



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

AGENDA: 4

Particulate Matter in the Bay Area

Advisory Council Meeting
March 26, 2018

Phil Martien, PhD
Bay Area Air Quality Management District

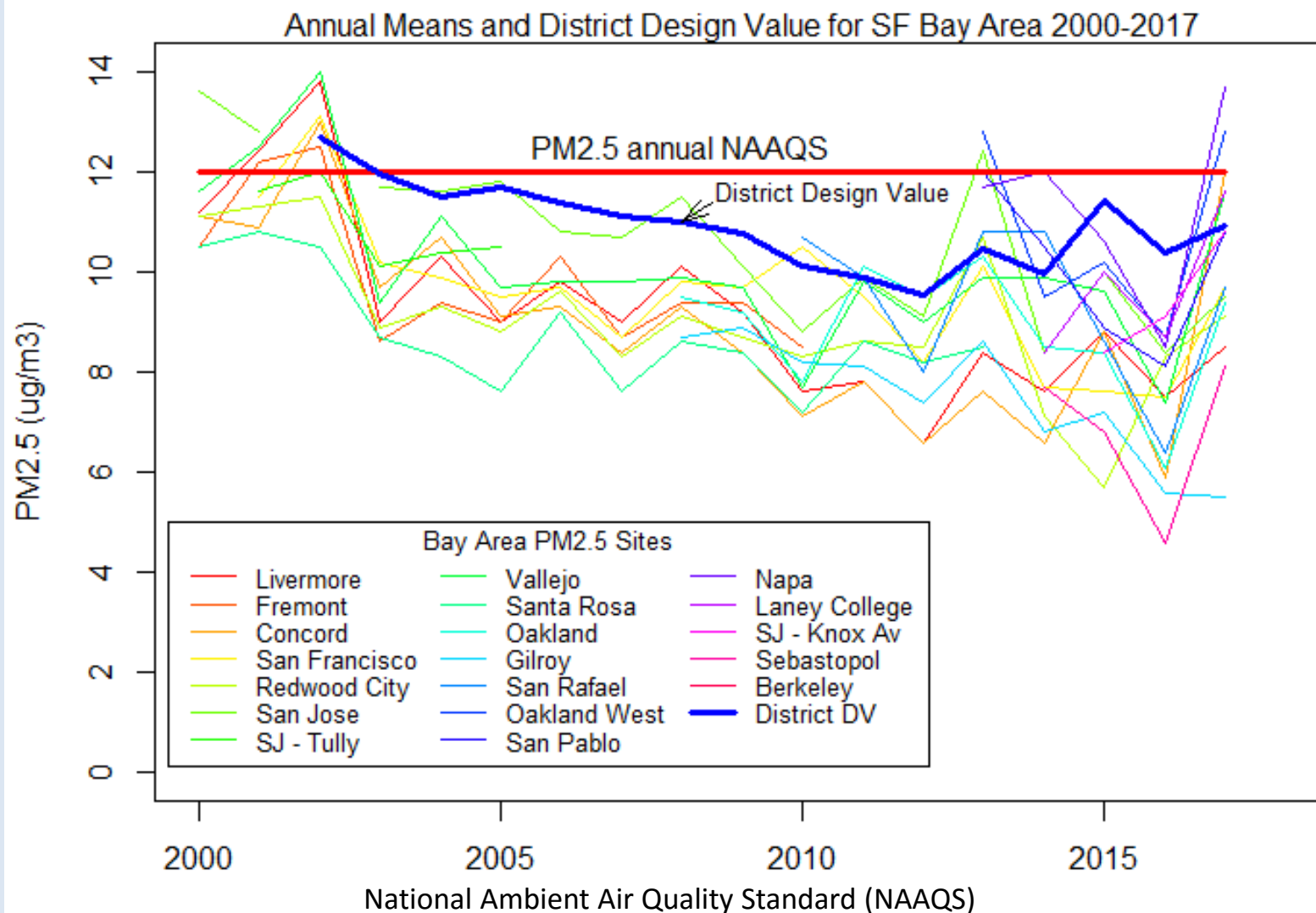
Overview

- Regional PM_{2.5} source apportionment: focused on informing actions to maintain attainment of PM standards
- To date, PM_{2.5} source apportionment in specific communities has focused on:
 - Areas with high health burdens and high traffic densities
 - Diesel PM, black carbon (BC), or elemental carbon (EC)

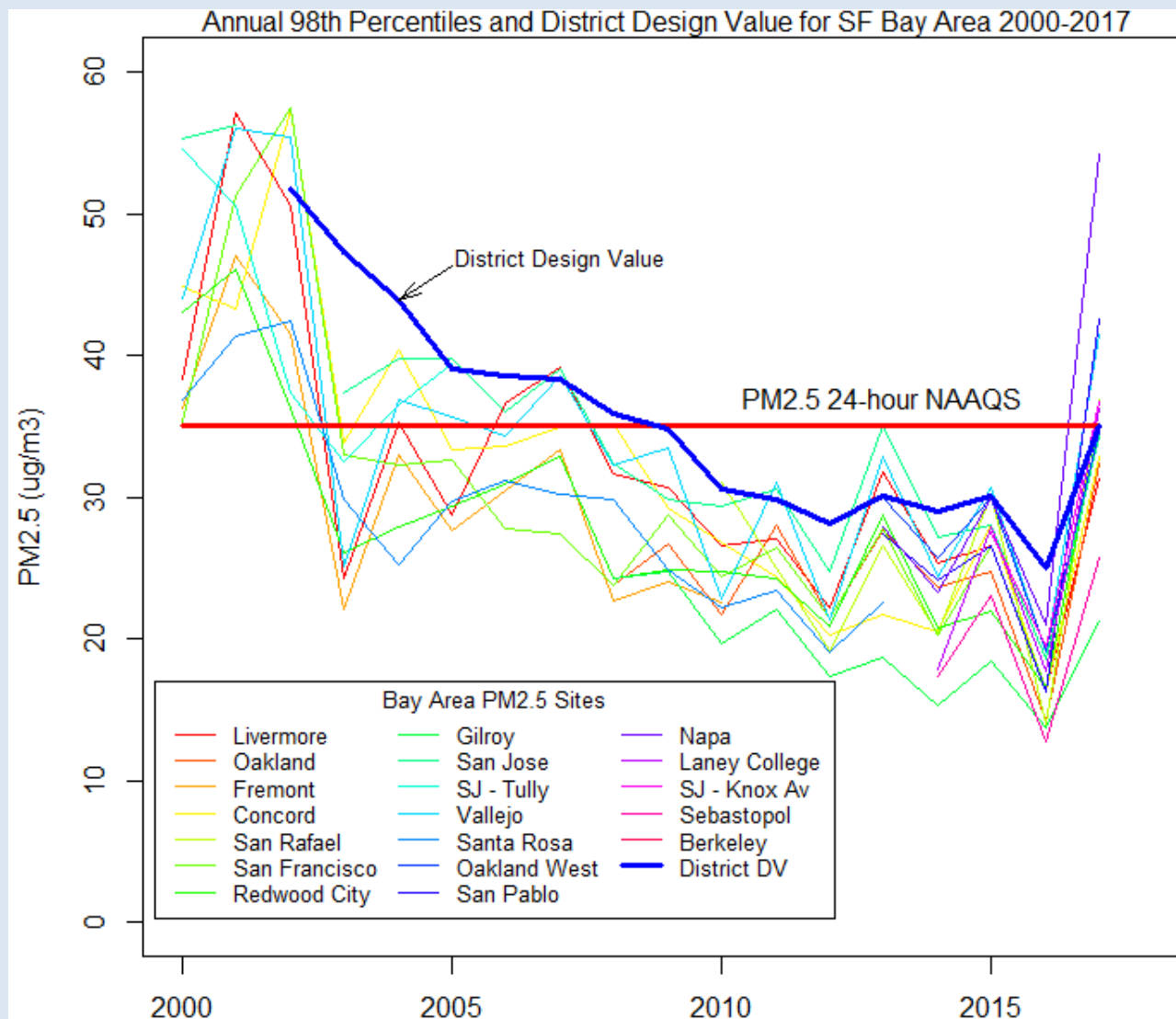
Overview (Cont.)

- Community-scale source apportionment will give us data to identify and quantify important sources within a community
- These assessments could be more actionable with methods to evaluate PM health risks

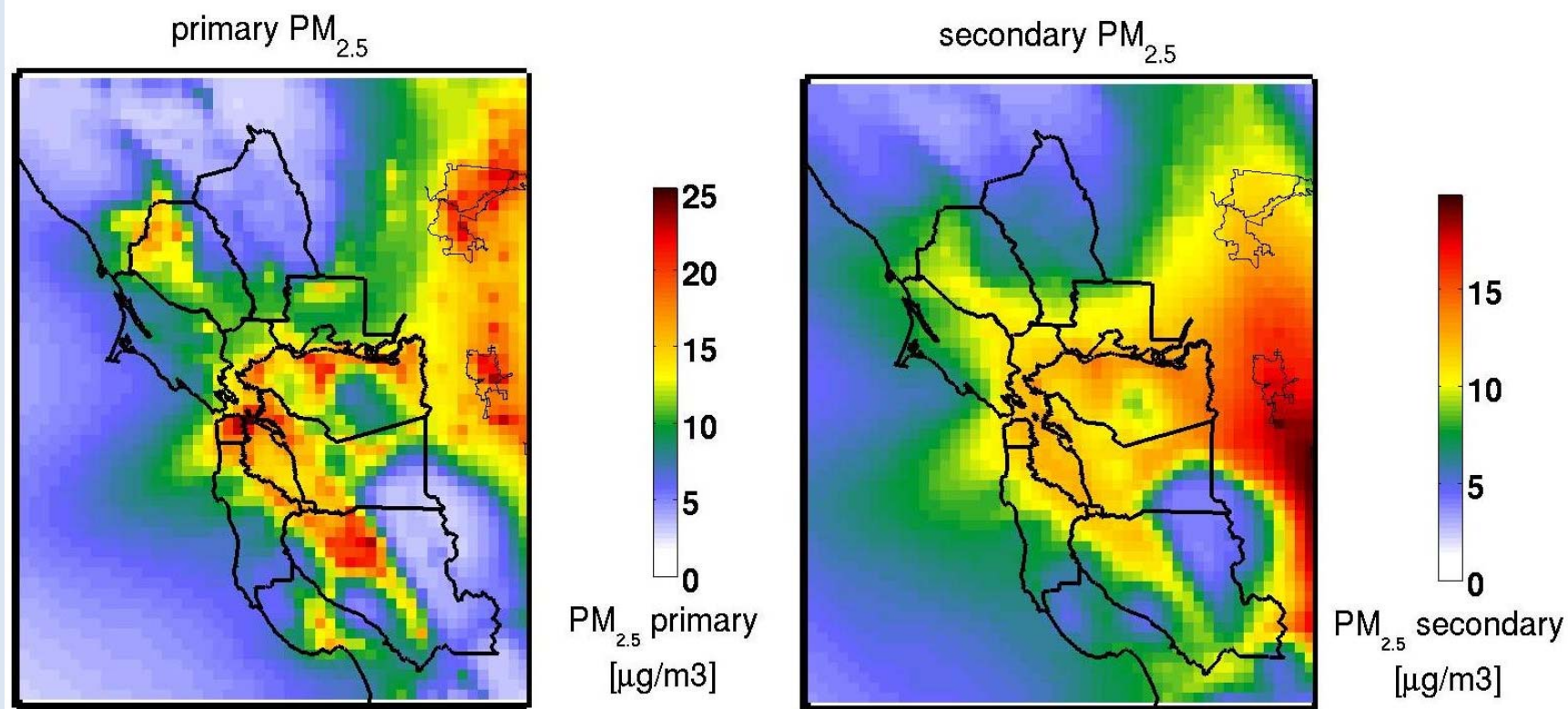
PM_{2.5} Annual Design Value Attains National Standard since 2003



PM_{2.5} 24 hour Design Value Attains National Standard since 2009

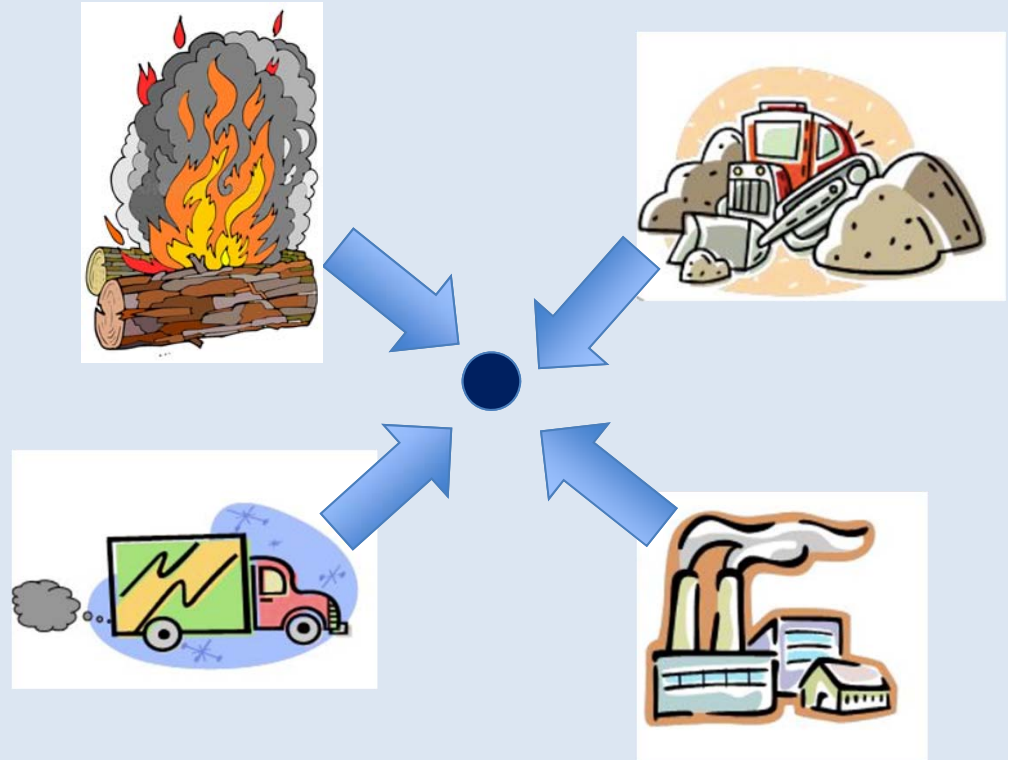


Modeled Primary and Secondary PM_{2.5}: about 1/3 of PM_{2.5} is Secondary



Receptor Modeling: Chemical Mass Balance

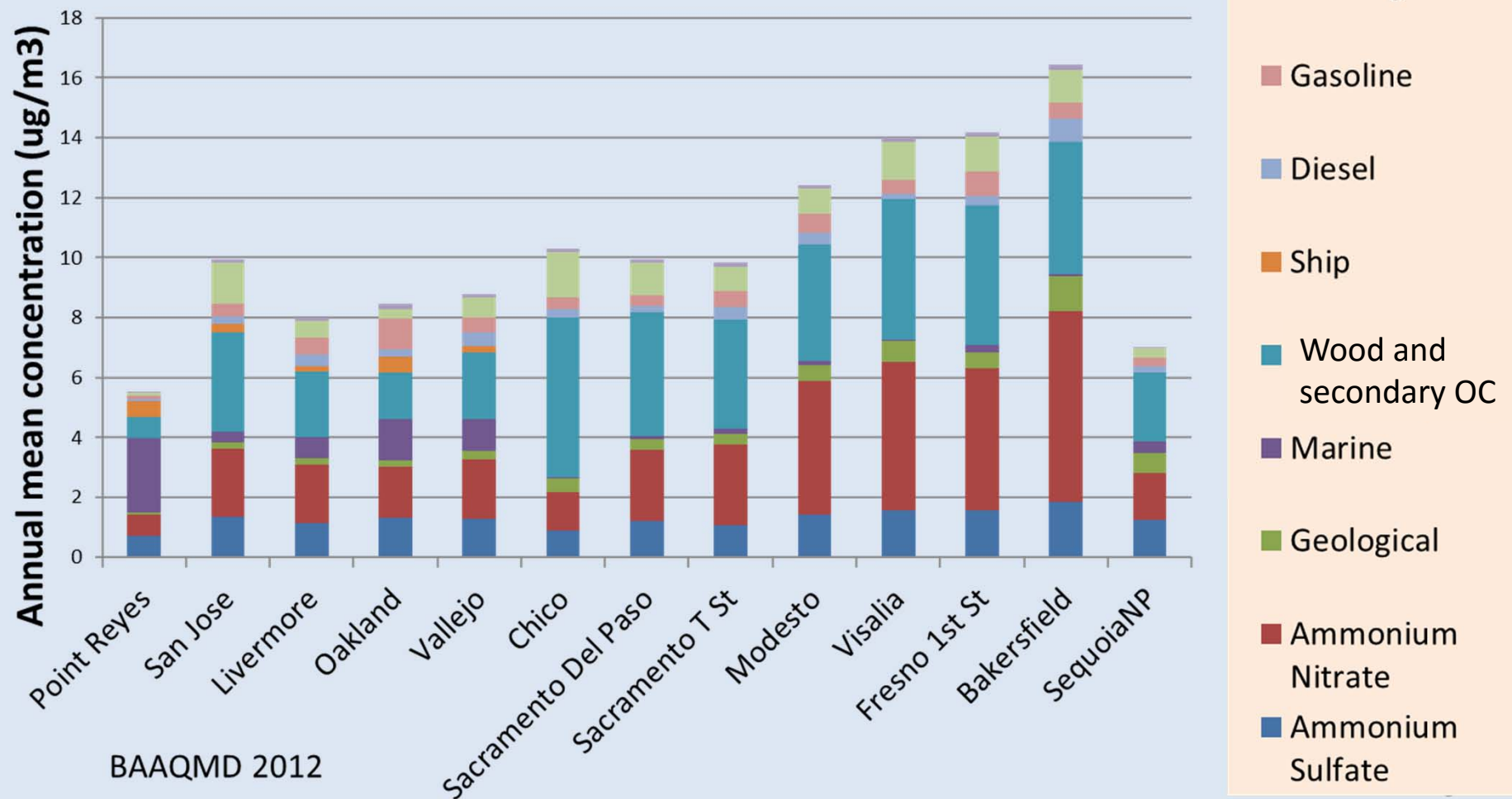
$$C_i = \sum_{j=1}^m f_{ij} S_j$$



C_i : ambient concentration of species i
 f_{ij} : fraction of species i from source j
 S_j : contribution of source j

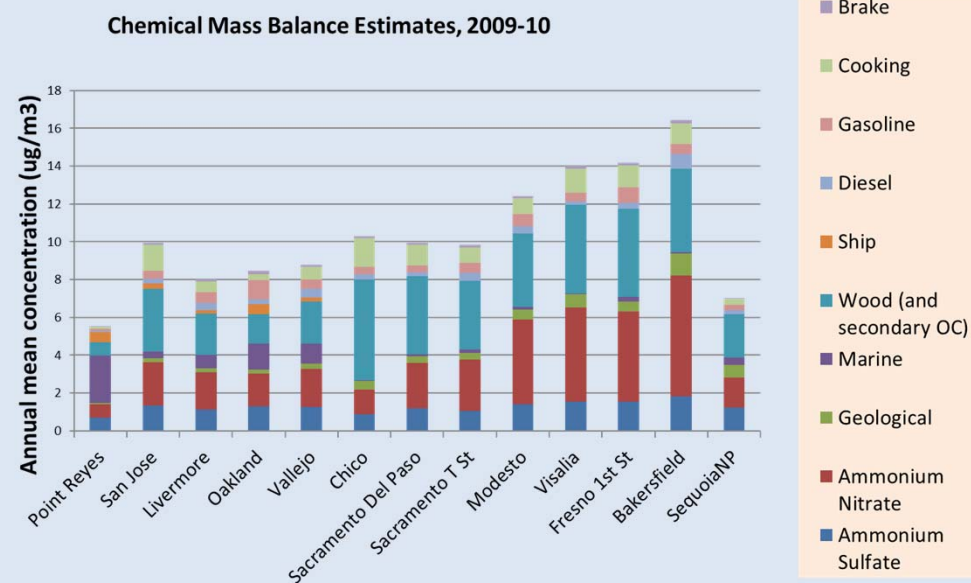
PM_{2.5} Source Apportionment: Bay Area and Central Valley

Chemical Mass Balance Estimates, 2009-10



Bay Area Source Apportionment Shifts during PM_{2.5} High Periods

- More wood burning (winter)
- Stagnant winds
- Transport from the east



Wood
burning



Secondary
PM



Vehicles



Cooking

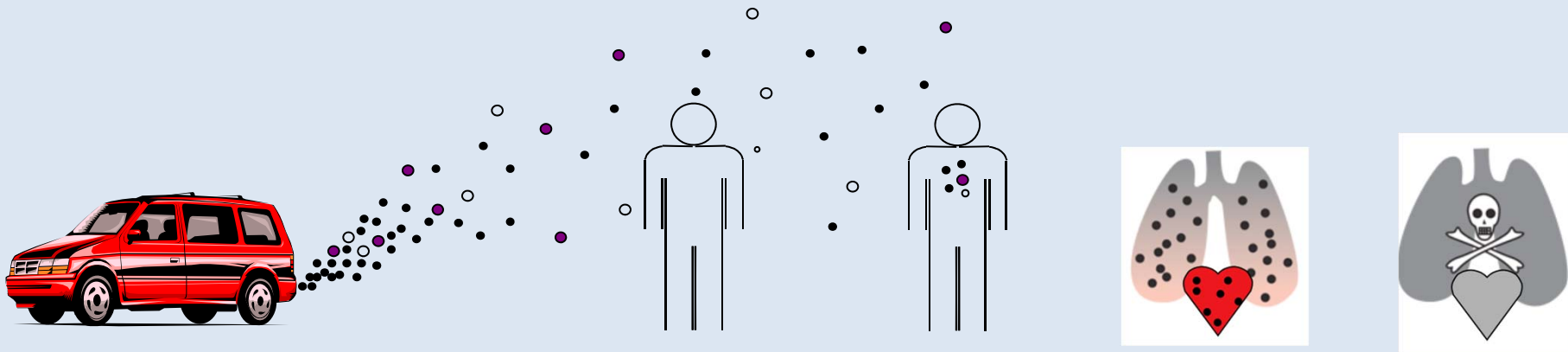


Marine



Geological

For Community-Scale Source Apportionment: Intake Fraction (IF)



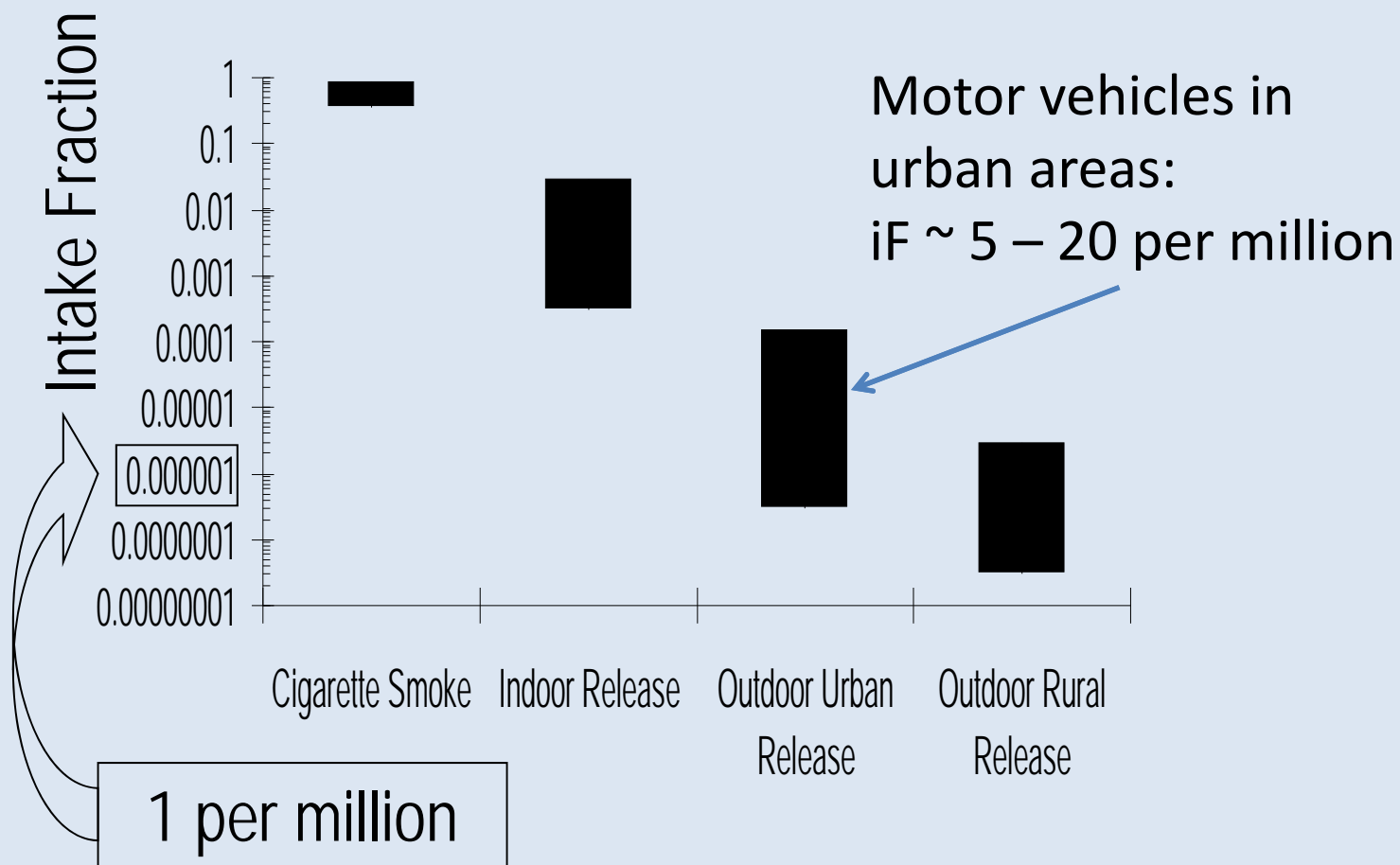
emissions → concentration → exposure → intake → dose → health effects

emissions → intake

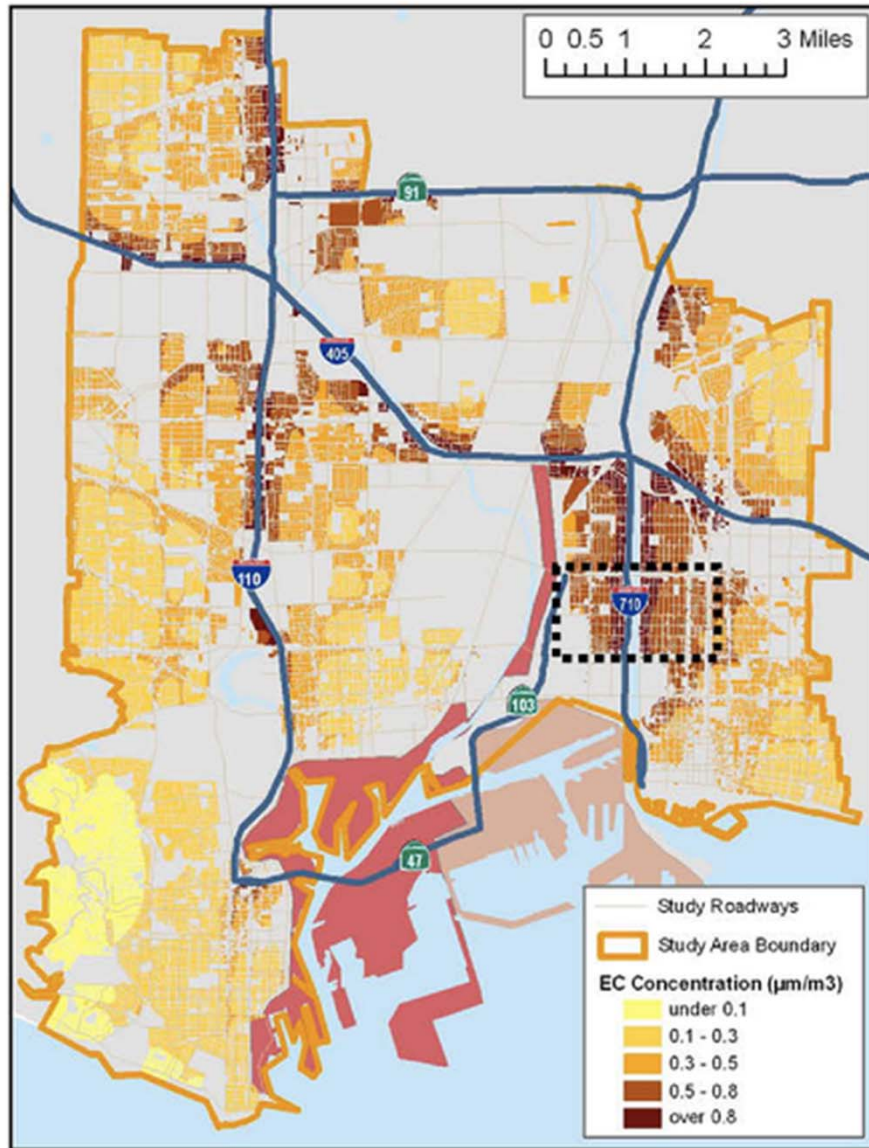
$$\text{intake fraction} = \frac{\text{intake rate}}{\text{emissions rate}}$$

health impact ~ emissions × intake fraction × toxicity

Intake Fraction: Determinants and Typical Values

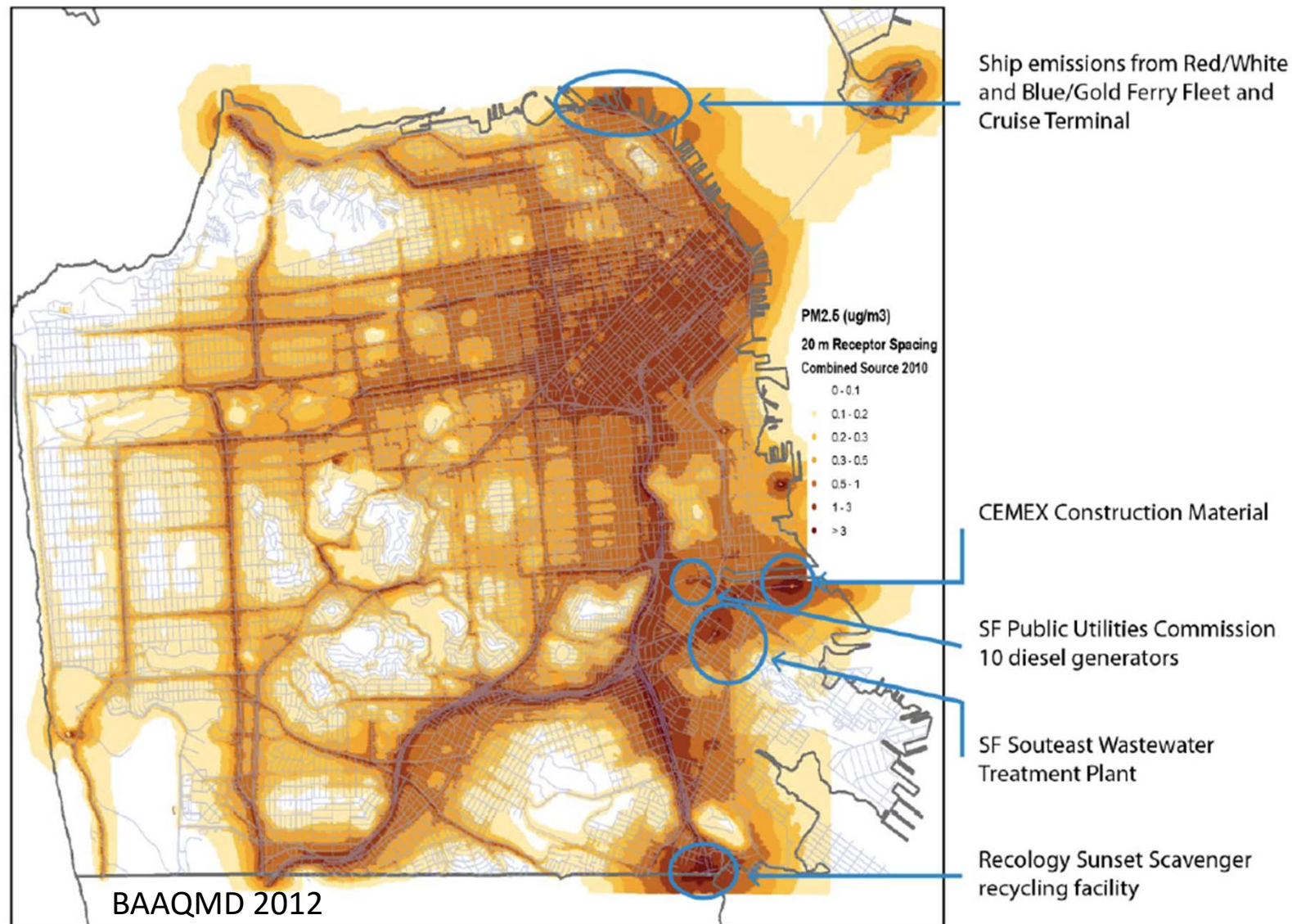


Ports of LA/Long Beach Modeled Exposures

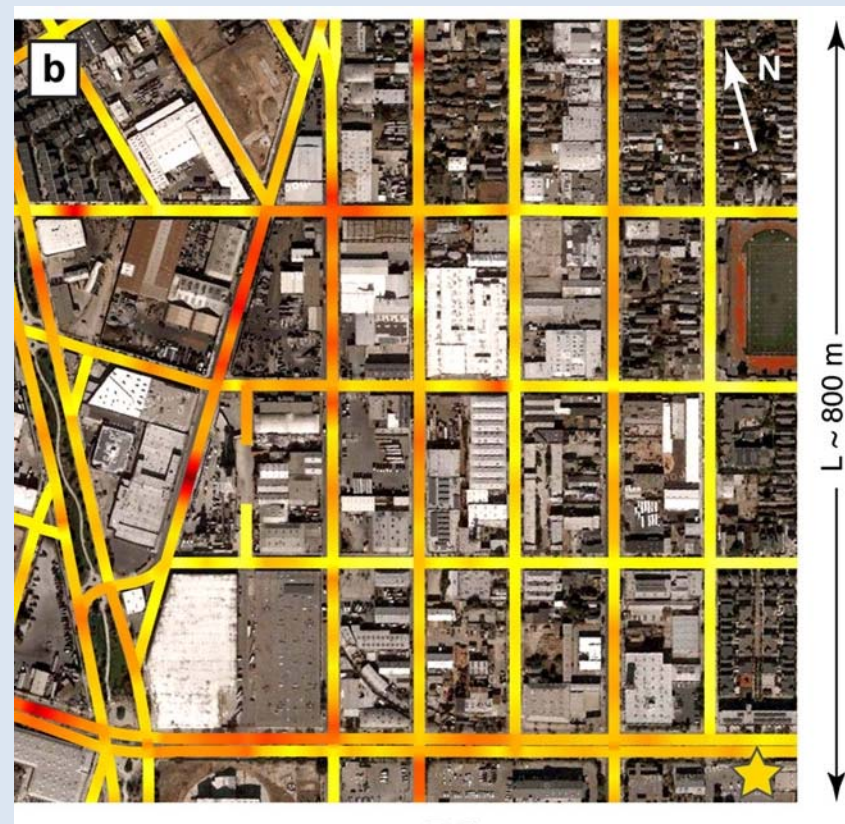
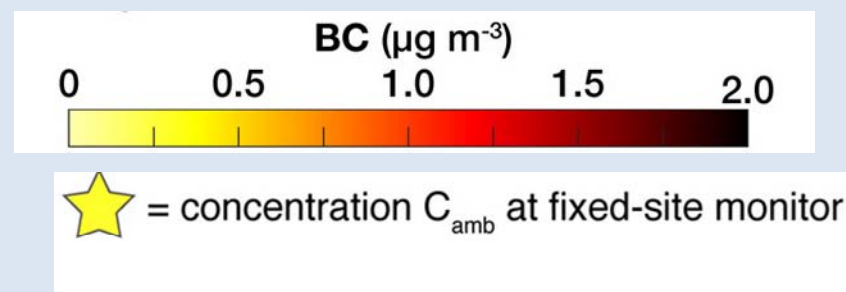
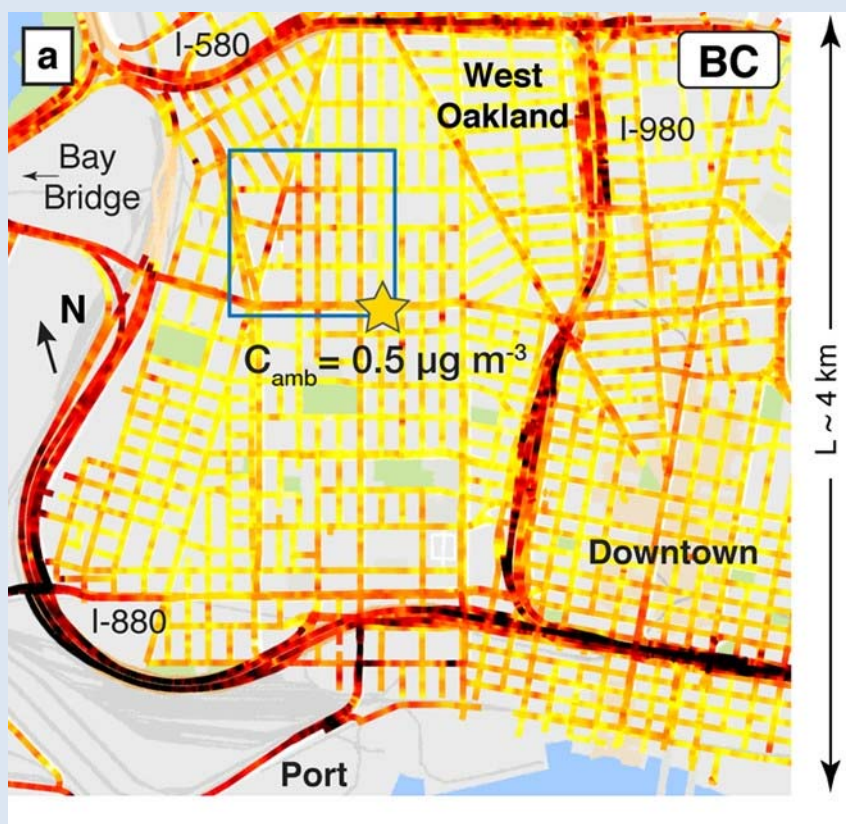


- Exposures of $\text{PM}_{2.5}$ and EC at a neighborhood scale
- Gasoline & diesel vehicles on freeways & surface streets
- Light-duty vehicles contributed more exposure to $\text{PM}_{2.5}$ exposure than heavy-duty trucks (61% vs. 39%), but slightly less EC (49% vs. 51%)
- Intake fraction on surface streets = 1.4 x intake fraction on freeways → benefit of moving trucks off streets

Modeled PM_{2.5} Contribution from Multiple Sources in San Francisco



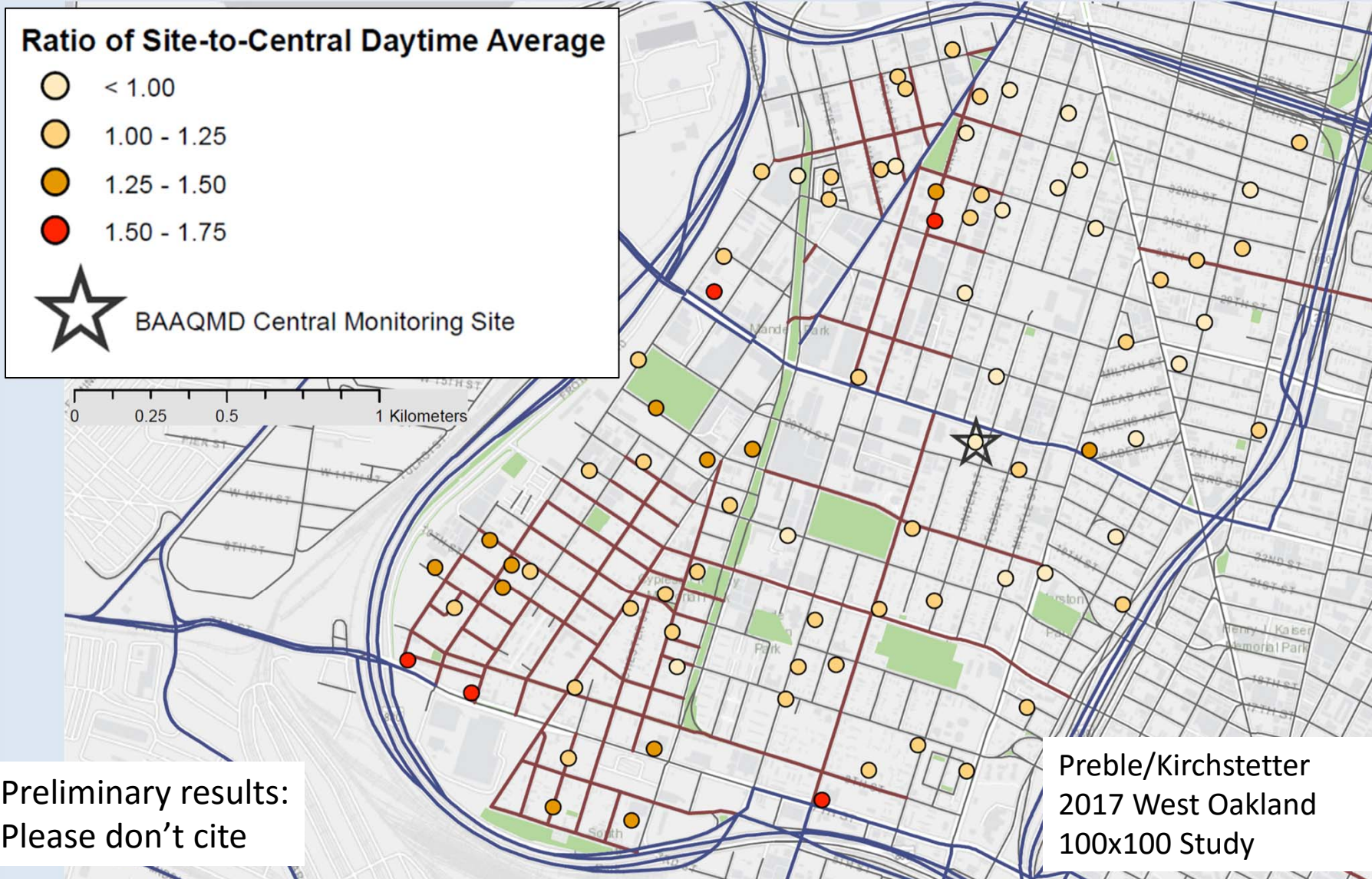
West Oakland Google Car Monitoring Study



BC	
Highways	1.10 ± 0.05
Arterials	0.52 ± 0.01
Residential	0.41 ± 0.01

West Oakland 100 x 100 BC Study

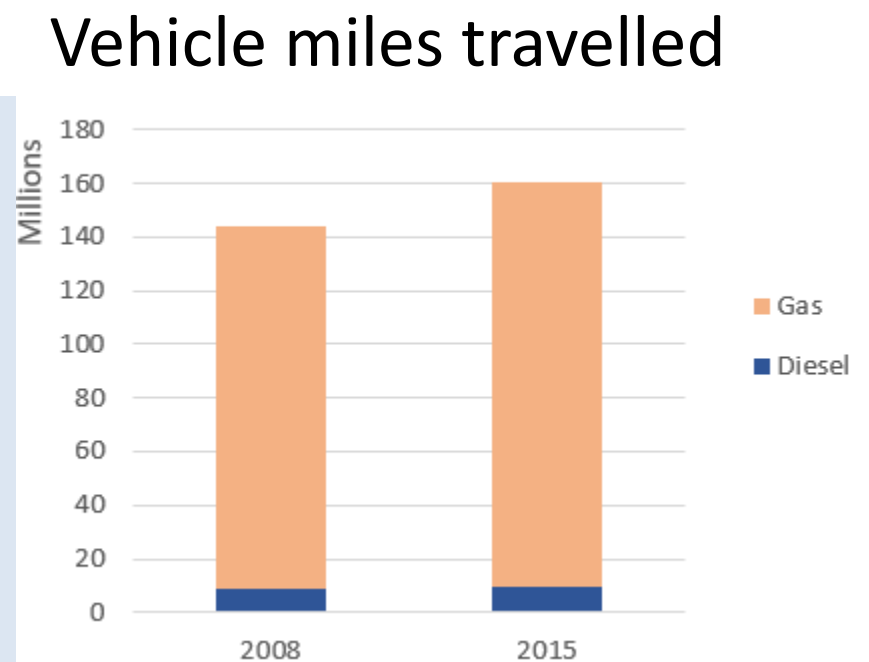
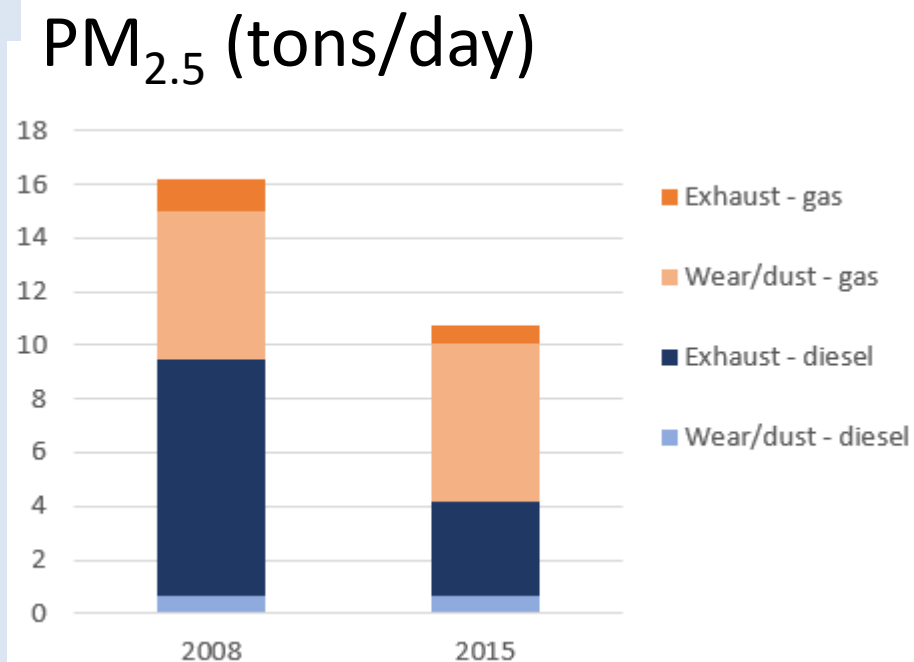
$\frac{3}{4}$ of community sites are more polluted than central site,
daytime average BC up to 1.75x higher



Preliminary results:
Please don't cite

PM_{2.5} Emissions Apportionment: On-Road Vehicles

- Gas vs. diesel powered vehicles
- Exhaust emissions vs. brake wear, tire wear & road dust

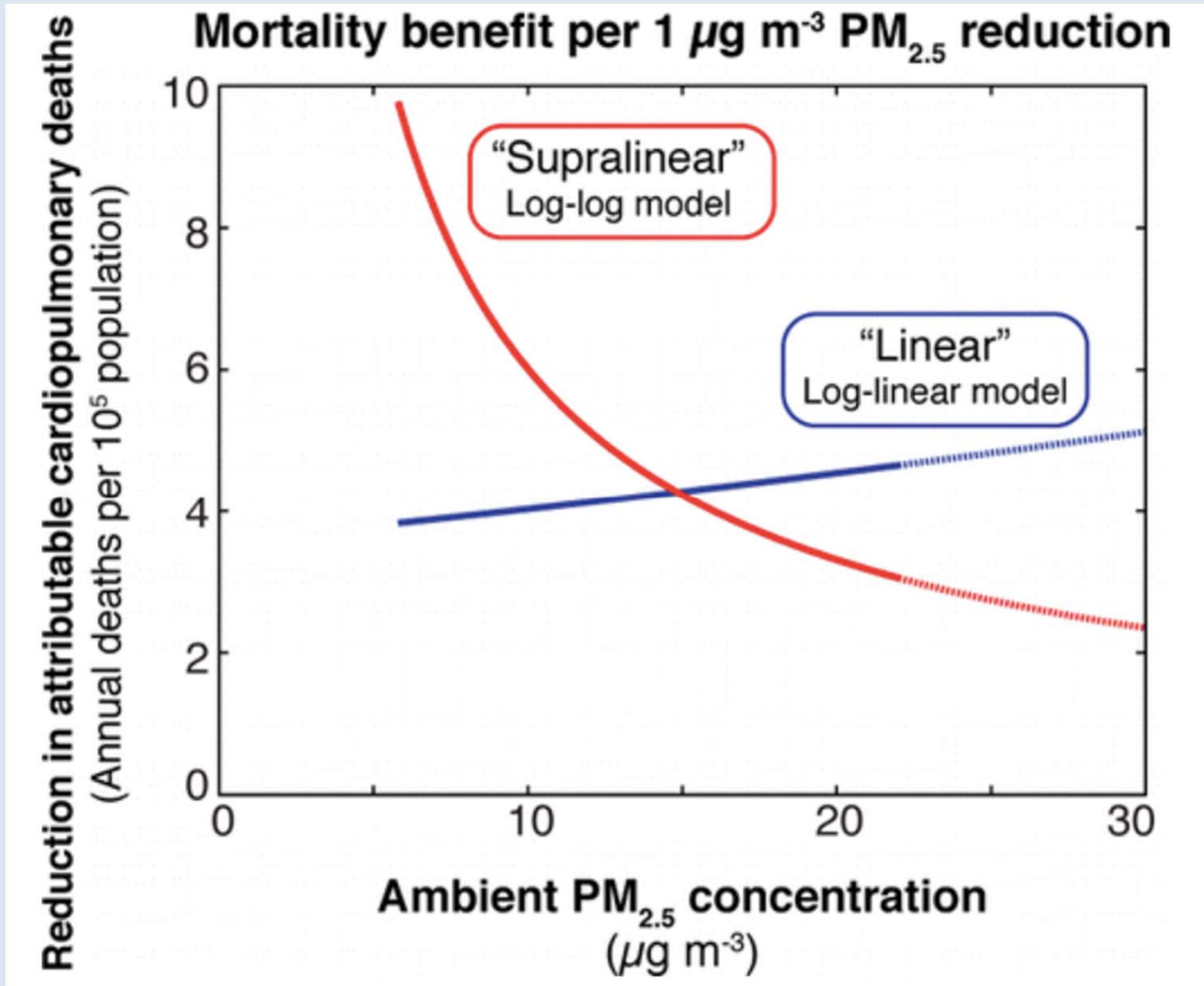


Based on EMFAC2017. Note: ARB research proposal 17RD016, “Brake and Tire Wear Emissions,” will explore uncertain wear estimates

Apportionment to Action: Diesel PM Reductions

- In the heavily trafficked areas and near-Port communities studied so far—for example in West Oakland—continued diesel PM reductions are a clear next step
- These are areas with
 - Existing poor health outcomes
 - Where we expect diesel PM reductions to have important health benefits
 - Where we have developed ideas on specific emission reduction measures
- In other areas, the pollutants of concern and the types of actions are more extensive
- In all areas, diesel PM reductions will be beneficial

Greater Health Benefits, per $\text{PM}_{2.5}$ Increment, Below the NAAQS?



Marshall et al ES&T 2015

Methods Needed for PM Health Risk Assessment

- When we identify a persistent PM_{2.5} “hotspot” (~0.5 - 1.5 µg/m³) or BC or EC hotspot, what can we infer about health impacts?
- Above or below air quality standards?
- Some community-scale studies have focused on ultrafine PM instead of, or in addition to, PM_{2.5}.
- If we are seeking new assessment methods, is PM_{2.5} the optimal focus?

Summary

- Regional source apportionment (SA) of PM_{2.5} has a clear purpose: inform actions to attain or maintain air quality standards. We learn how to reduce the most typical sources
- Community-scale SA of PM_{2.5} will give us data to identify and quantify important sources within a specific community
- Community-scale SA of PM_{2.5} might provide more actionable results if methods for health risk assessment were developed
 - ✓ Actions to reduce diesel PM have clear benefits
- Other areas with a complex mix of sources, such as Richmond, need more investigation
- Community-scale SA has focused on heavily trafficked areas, such as Port corridors, to map PM_{2.5} hot spots



Advisory Council Next Area of Focus: Continuation of Discussions of Particulate Matter

Advisory Council Meeting
March 26, 2017

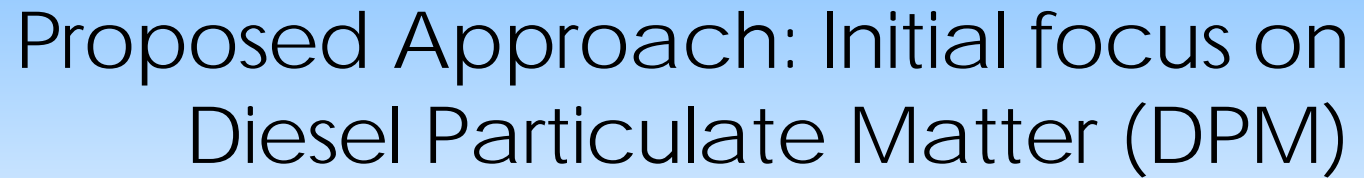
Damian Breen
Deputy Air Pollution Control Officer



Particulate Matter

Overview

- Proposed Approach: Initial focus on Diesel Particulate Matter
- Bay Area Sources of Diesel Particulate Matter (DPM)
- Current Efforts to Reduce DPM
- Trends in Light and Heavy Duty Vehicle Deployment
- Trends in Stationary Sources
- Commitments on DPM
- Proposed Strategy – DPM
- Proposed Strategy - Particulate Matter



- DPM significant driver of health risk in many Bay Area communities





Sources and Impacts of DPM

Figure 2-9. Cancer-Risk Weighted Emission Estimates by TAC, 2015

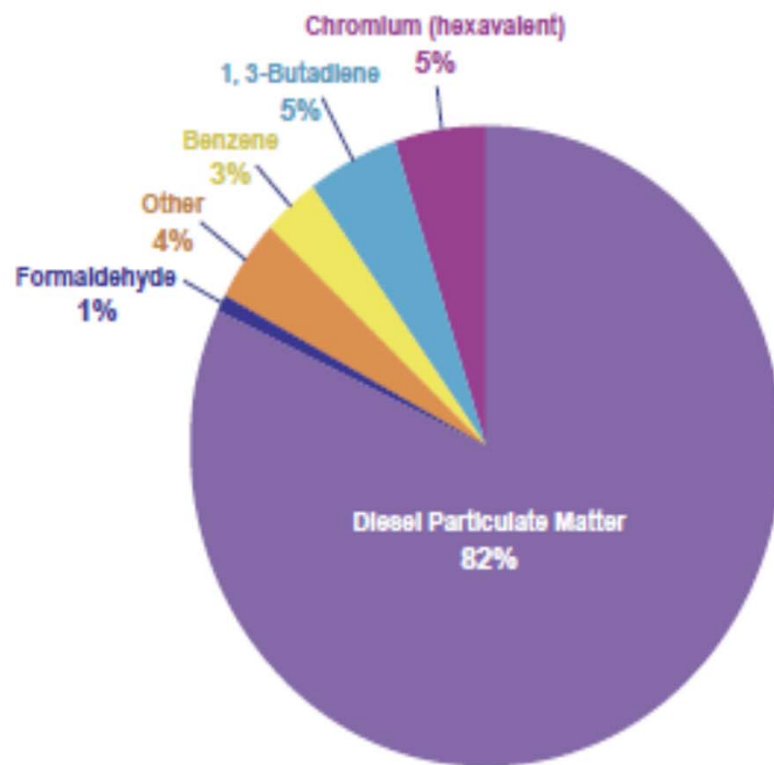
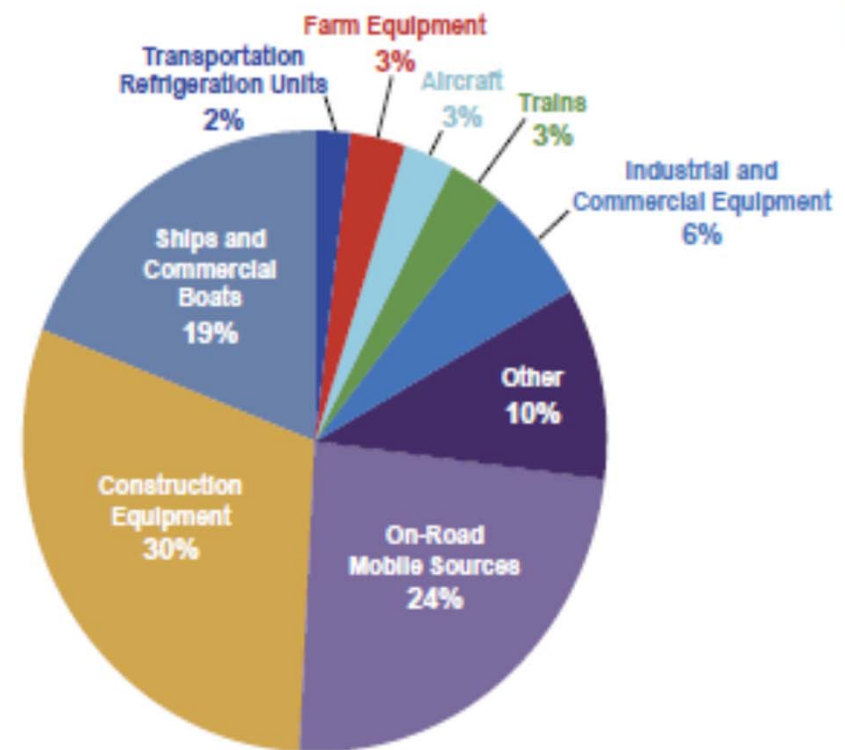


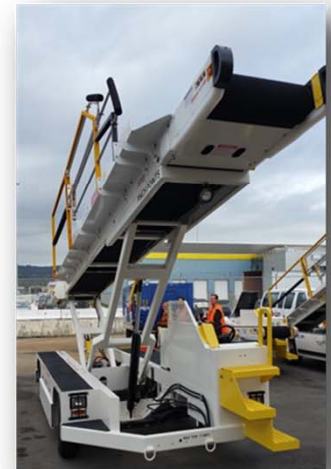
Figure 2-10. Cancer-Risk Weighted TAC Emissions by Emission Source Category, 2015





Current Efforts to Reduce DPM

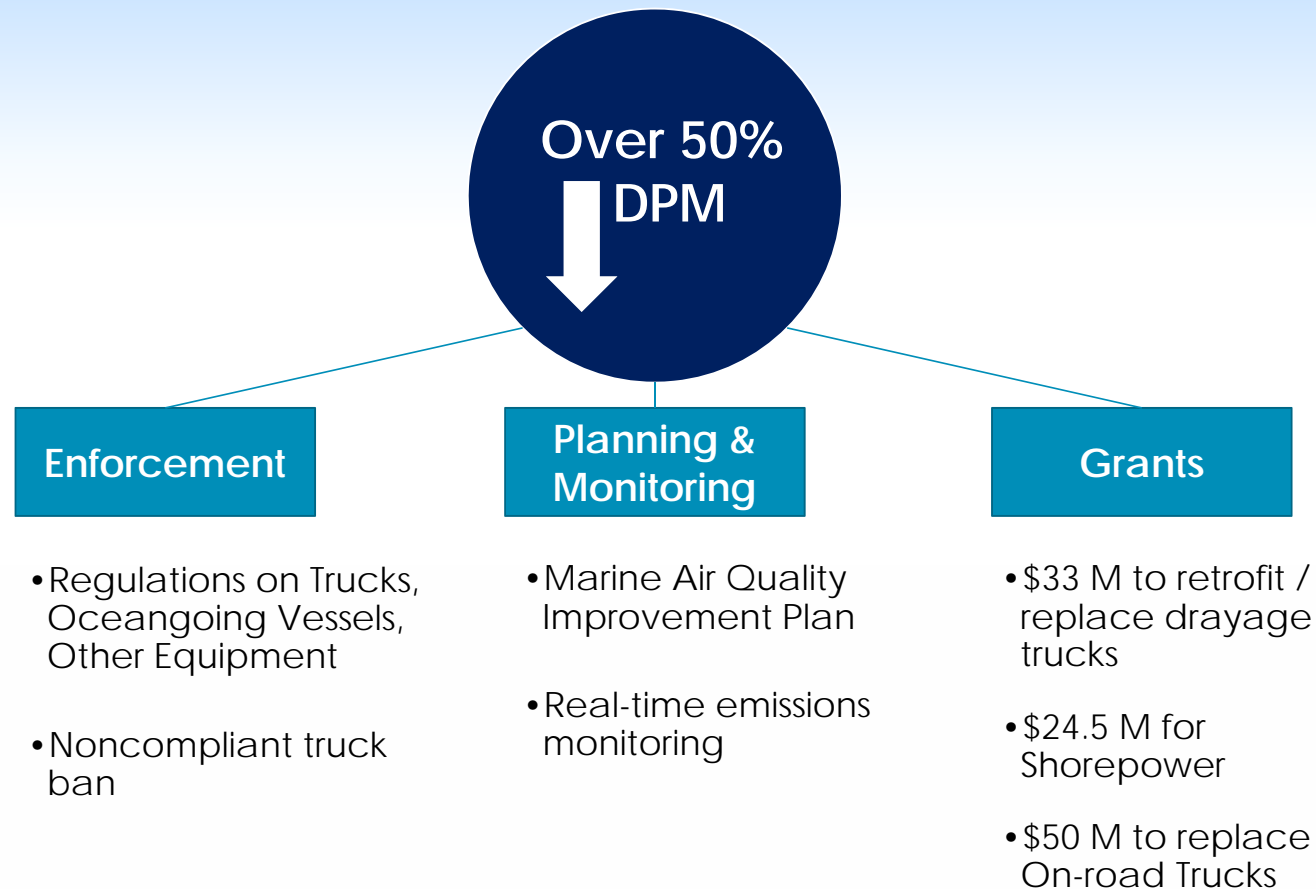
- ARB/Federal Regulations
- Air District Incentives
- City & County Plans





Case Study

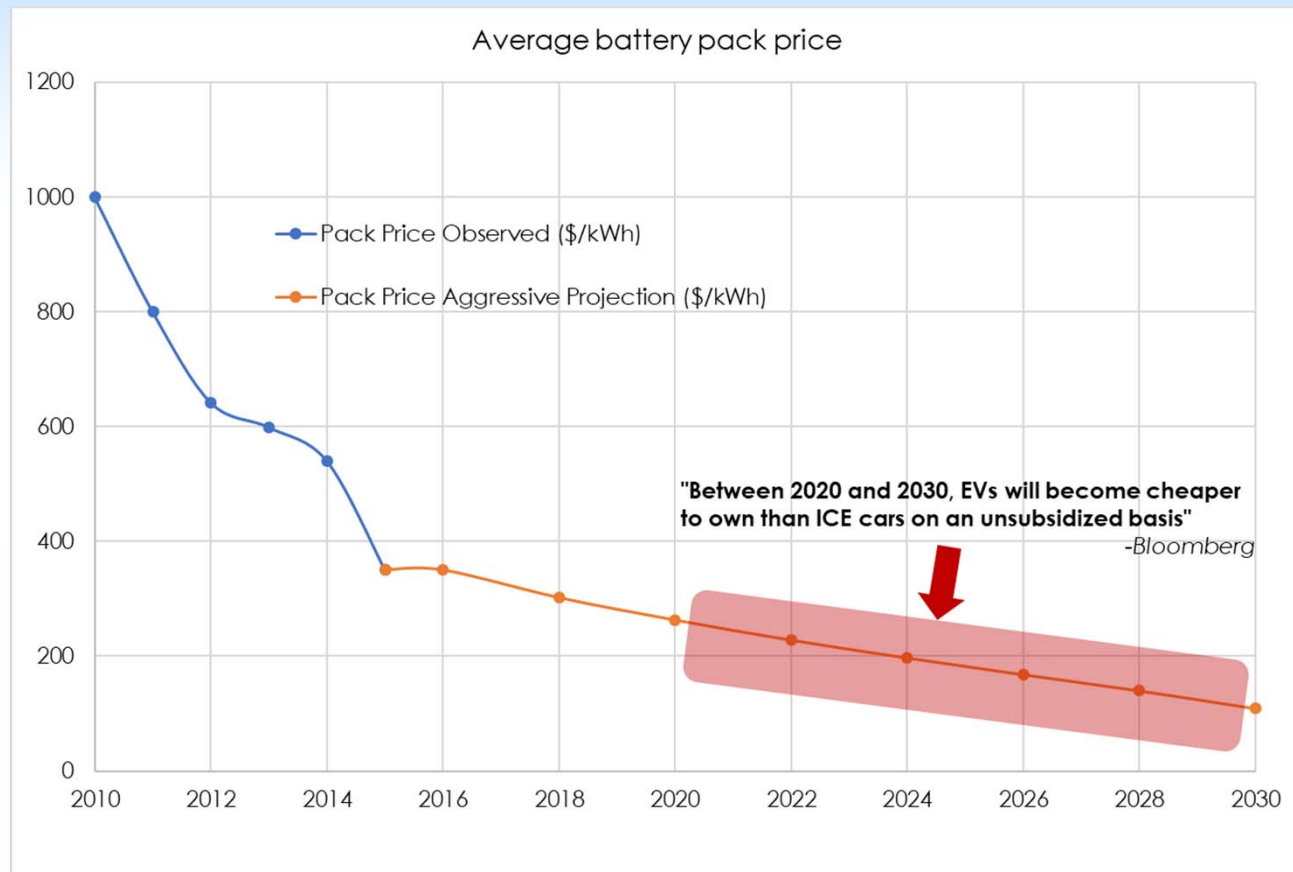
Port of Oakland: 2008-2017





Trends in Light and Heavy Duty Vehicle Deployment

"Cost-effectiveness schedule" for Batteries





Trends in Stationary and Off-Road Sources

- Stationary Sources – Diesel Generators
 - Demo and limited deployment projects – Battery and Hydrogen generators
 - *Staff assessment* – products in pre-commercial/early commercial phase, costs are high relative to ICE
- Off-Road Sources
 - Electrification in many areas – Cargo handling and ground support equipment
 - Construction/Agricultural equipment – beginnings of hybridization
 - TRU – commercial zero and hybrid solutions available
 - Shipping/Vessels – extremely limited hybridization and Hydrogen propulsion
 - Locomotives – beginnings of hybridization – limited range batteries
 - *Staff assessment* – products in various commercial phases but not for every category



Trends in Light and Heavy Duty Vehicle Deployment

Air District Investment in Zero Emissions Technology

2011-2017: \$66 Million



**Plug-in
Electric
Vehicles**

\$12 M

1600 LDV
200 HDV
99 SAVs



**Charging
Infrastructure**

\$11 M

1600 Level 2
100 DC Fast
1400 home
Level 2



Shore Power

\$21 M

14 Berths
at
Port Of Oakland



**Off-Road
Equipment**

\$2.5 M

81 GSE Units at
SFO
121 Commercial
Lawn & Garden



Rail/ Caltrain

\$20 M

Caltrain
Electrification
by 2022



Commitments on DPM

- Ports of Los Angeles
 - Zero-emission on-road drayage fleet by 2035
 - Zero-emissions terminal equipment by 2030
- ARB Regulation
 - Zero-Emissions Cargo-handling equipment 2031
 - Truck – drayage, class 4-6 trucks
 - Buses – school and transit buses





Commitments on DPM to reduce petroleum/diesel

Legend:

Country/regional, ban sales of gasoline/diesel vehicles

- By 2025
- By 2030
- By 2040
- TBD

Country/regional, all zero emission vehicles

- By 2050

State, reduce petroleum consumption by 50%

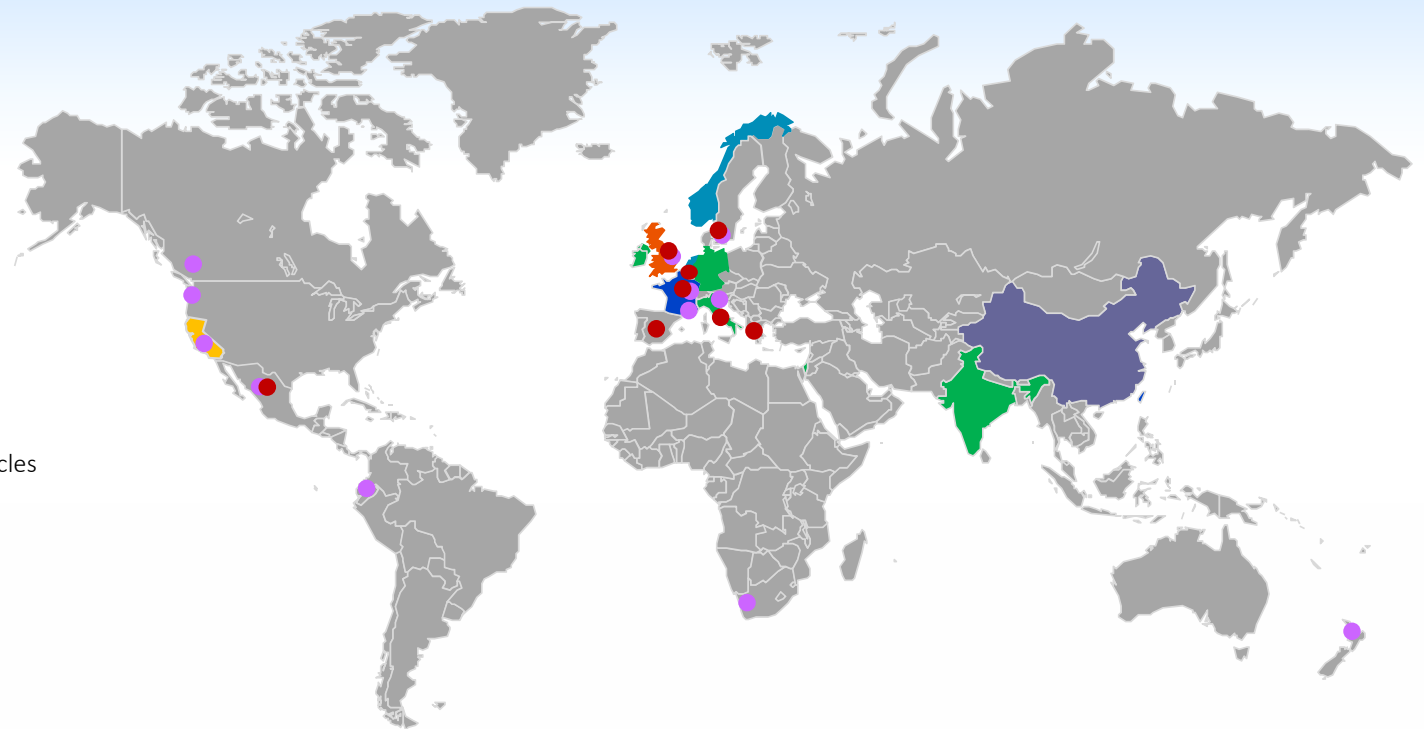
- By 2030

City, diesel vehicle ban

- 2018-2025

C40 cities with pledges for zero emissions

- By 2030





Proposed Strategy – DPM

- Investigate trends and technology further
- Explore local authorities and voluntary commitments
- Explore Air District Authority
- Refine Targeting of Air District Incentives
- Report back to Advisory Council at next meeting
- Seek input on proposed approach by end of summer 2018



Proposed Strategy – Particulate Matter

- March – Sept 2018 - Focus initially on DPM
- Sept 2018 – Dec 2019 - Continue work on Health Effects:
 - Differentiated PM
 - Undifferentiated PM
 - Ultra-fine PM
- Goals:
 - What should we prioritize?
 - How low is low enough?