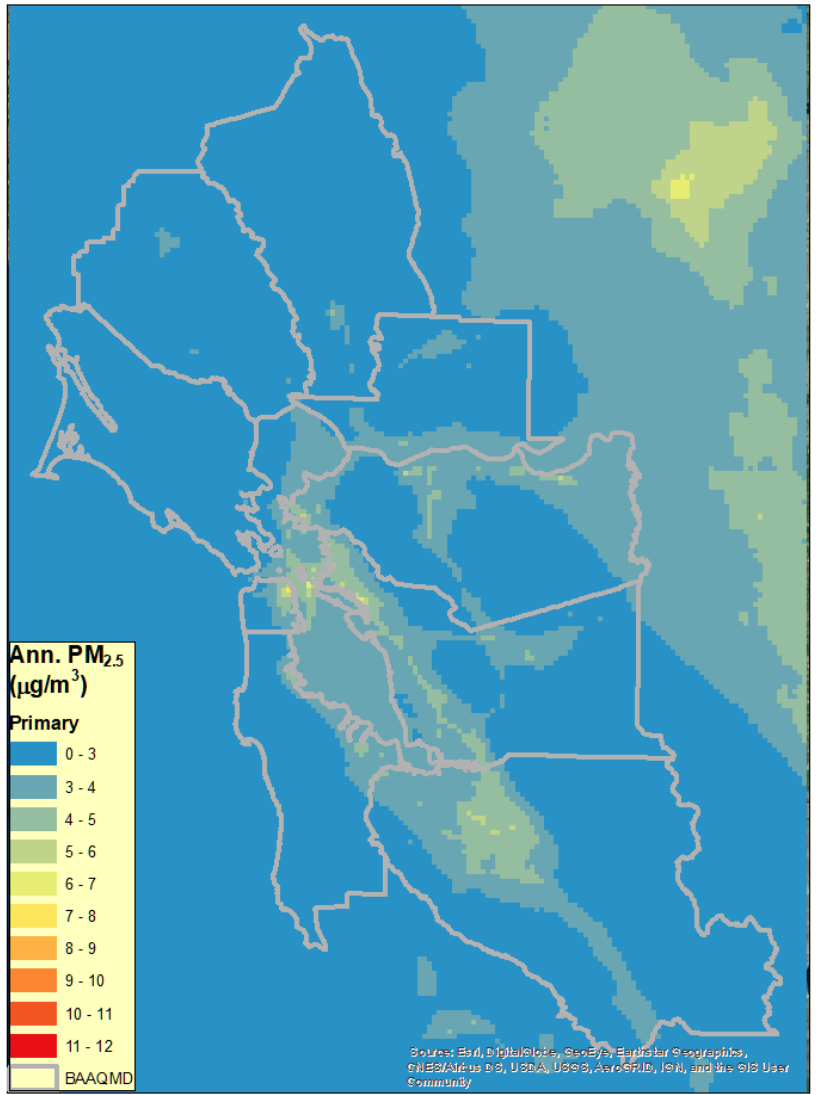
- **Regional-scale $PM_{2.5}$ source apportionment:**
  - Informs actions to maintain attainment of PM standards
  - Reveals information gaps, as top sources are controlled
- **Local-scale $PM_{2.5}$ source apportionment:**
  - Indicates near-source exposures add to total pollution burden
  - Reveals additional information gaps
  - Suggests a regulatory gap: actions to reduce near-source exposures?

Regional Modeling: Primary and Secondary Contributions

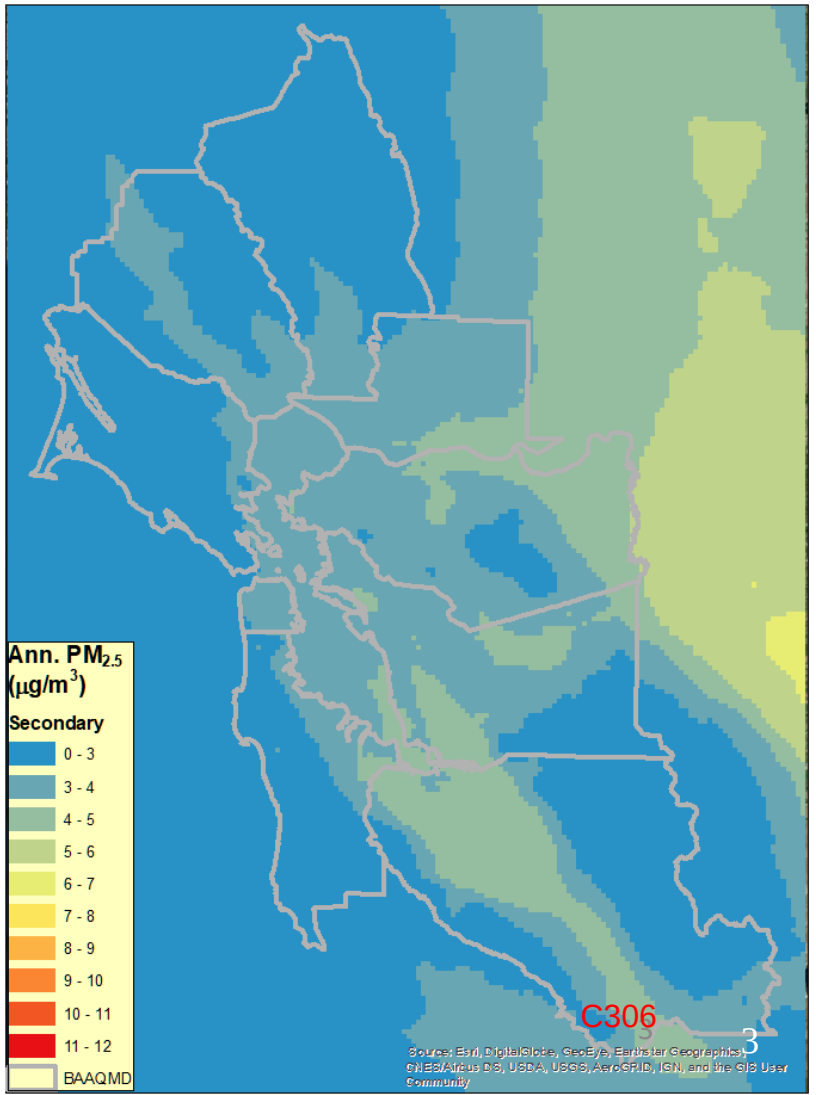
Total $PM_{2.5}$



Primary $PM_{2.5}$ (about 53%)

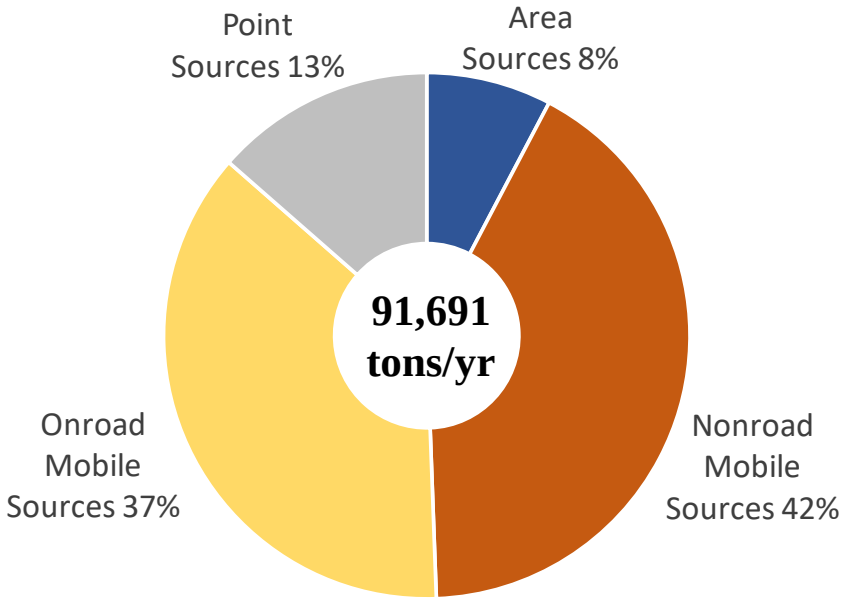


Secondary $PM_{2.5}$ (about 47%)



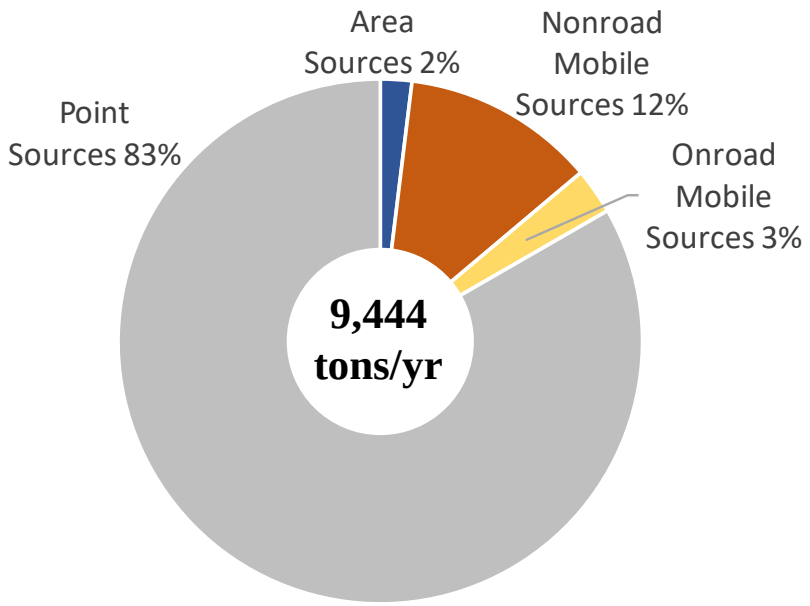
2016 Bay Area Emissions Summary for Key Secondary $PM_{2.5}$ Precursors

NO_x



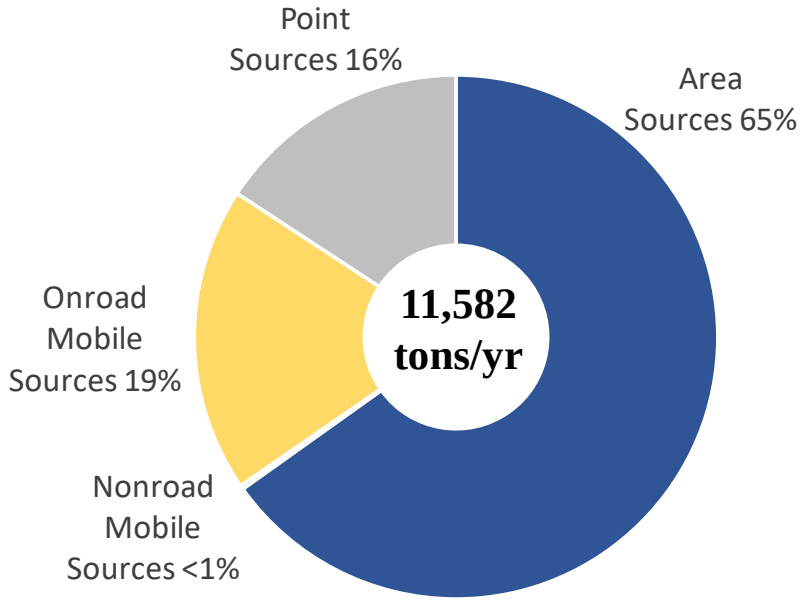
Key NO_x Sources: Diesel trucks and diesel-powered off-road equipment

SO_2



Key SO_2 Sources: Petroleum refineries, manufacturing plants (cement, chemicals)

NH_3

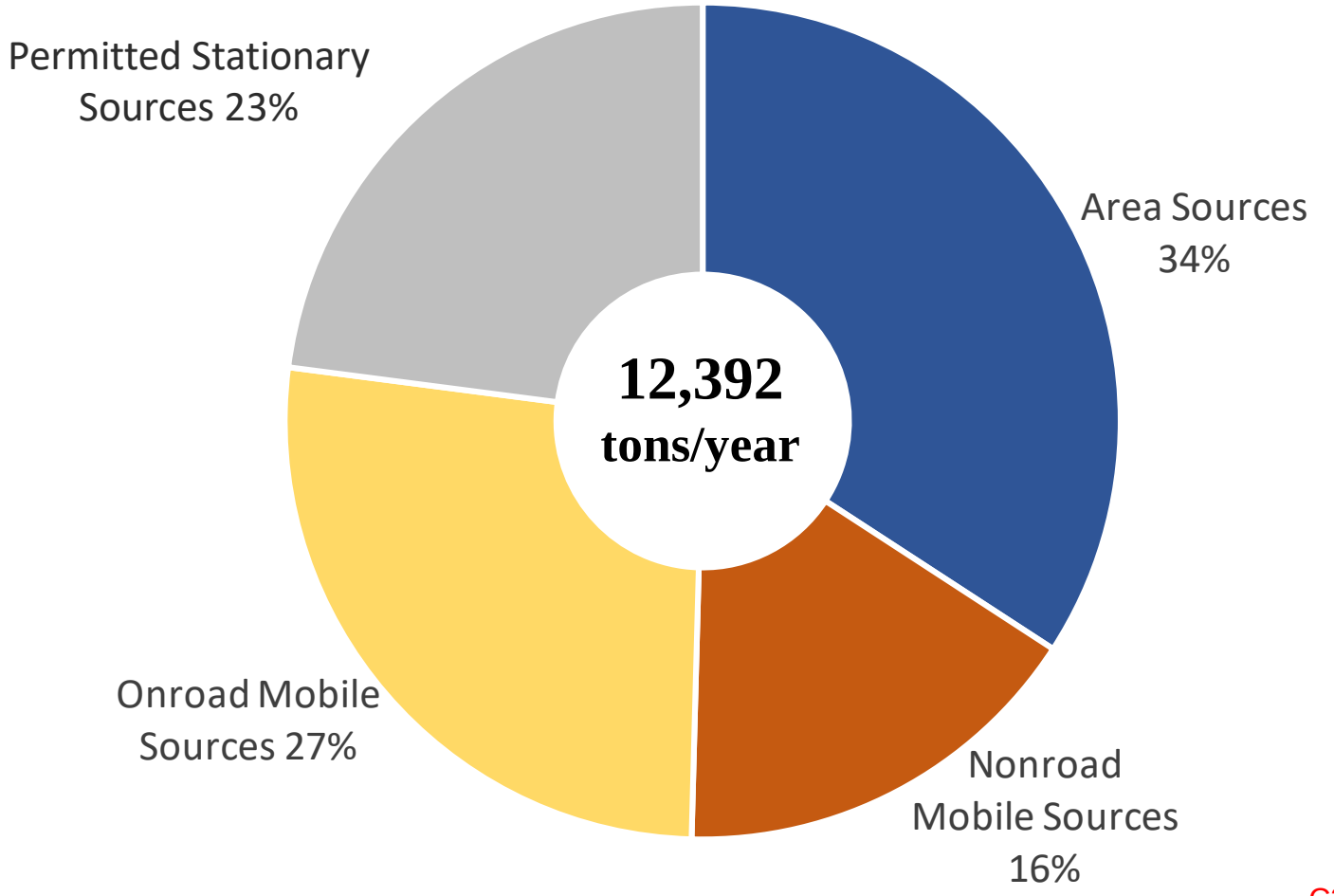


Key NH_3 Sources: Agricultural activity (livestock husbandry, fertilizer application)

C307

$PM_{2.5}$ Bay Area Emissions Summary for Primary $PM_{2.5}$

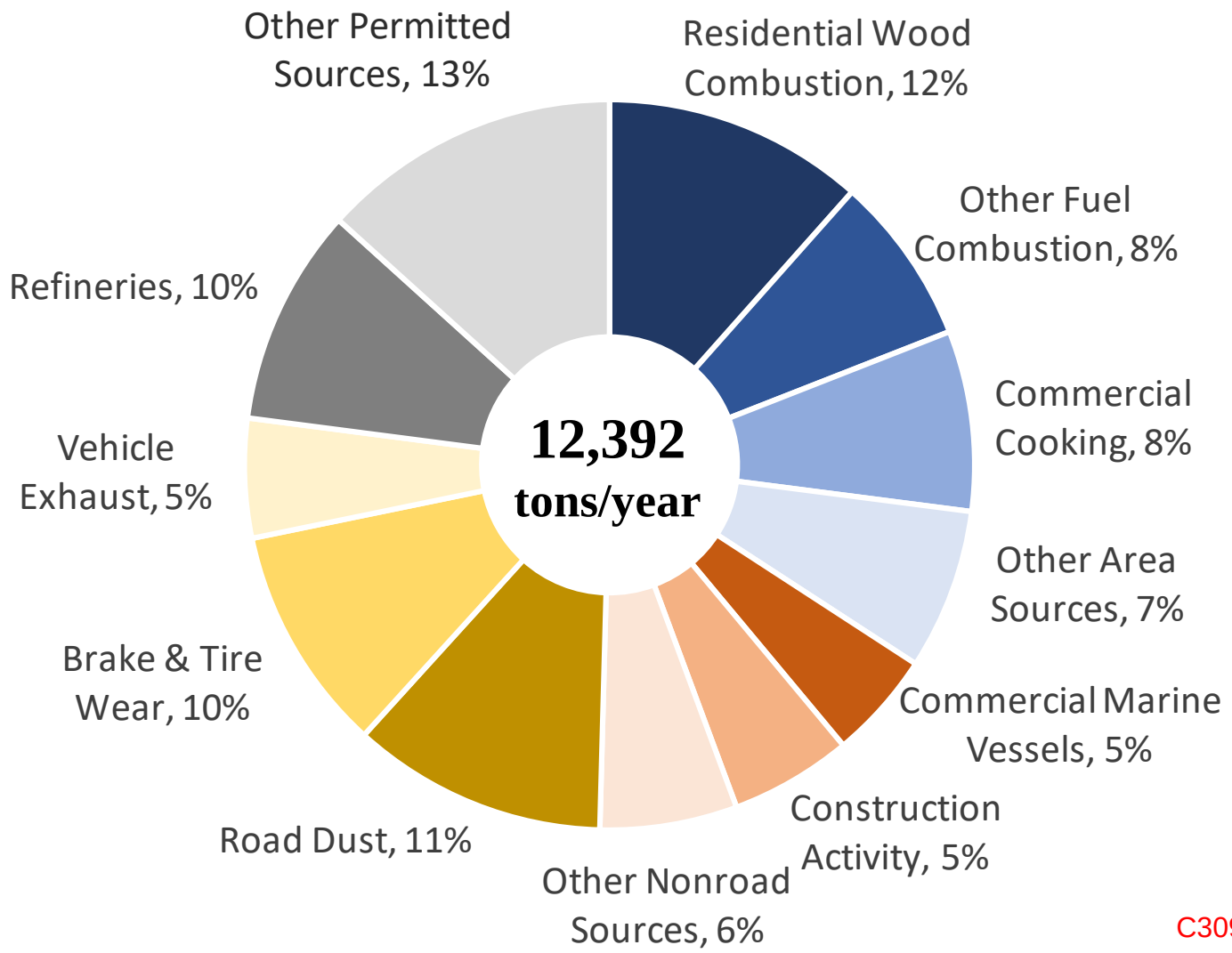
2016 annual average $PM_{2.5}$ emissions



C308

$PM_{2.5}$ Bay Area Emissions Summary for Primary $PM_{2.5}$

2016 annual average $PM_{2.5}$ emissions

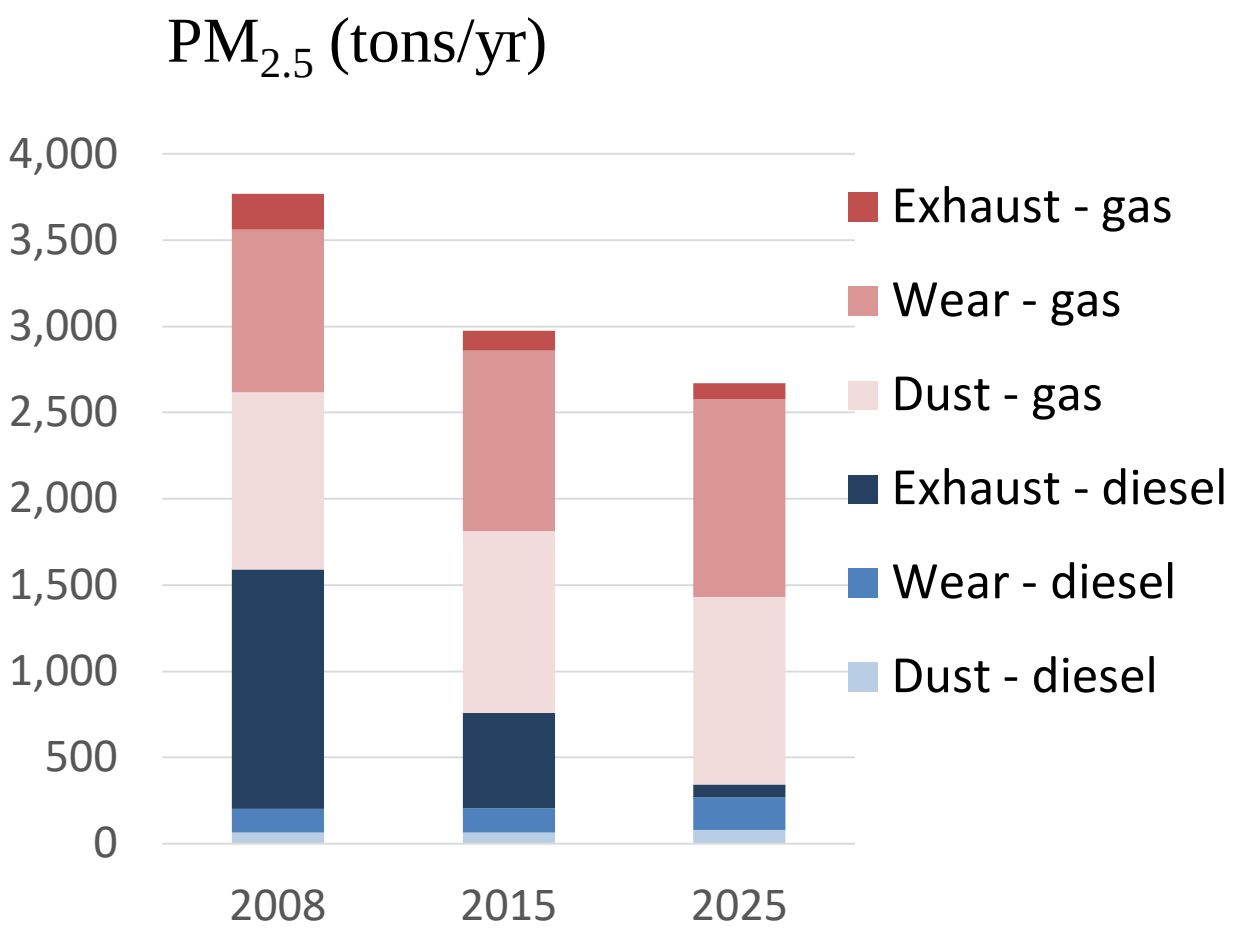


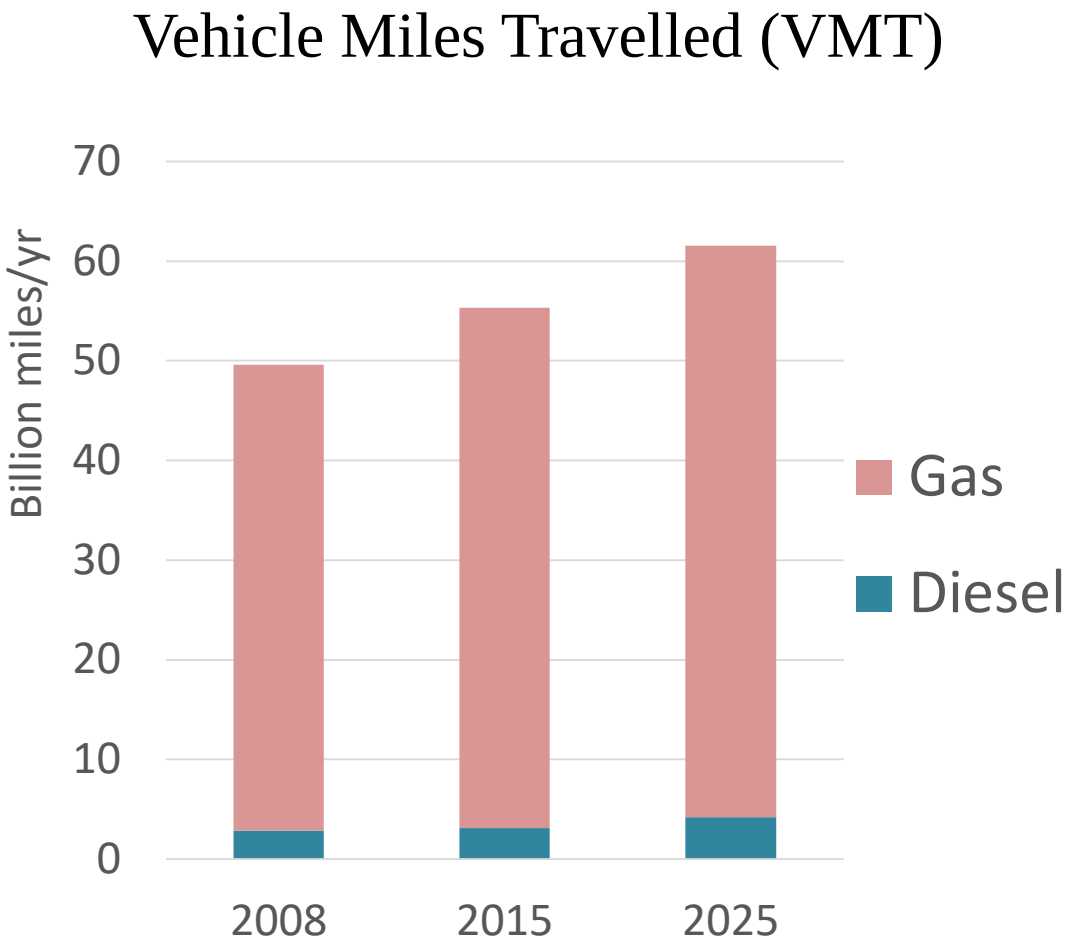
C309

Emissions Inventory Information Gaps

- **On-road wear emissions and road dust**
- **Some area source categories**
  - Residential wood combustion
  - Commercial cooking

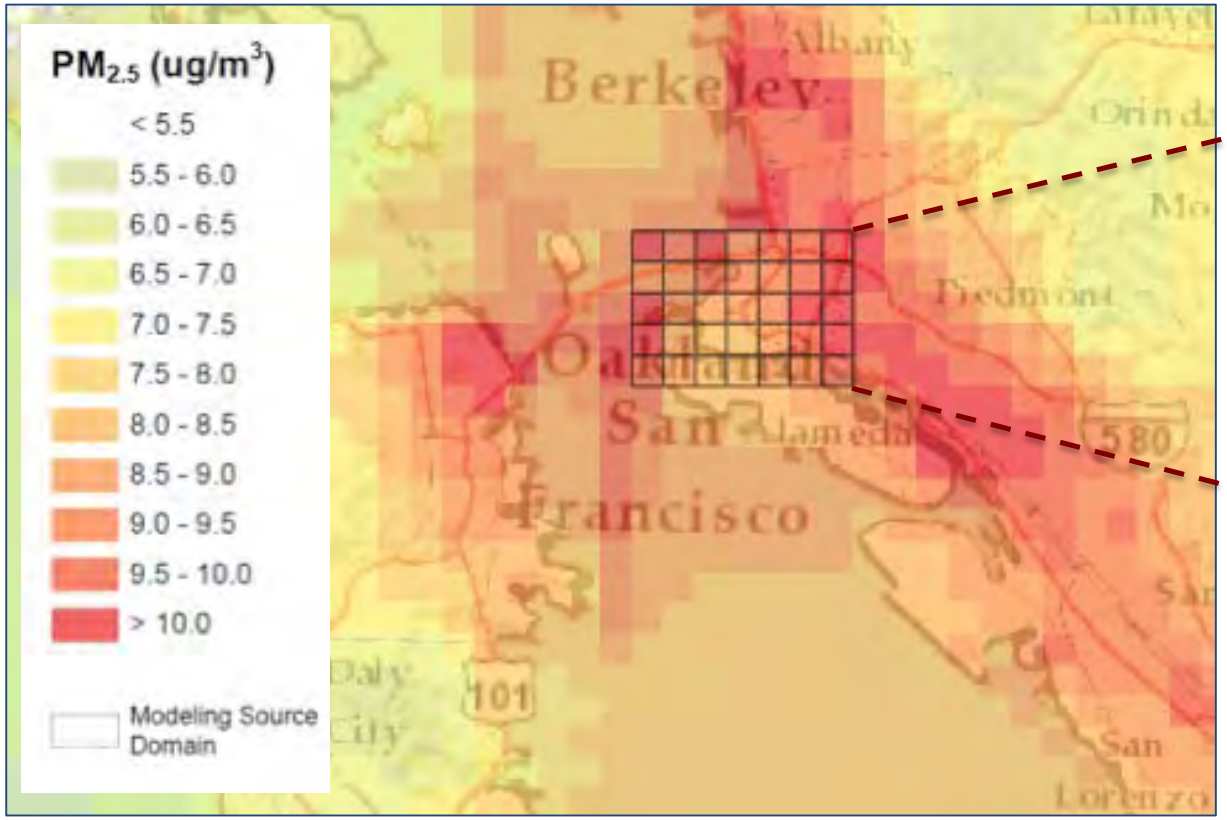
$PM_{2.5}$ Bay Area Emissions Apportionment: On-road Vehicles



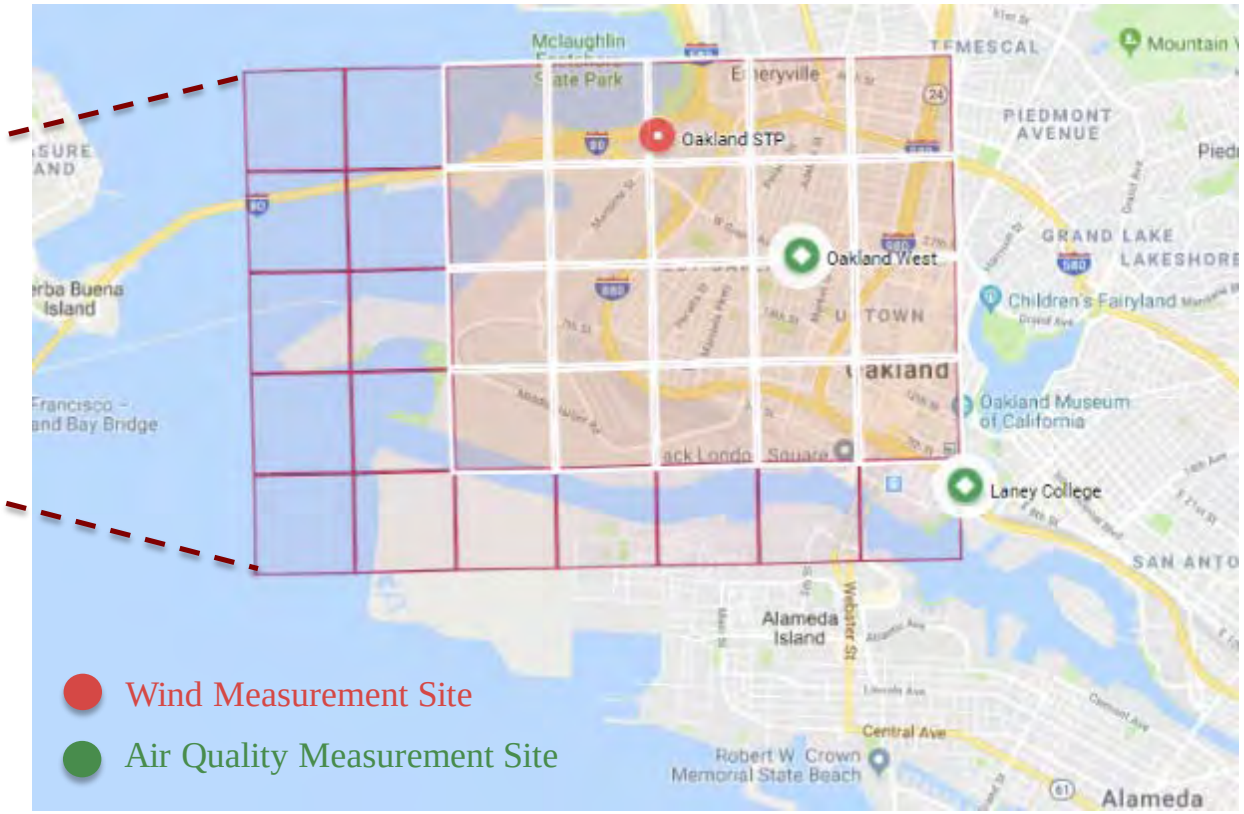


Data sources: EMFAC2017, California Air Resources Board 2016 State Implementation Plan Inventory C311

Regional-Scale and Community-Scale Modeling (2017)



Regional-scale modeling: covers the Bay Area

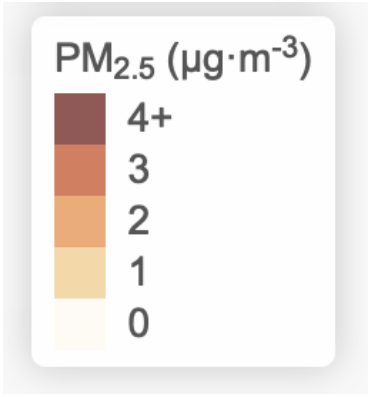


Local-scale modeling: covers West Oakland, including impacts in receptor area (white) from sources in source area (red)

C312

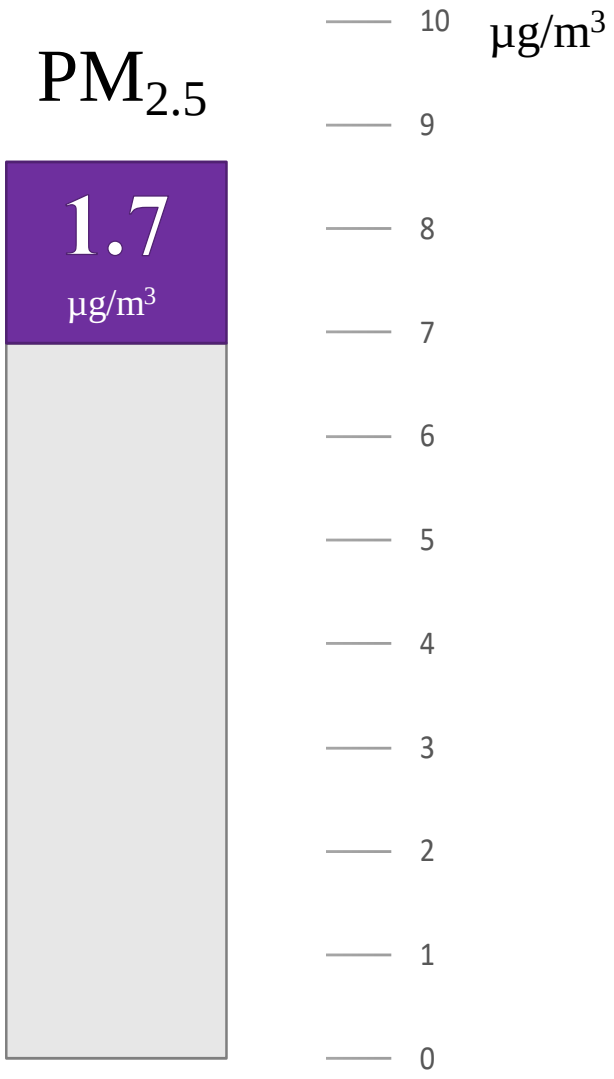
Modeled Primary $PM_{2.5}$ (from Local Sources)*

* 30% of $PM_{2.5}$ sources, including construction, residential woodburning, and restaurants not modeled



C313

Local vs. Regional: West Oakland Example



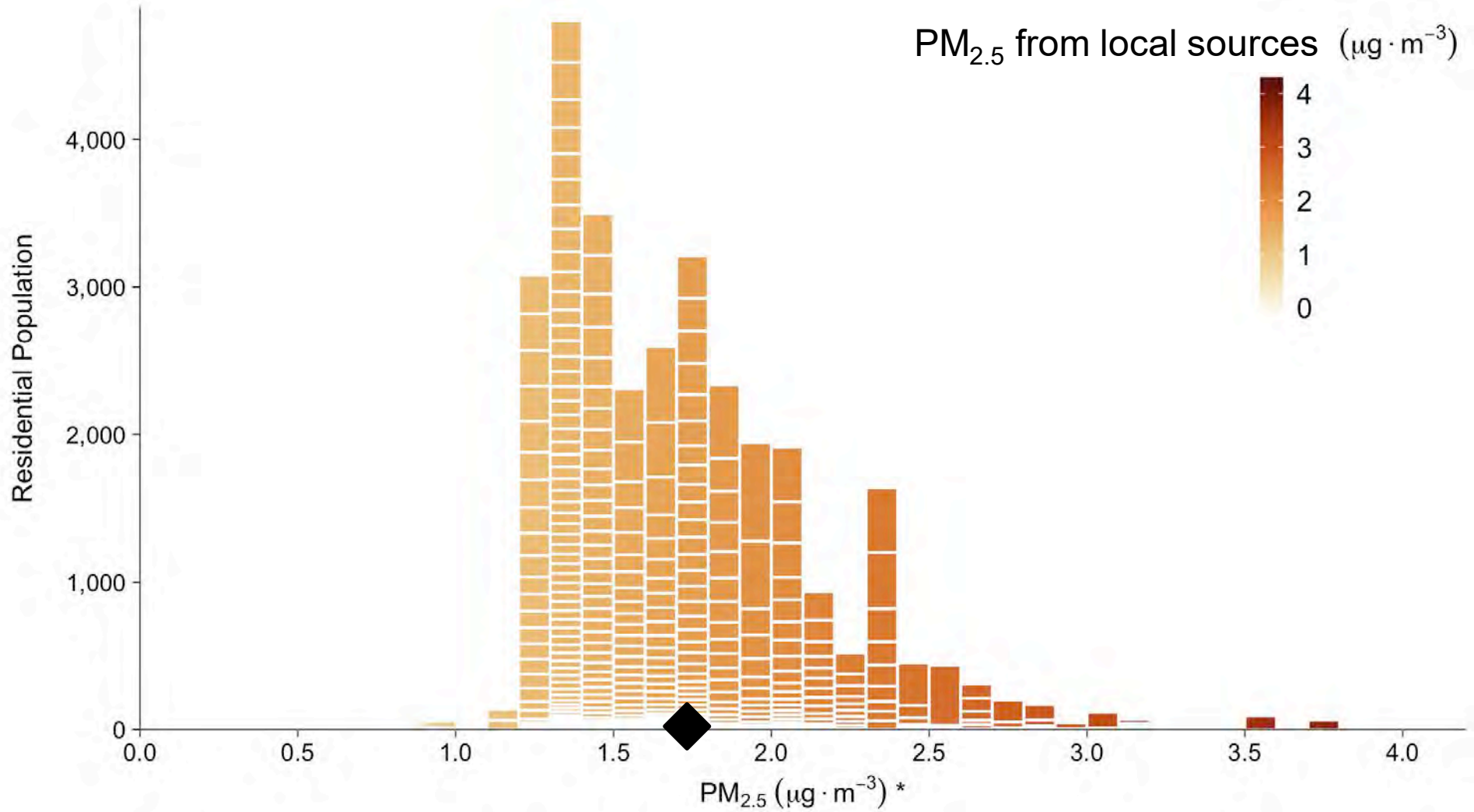
Community-scale model – mapped impacts*

Regional-scale model (minus West Oakland)

*30% of $PM_{2.5}$ sources, including construction, residential woodburning, and restaurants not modeled

C314

Unequal Impacts: $PM_{2.5}$ in West Oakland



* Contributed by modeled "present-day" emissions from existing local sources. Impacts from sources outside West Oakland not included.

DRAFT 2019-08-16

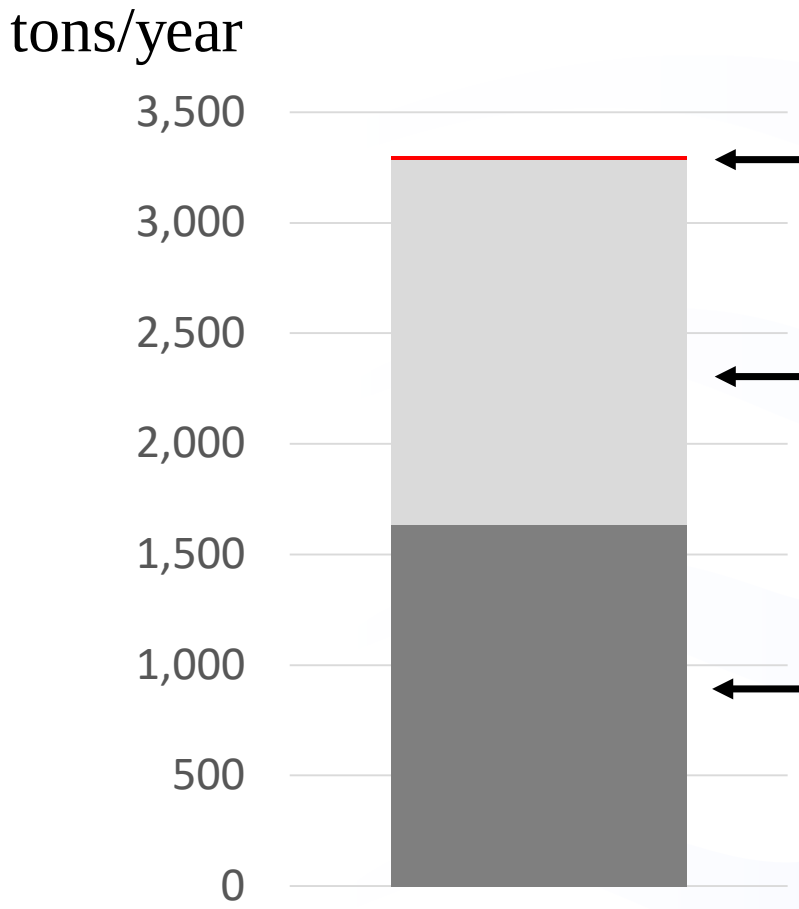
C315

Additional Emissions Inventory Information Gaps Identified

- Local-scale exposures: a different lens for evaluating priorities
- Same concerns about on-road wear and road dust emissions estimates
- We require more information about permitted sources that are not top priorities from a regional perspective

C316

$PM_{2.5}$ Emissions (tons/yr) from Permitted Facilities



West Oakland facilities ≈ **0.5%** (15 tons/yr, within community boundary)

Top 5 facilities (Air District-wide) ≈ **50%**

(All others)

C317

Summary

- Continuing regulatory programs to reduce $PM_{2.5}$ with the current regional focus will improve health throughout the Bay Area
- As top sources are controlled, new sources become priorities and we identify new information gaps
- Local-scale assessments bring to focus the importance of some permitted sources that are a low priority from a regional perspective
- A regulatory gap: a framework that promotes $PM_{2.5}$ reductions from near-source exposures will improve health in Assembly Bill 617 communities

C318

AGENDA: 5B

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Update on Particulate Matter (PM) Air District Work:

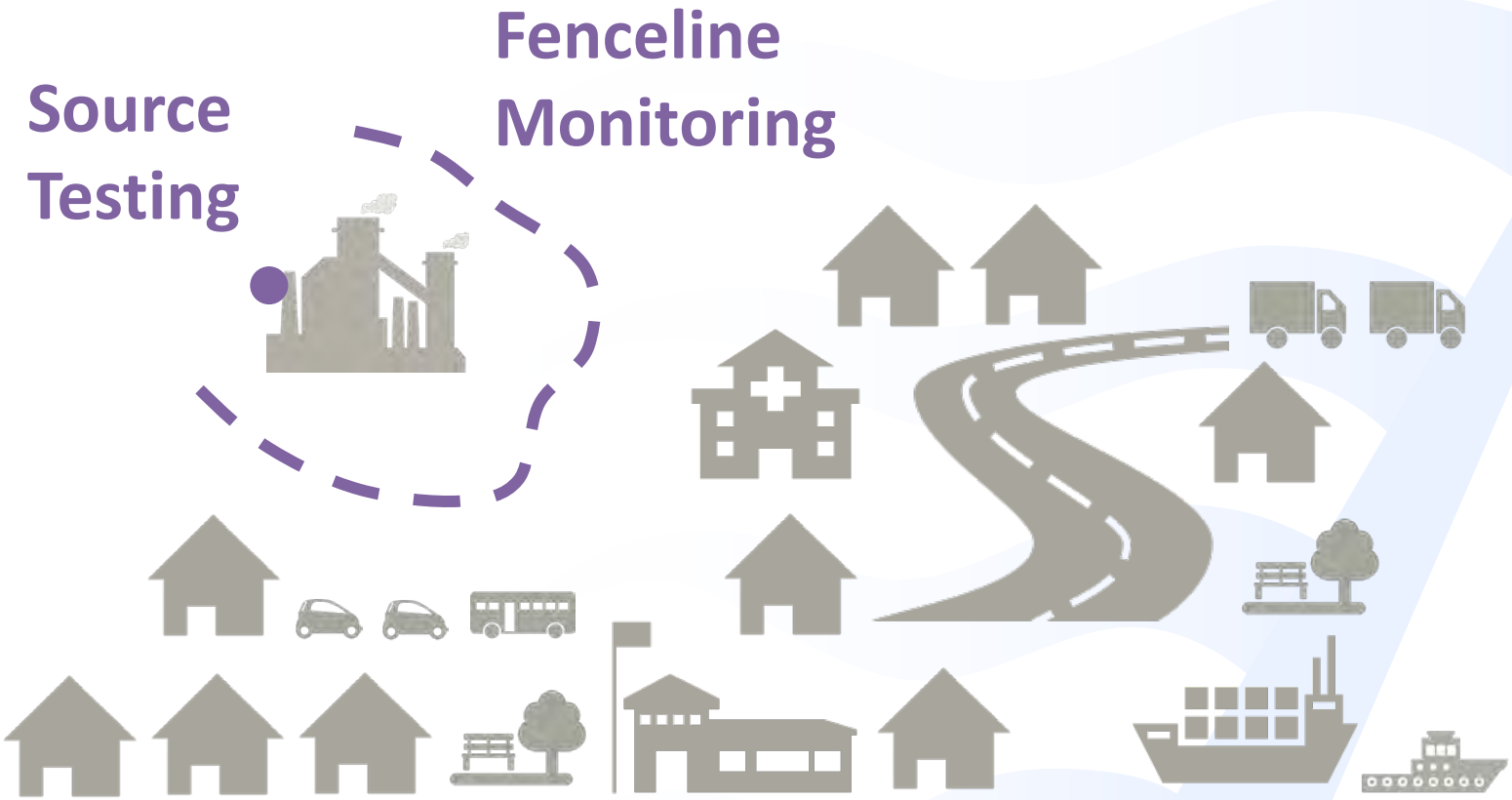
Monitoring

Ranyee Chiang
Director of Meteorology & Measurements

Advisory Council Meeting
December 9, 2019

Measurements in the Bay Area

Measurements in the Bay Area (cont.)



Measurements in the Bay Area (cont.)

Measurements in the Bay Area (cont.)

Sensor Networks

Outline: PM Monitoring

- Regional Network and Community Monitoring
  - Current capabilities
  - New developments
- What does the data show?
  - Ultrafine particles
  - Wildfire incidents
- Looking ahead
  - How could data be used
  - Options to strengthen air quality monitoring

Regional/Regulatory Network: Objectives

- Provide timely ambient air quality data to the general public
- Air quality forecasting for Spare the Air Program
- Support compliance with California and national ambient air quality standards
- Support air pollution research studies

Monitoring Network Design Criteria

- Site Types
  - Population-oriented
  - Highest concentration of pollutants
  - Source-oriented (downwind of major pollution sources)
  - General background sites
  - Regional transport (near borders of the Air District)

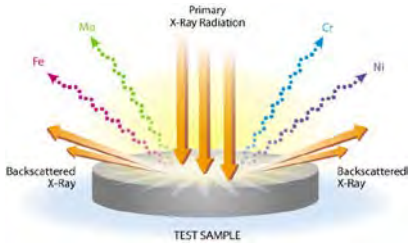
40 Code of Federal Regulations 58 Appendix D

- Based on population (2010 Census or estimates)
  - Number of monitoring sites in the Bay Area exceeds the required number

Particulate Matter (PM) Measurements

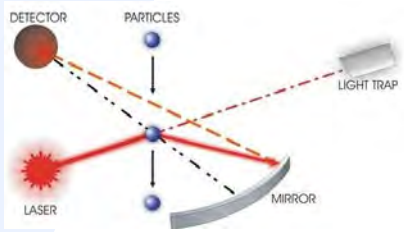
Mass Measurements

- Compliance with California and National PM_{10} and $PM_{2.5}$ standards
- Designate areas as attainment or nonattainment



Chemically Resolved or Speciated Data

- Support emission reduction strategies



Particle Counts

- Explore science on emissions, air quality impacts, and health effects associated with exposures

Air District PM Instrumentation

	PM_{10} Mass	$PM_{2.5}$ Mass	$PM_{2.5}$ Speciation	Ultrafine Particles ($PM_{0.1}$)	Black Carbon Mass
Analytical methods	Gravimetric	Gravimetric or Filter-based beta attenuation	Chemical extraction	Laser-based particle counter	Filter-based light attenuation
Active monitors	7	20	4	6	7
Example photo					

Ultrafine PM Monitoring

Strengths:

- 7+ years of experience with deployment in diverse siting applications
- Current data can be used to understand diurnal and seasonal patterns, trends, or differences between background, near-road, and typical urban settings

Limitations:

- Cost ($60k - $100K / unit)
- Instruments in PM-burdened areas require frequent maintenance
- Difficult to assess sources and sinks
- Data may not be robust enough to link to specific health impacts

New Developments: Hyperlocal, Street-by-Street Monitoring

- Partnership with Aclima to determine differences in air quality on a highly localized scale
- Sensor-based instrumentation (NOx, CO, O3, BC, PM2.5)
- Data reported through a public portal
- Began in Richmond-San Pablo in summer 2019; entire Bay Area within two years

Use cases:

- Empower communities with information about air quality typical of where they live and work
- Identify areas having elevated background concentrations for further investigation

New Developments: Mobile Laboratory

- High accuracy, real-time instrumentation to screen for PM and air toxics at a local scale
  - PM concentration
  - Inferred particle age
  - Size-binned measurements (ultrafine through PM_{10})
  - Black carbon
  - Potential to test for chemical components of PM in the future

Use cases:

- Identify and prioritize local sources of air toxics or PM
- Air quality between fixed-site monitors
- Identify locations for portable or fixed-site monitoring stations

New Developments: Portable Platforms

- High quality, battery powered, filter-based PM samplers that are relocatable
- Self-contained “suitcase” for continuous, real-time measurements using high quality, low power instruments

Use cases:

- Concentration variations throughout the day or week near an identified PM hotspot
- Measure air quality when the power is out due to high winds and fire hazard
- Verify low-cost sensor nodes

Outline: PM Monitoring

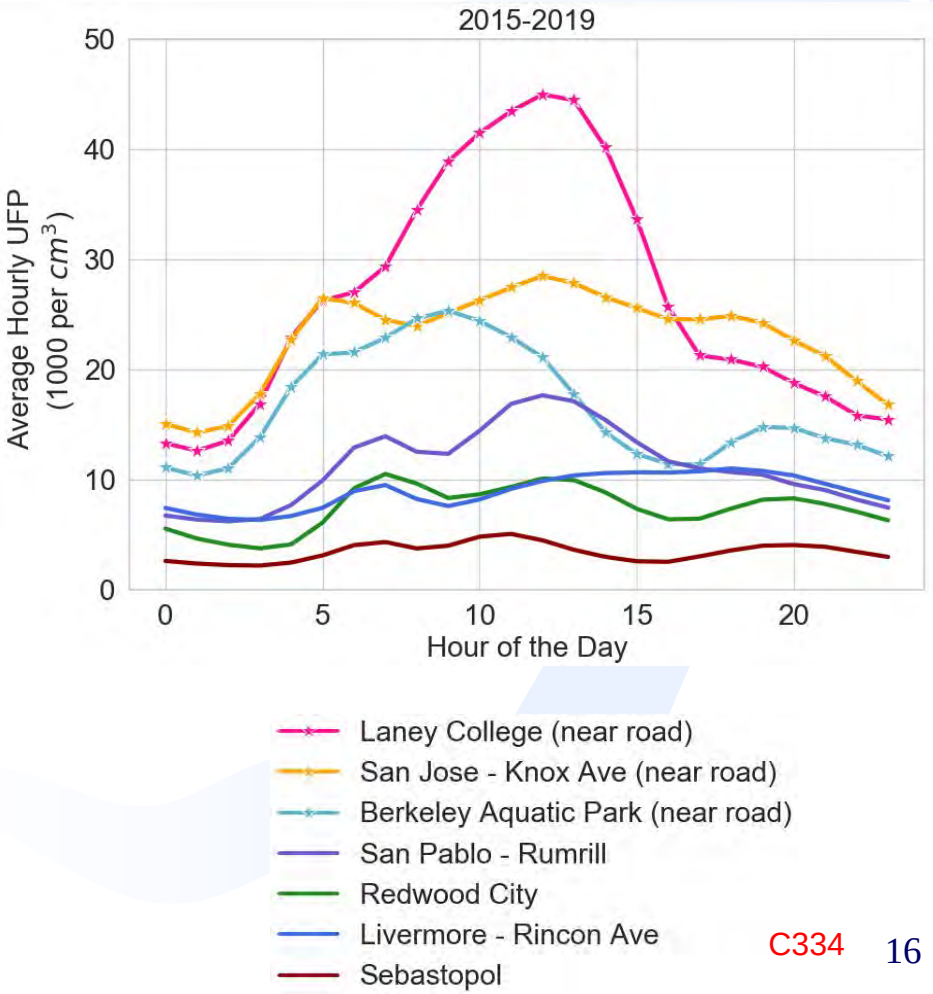
- Regional Network and Community Monitoring
  - Current capabilities
  - New developments
- What does the data show?
  - Ultrafine particles
  - Wildfire incidents
- Looking ahead
  - How could data be used
  - Options to strengthen air quality monitoring

What Do the Ultrafine Particulate (UFP) Data Show?

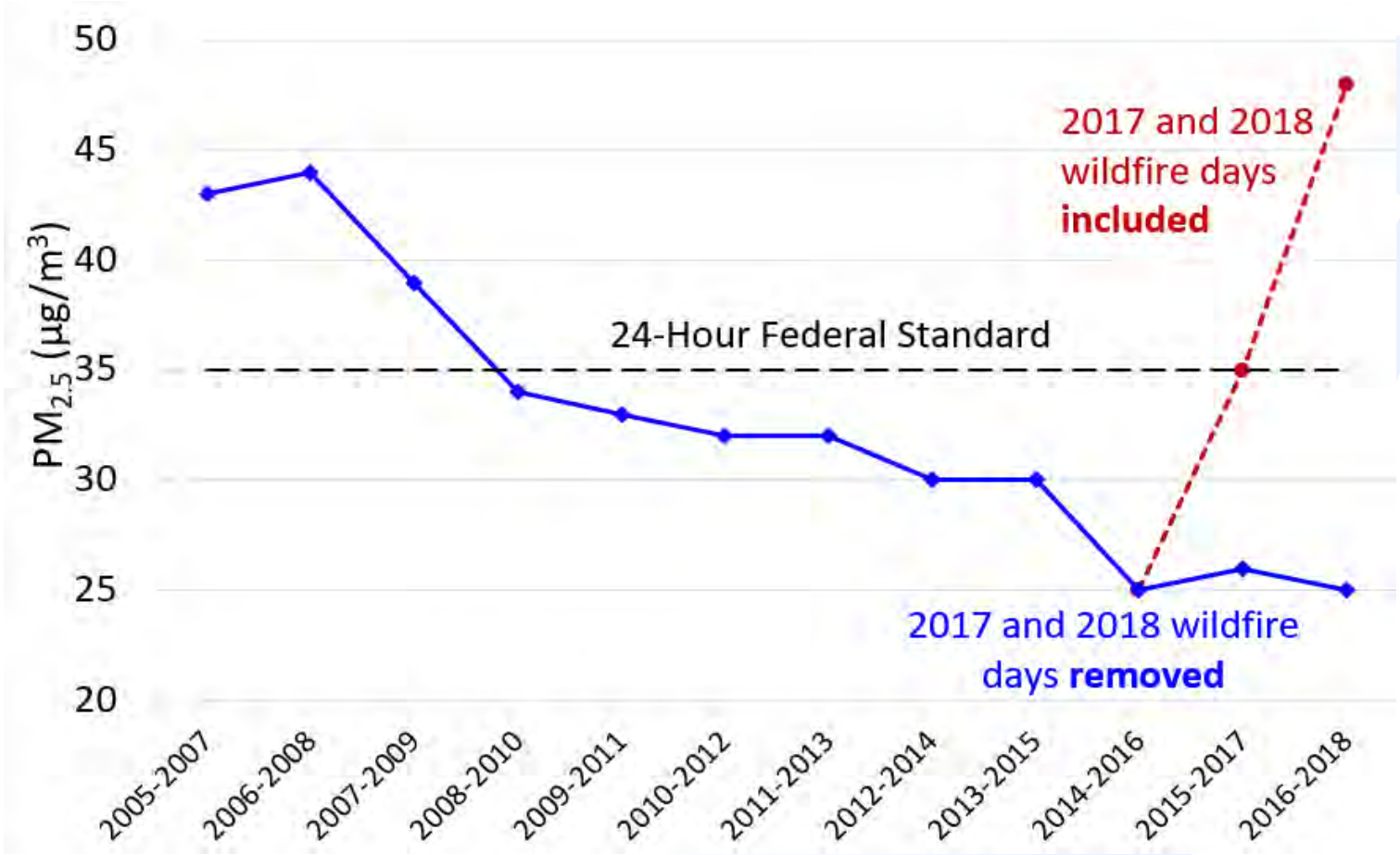
Levels influenced by traffic and/or photochemical reactions

- UFP highest at near-road sites
- Some sites consistently low, while others vary

Patterns of UFP throughout region differ from $PM_{2.5}$



Wildfire Smoke Dramatically Affects Bay Area $PM_{2.5}$ Levels



Air District's Strategy to Reduce Impacts from Wildfire Smoke

Communication with the public

- Issue smoke advisories and Spare the Air alerts based on air quality forecasts
- Understanding air quality measurements and data
- How to reduce exposure during smoke impacts

Grants and incentives for recovery assistance

Work with other Air Districts and Public Health Officers

- Consistent wildfire health information
- Provide guidance for schools

Outline: PM Monitoring

- Regional Network and Community Monitoring
  - Current capabilities
  - New developments
- What does the data show?
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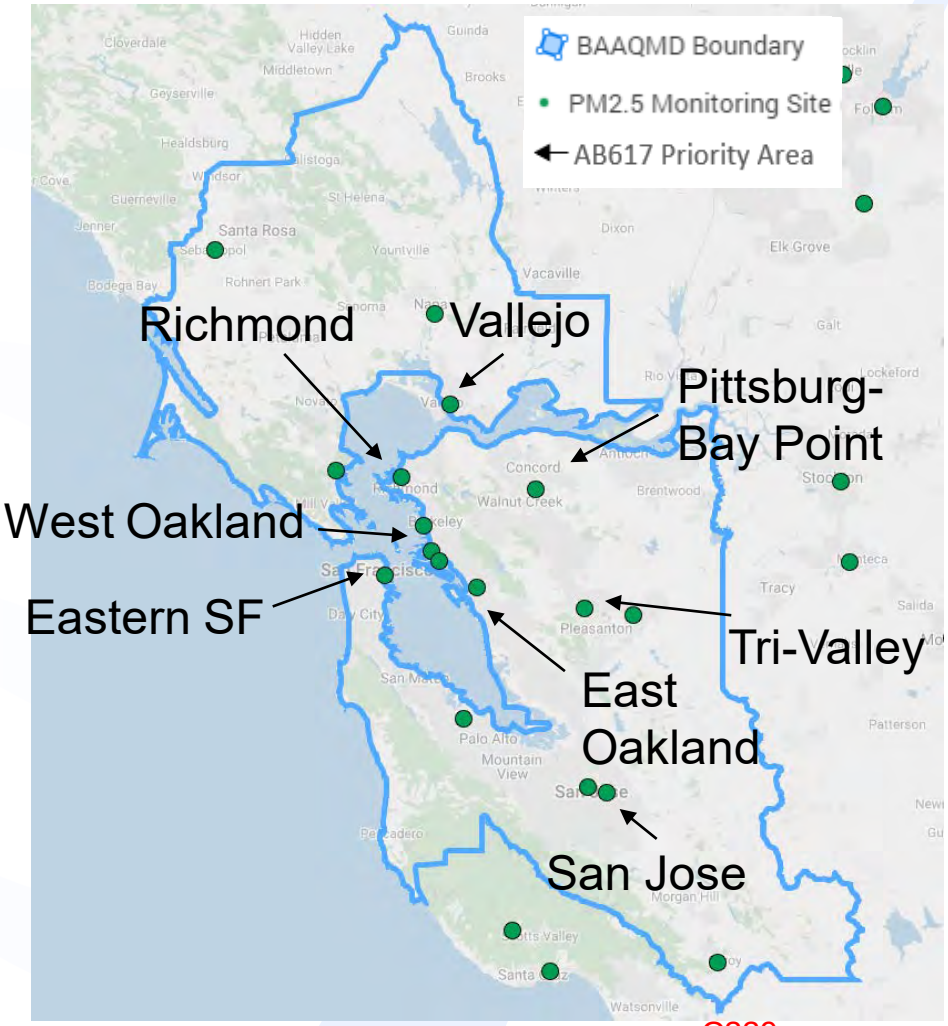
- Looking ahead
  - How could data be used
  - Options to strengthen air quality monitoring

Combining Monitoring Strategies for Multiple Objectives

Network	Measurements	Network Objectives
Regional Network	- $PM_{2.5}$ and PM_{10} Mass	- Comparison with health-based standards - Public information - Track long-term trends - Assess out of area transport
Special Projects (fixed site, portable, or mobile)	- PM size distribution - PM speciation - UFP - Black Carbon	- Source identification - Assessment of specific emission sources - Characterization of near-road environments
Sensor Networks (mobile or fixed)	- PM Mass - Particle Count	- More challenging to interpret due to higher levels of uncertainty - Public education - Personal exposure - Identification of hot-spots - Comparative assessment of local air quality - Tracking high PM episodes

Integrated PM Network Assessment (to be completed by July 2020)

- Evaluate PM measurement network to recommend improvements with available resources
- Address existing requirements and goals
  - Federal and state requirements
  - Understand criteria pollutant levels
- Strengthen network to address gaps
  - Incorporate multiple monitoring approaches
  - Support community air monitoring activities
  - Provide data to support other Air District activities



AGENDA: 5C

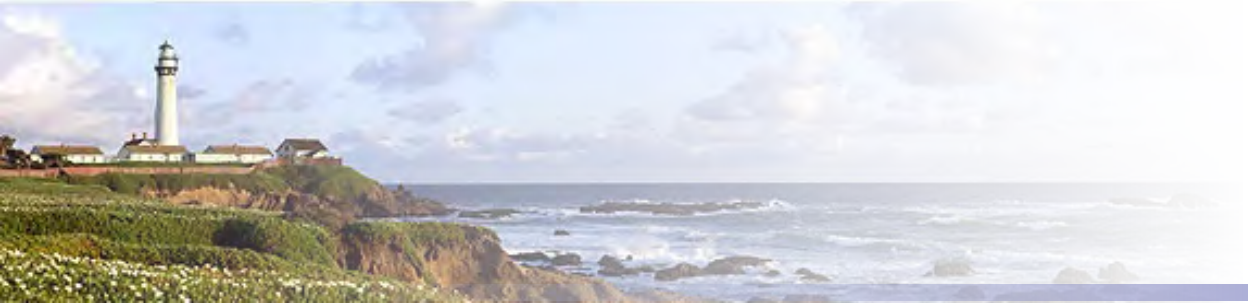
BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Update on Particulate Matter (PM) Air District Work:

Air District Grant Programs Overview

Karen Schkolnick
Strategic Incentives Division Director

Advisory Council Meeting
December 9, 2019



Overview

- Background
- Grants Overview and Priorities
  - Project Evaluation
  - Eligible Projects
- Supporting Air District Initiatives
- Results and Highlights
- Next Steps

Background

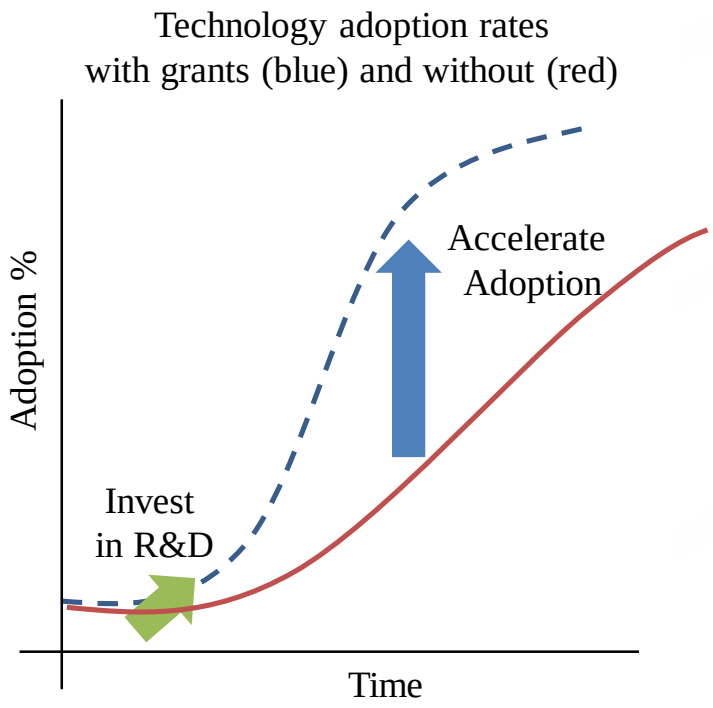
Monitoring
Planning
Regulations &
Enforcement

spare the air

Education
&
Outreach

Grants
&
Loans

Grants Overview and Priorities



- Cost-effective air quality and climate protection benefits
- Accelerated adoption of cleanest commercially available technologies and investments in R&D
- Expedited emissions reductions in disproportionately impacted communities

Project Evaluation

Cost-Effectiveness (CE)

$$CE = \frac{Funds\ Awarded}{Tons\ of\ NOx + ROG + (\boldsymbol{PM_{10}\ x\ 20})\ reduced}$$

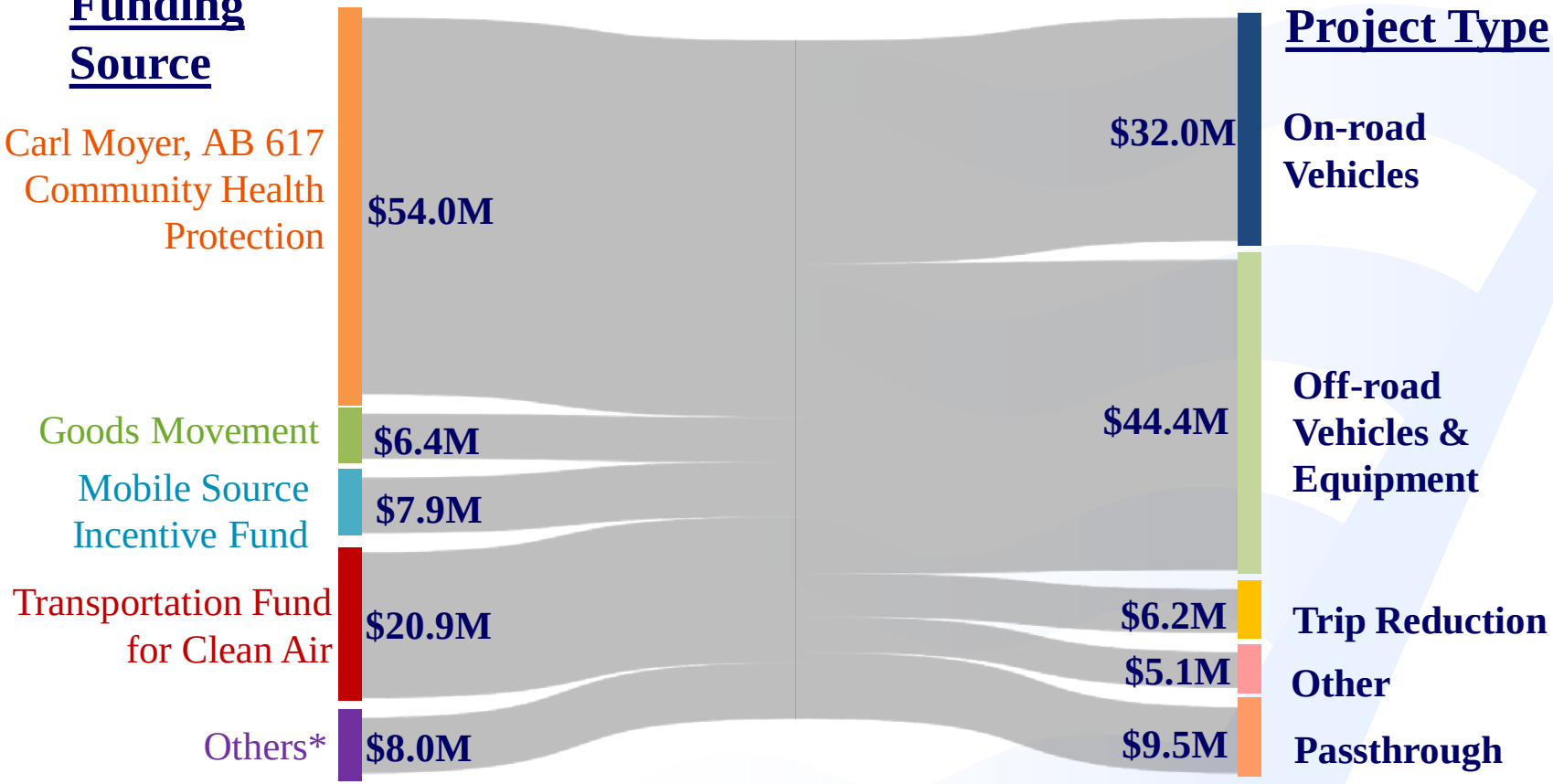
CE* estimates ***quantifiable,***

verifiable,

and surplus lifetime emission reductions

**CE formula is provided by CARB Carl Moyer Program Guidelines*

>$97M Awarded in 2018 to Eligible Projects



* Other funding sources include U.S. EPA's DERA, California Climate Investments, & Air District's general fund