BAY AREA AIR QUALITY MANAGEMENT DISTRICT

AGENDA: 3A

Update on the Development of Amendments to Rule 6-5

Stationary Source Committee Meeting
October 1, 2020

David Joe, PE
Assistant Manager
Rule Development

Outline

- Overview and Background
- Draft Amendments
- Other Potential Control Options
- Update on Potential Impacts
- Next Steps

Overview and Background

- Fluidized Catalytic Cracking Units (FCCUs) convert heavy components of crude oil into gasoline and high-octane products
- Large source of particulate matter (PM) emissions
- Four of the five Bay Area refineries operate FCCUs
  - Three FCCUs currently in operation
  - Marathon FCCU has been indefinitely idled, but would be subject to rule and amendments if restarted
- Approximately 40% of overall PM emissions at these refineries

Overview and Background (cont.)

- Rule 6-5 originally adopted in 2015
  - Requirements to reduce ammonia to limit formation of PM
- Assembly Bill (AB) 617
  - Expedited Best Available Retrofit Control Technology (BARCT) Implementation Schedule – Identified potential rule development efforts to evaluate and implement BARCT at FCCUs
  - Community Emission Reduction Plans – Identify and implement additional control measures in AB 617 communities, including Richmond-San Pablo

Overview and Background (cont.)

- Further address PM emissions
- Achieve public health benefits and continue progress towards attainment of ambient air quality standards

Draft Amendments to Rule 6-5

- New and modified limits on particulate matter components
  - Modified requirements for ammonia limit of 10 parts per million (ppm)
  - New limits on sulfur dioxide:
    - 25 ppm on a 365-day rolling average basis
    - 50 ppm on a 7-day rolling average basis
- New limit on total PM_{10} of 0.020 gr/dscf
- Additional monitoring and testing requirements

Other Potential Control Options

More Stringent PM Limits

- Lower levels of total PM_{10} mainly at facilities with wet gas scrubbing
- FCCUs with wet gas scrubbing may achieve total PM_{10} levels of 0.010 gr/dscf or below
- A more stringent total PM_{10} limit (0.010 gr/dscf) would likely require installation of wet gas scrubbing

Potential Impacts – Emissions and Costs (Draft Amendments)

- Preliminary estimates of potential emission reductions and cost impacts for limits in **Draft Amendments (0.020 gr/dscf)**

Facility	PM_{10} Emissions (tpy)	PM_{10} Reductions (tpy)	Capital Costs ($MM)	Total Annualized Costs ($MM)	Cost Effectiveness ($/ton)
Chevron Richmond	245	80	$30	$4.5	$56K/ton
Marathon Martinez*	*190*	*0*	–	–	–
PBF Martinez	309	170	$80	$14	$85K/ton
Valero Benicia	83	0	–	–	–

** Facility has been indefinitely idled*

Potential Impacts – Emissions and Costs (More Stringent Option)

Preliminary estimates of potential emission reductions and cost impacts for **more stringent control option (0.010 gr/dscf)**

Facility	PM_{10} Emissions (tpy)	PM_{10} Reductions (tpy)	Capital Costs ($MM)	Total Annualized Costs ($MM)	Cost Effectiveness ($/ton)	Incremental Cost Effectiveness ($/ton)
Chevron Richmond	245	160	$182	$31	$194K/ton	$331K/ton
Marathon Martinez*	*190*	*93*	*$179*	*$31*	*$330K/ton*	–
PBF Martinez	309	240	$218	$35	$145K/ton	$293K/ton
Valero Benicia	83	0	–	–	–	–

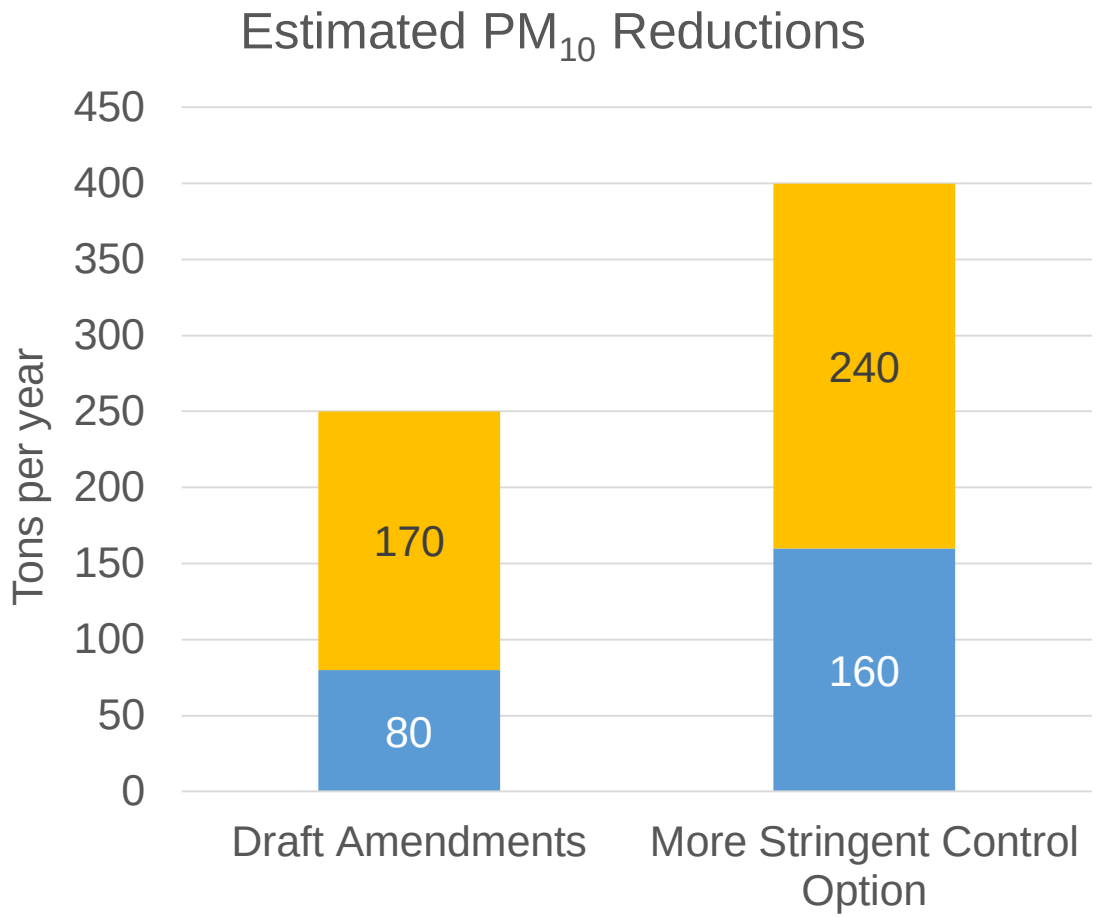
** Facility has been indefinitely idled*

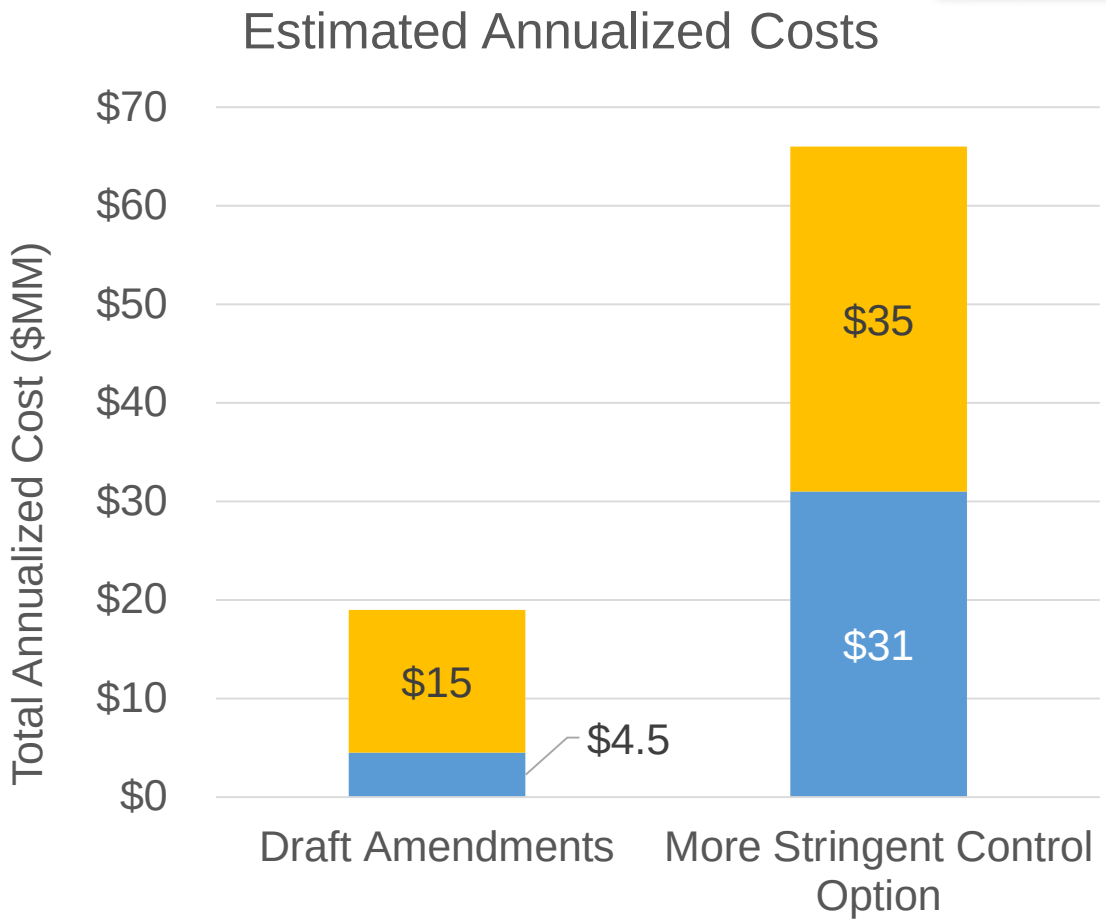
Potential Impacts – Cost Effectiveness

- Historical cost effectiveness for other PM rules

District (Year)	Rule/Amendment	Pollutant	Cost Effectiveness Data (2019 Dollars)
BAAQMD (2018)	Rule 6-1 Amendments – General Requirements	TSP	$2,500/ton - $14,000/ton
BAAQMD (2018)	Rule 6-6 – Prohibition of Trackout	PM_{10}	$4,700/ton
		$PM_{2.5}$	$32,500/ton
SCAQMD (2003)	Rule 1105.1 Amendments – FCCUs	Filterable PM	$19,600/ton - $34,800/ton
		Filterable and Condensable PM	$4,500/ton - $7,600/ton
SCAQMD (1999)	Rule 1158 Amendments – Coke/Coal/Sulfur Handling	PM_{10}	$4,700/ton - $46,700/ton ($15,600/ton overall)

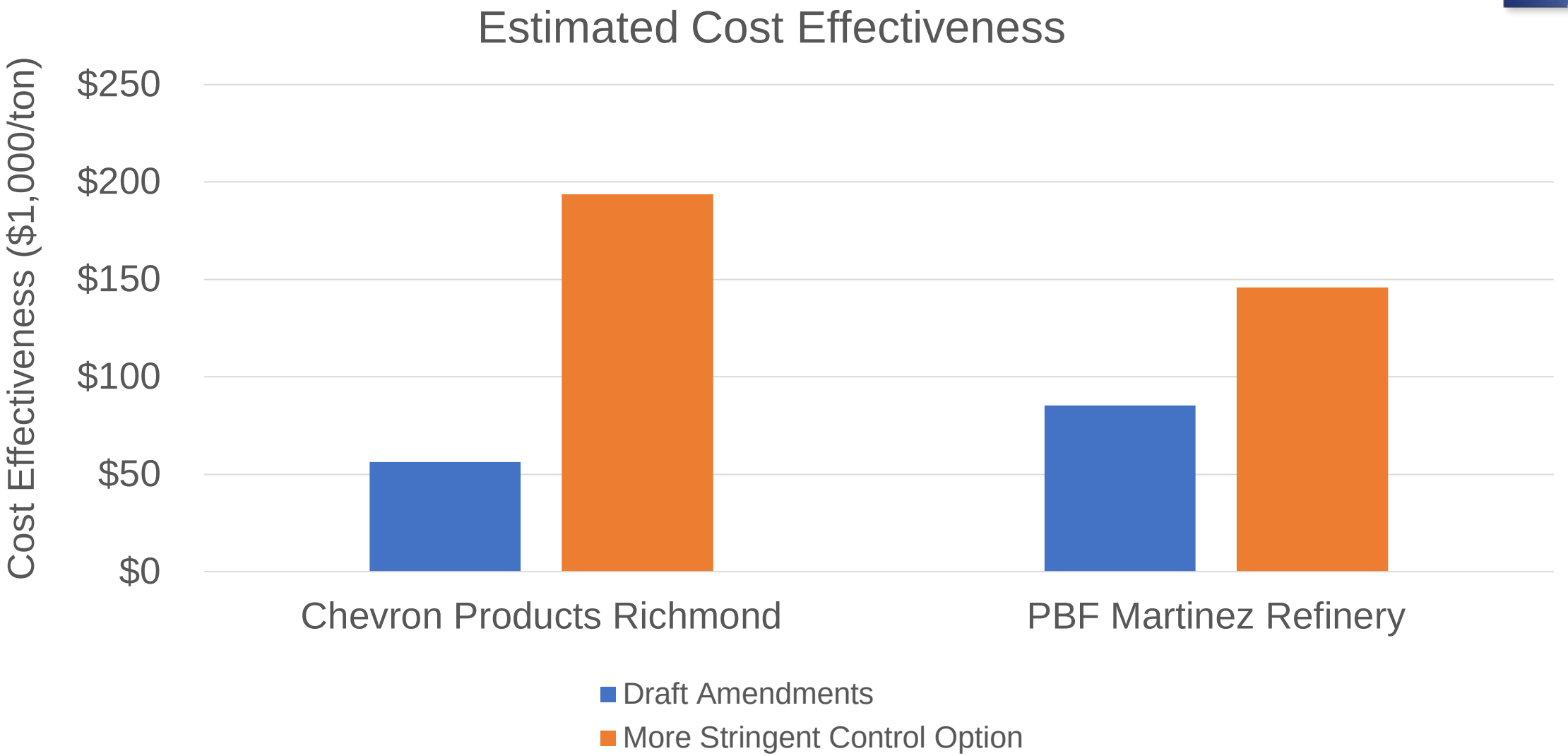
Potential Impacts – Emissions and Costs





PBF Martinez Refinery
Chevron Products Richmond

Potential Impacts – Cost Effectiveness



Potential Impacts – Socioeconomic

- Estimates of compliance costs as a proportion of profits
- Based on most recent financial information for year 2019
  - Does not reflect demand destruction due to current pandemic
  - Future fuel demand may not return to pre-pandemic levels

Facility	Annual Cost as % of Annual Net Profit (Draft Amendments)	Annual Cost as % of Annual Net Profit (More Stringent Control Option)
Chevron Richmond	1.6%	11.0%
Marathon Martinez*	–	*21.2%*
PBF Martinez	7.9%	19.7%
Valero Benicia	–	–

** Facility has been indefinitely idled*

Potential Impacts – Socioeconomic

- Under more stringent control option, refineries would be expected to reduce cost impacts below significant level (10%)
- Several potential adjustments:
  - Reduce labor costs – Equivalent to reducing employment by:
    - 17 jobs at Chevron Richmond
    - 101 jobs at PBF Martinez
    - *96 jobs at Marathon Martinez (facility has been indefinitely idled)*
  - Increase gas prices – Equivalent to approximately $0.01 per gallon increase
- Feasibility of cost/revenue adjustments uncertain
  - Feasibility of operating at reduced staffing
  - Limited ability for individual refineries to unilaterally increase pricing

Potential Impacts – Environmental

- Final Environmental Impact Report (EIR) for the AB 617 Expedited BARCT Implementation Schedule certified by Board of Directors in December 2018
- Identified significant water usage impacts for use of Wet Gas Scrubbing (WGS)
- Staff reviewing if further analysis would be required under California Environmental Quality Act (CEQA) for Rule 6-5 amendments due to new or substantially increased impacts

Potential Impacts – Water Use

- Significant water usage impacts for use of WGS – Approximately 400,000 gallons per day for each system
- Reducing make-up water requirements
  - Pre-scrubber quenching
  - Regenerative systems
  - Increased costs and complexity
- Reducing use of fresh water
  - Water quality-related issues
  - Reclaimed water use and availability
- Water use at Valero Benicia WGS system

Potential Impacts – Hazards

- AB 617 BARCT Schedule EIR identified less than significant hazards impact for controls, including (Electrostatic Precipitators) ESPs
- Standard industry and safety practices
- Chemical Safety Board findings for 2015 ExxonMobil Torrance Refinery ESP Incident
  - No established safe operating limits for FCCU standby mode
  - Insufficient hazard analysis and safeguards for maintenance operation
  - Operation of equipment beyond safe operating life
  - Lack of safety instrumentation to detect flow of flammable hydrocarbons
  - Process equipment opened without conforming to refinery standards

Next Steps

- Additional development and refinement of estimates for emissions, costs, and other impacts
- Continued stakeholder engagement
- Development of regulatory proposal package
- Anticipated consideration by the Air District's Board of Directors in Q4 2020/Q1 2021

AGENDA: 3B

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Fine Particulate Matter ($PM_{2.5}$) Impacts from Two Bay Area Petroleum Refineries

Stationary Source Committee Meeting
October 1, 2020

Phil Martien, PhD
Director
Assessment, Inventory, & Modeling Division

Overview

Computer Modeling Study Underway to Assess Impacts

- Major industrial sources of fine $PM_{2.5}$
- First assessed: Chevron Richmond and PBF Martinez Refineries
- Emission limits in Rule 6-5 proposed amendments

Key Insights

- Most impacted populations
- Relative importance (source apportionment)
- Benefits of proposed emission limits

Modeling Approach

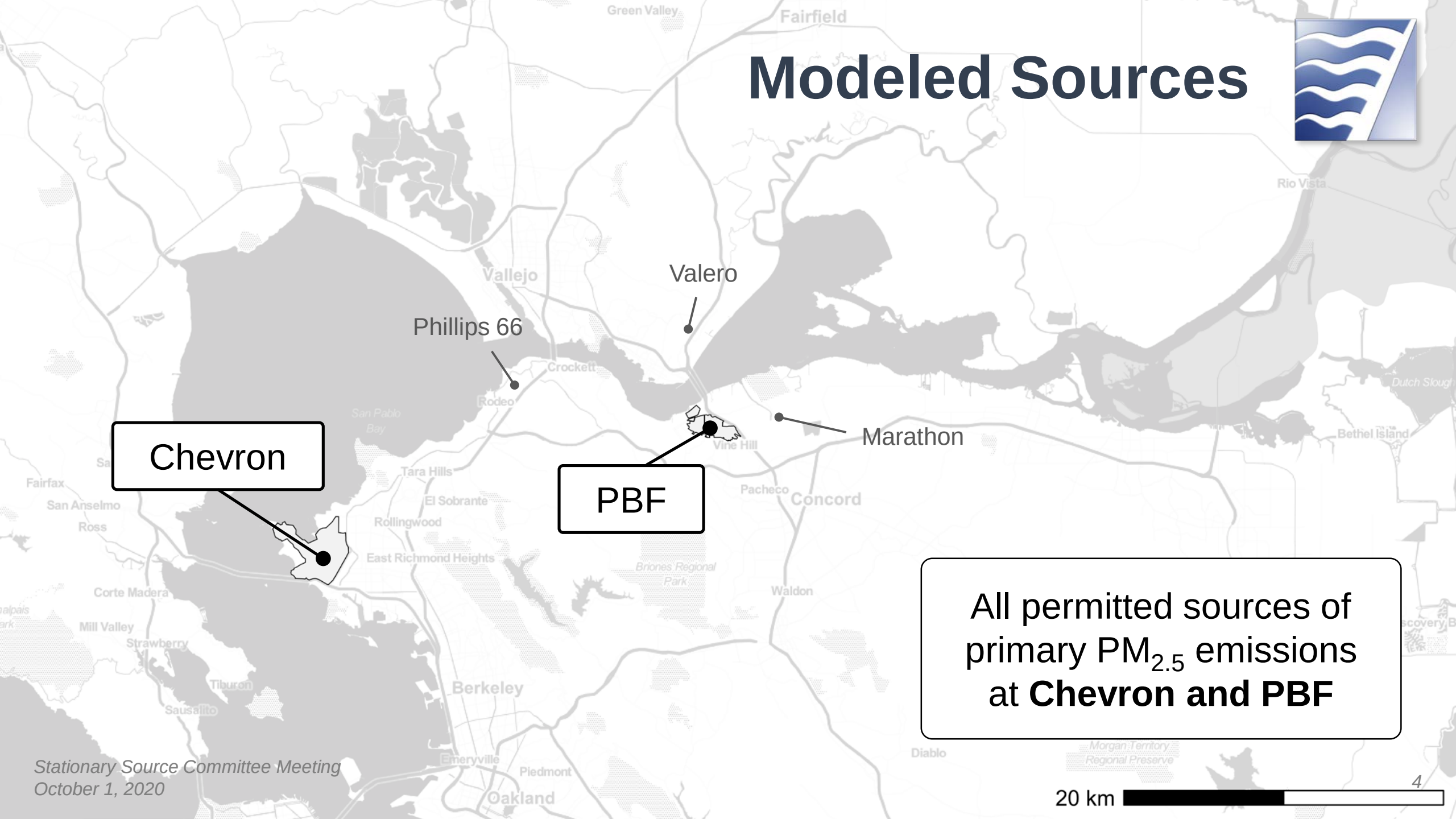
Key Inputs

- Emissions: permitted sources of primary $PM_{2.5}$ at Chevron and PBF (PBF source testing is currently in progress)
- Stack parameters: location, height, stack gas temperature, and velocity

Methods

- Modeled winds and CalPUFF dispersion model (2016 – 2018)
- Overlay with population estimates (2010 Census → 2018 forecast)
- Estimate mortality using EPA BenMAP methods

Modeled Sources



All permitted sources of primary $PM_{2.5}$ emissions at **Chevron and PBF**

Modeled Emissions

Baseline

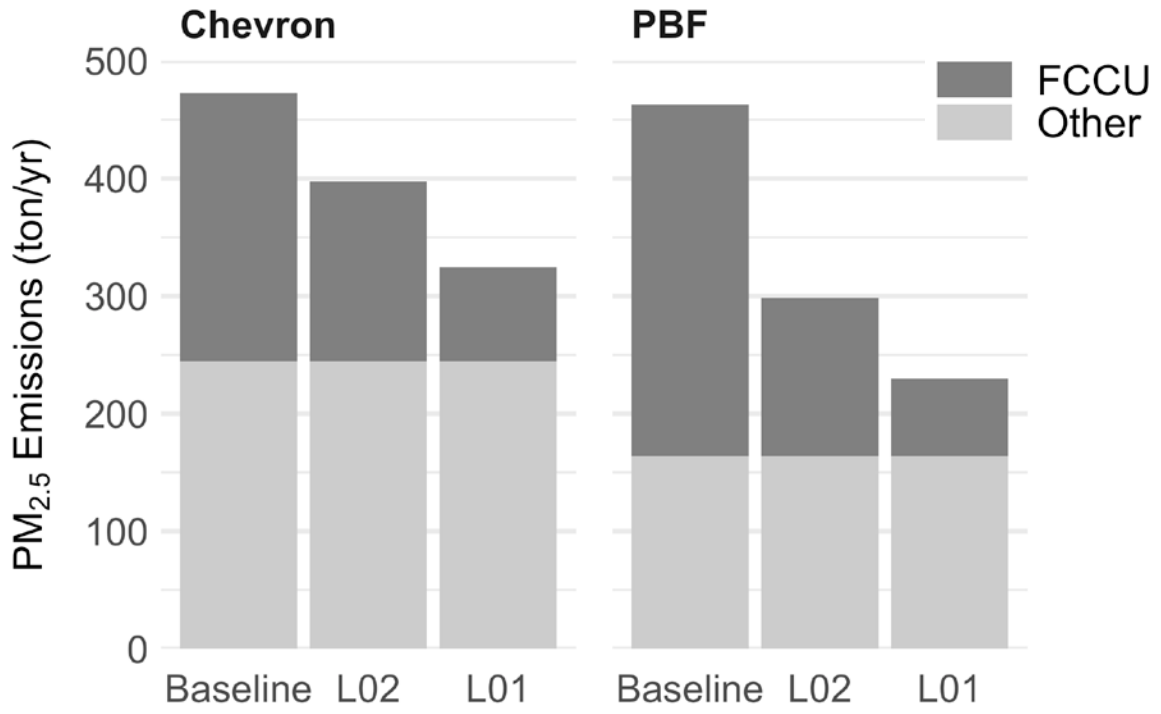
- Current (2018) emissions

Scenario L02

- 0.020 gr/dscf* limit
- FCCU: Chevron -33%; PBF -55%

Scenario L01

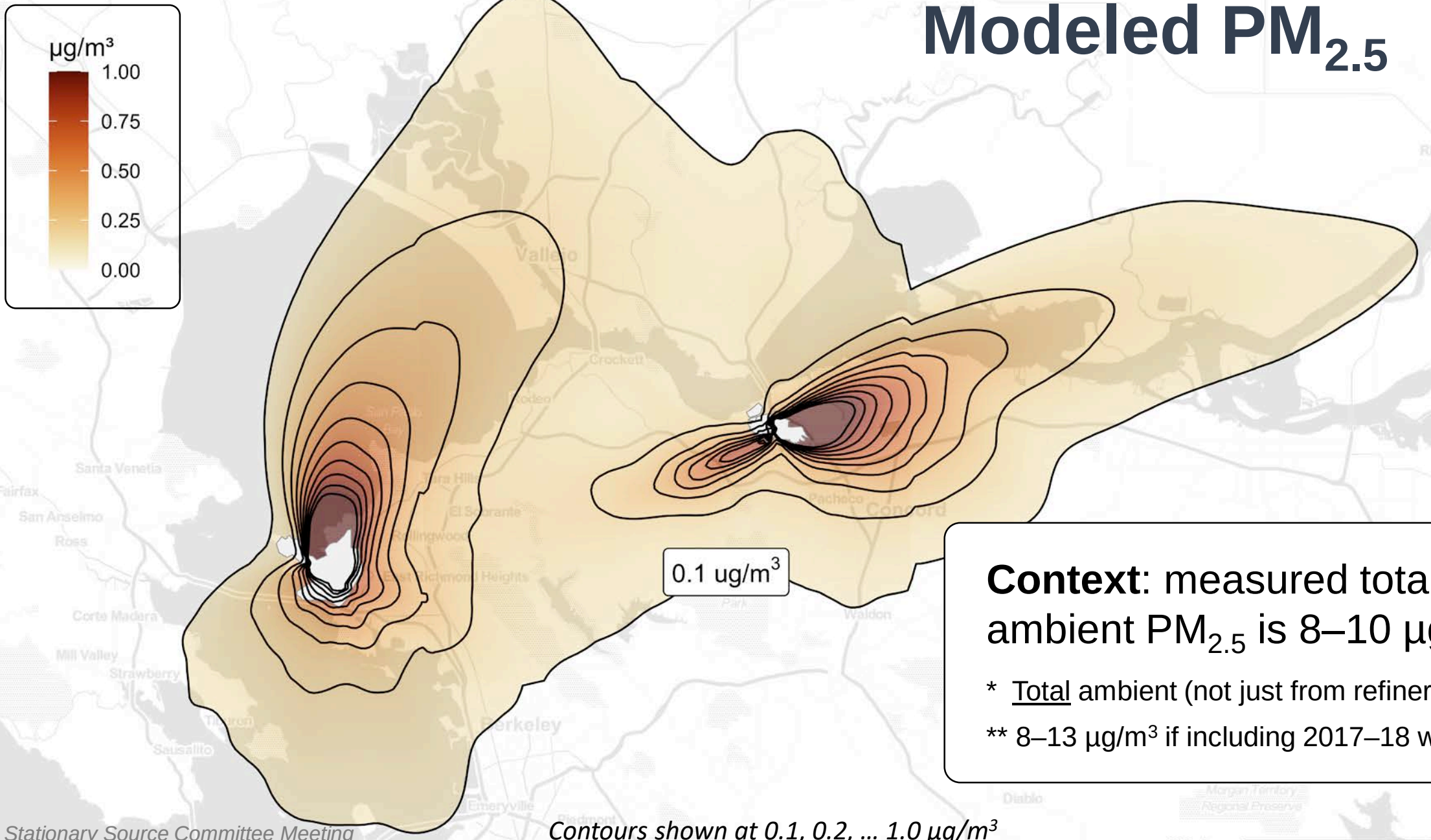
- 0.010 gr/dscf limit
- FCCU: Chevron -65%; PBF -78%
- FCCU stack parameters modified



FCCU impacts shown in dark gray
Bar heights = totals (FCCU + Other)

** gr/dscf = grains per dry standard cubic foot*

Modeled $PM_{2.5}$



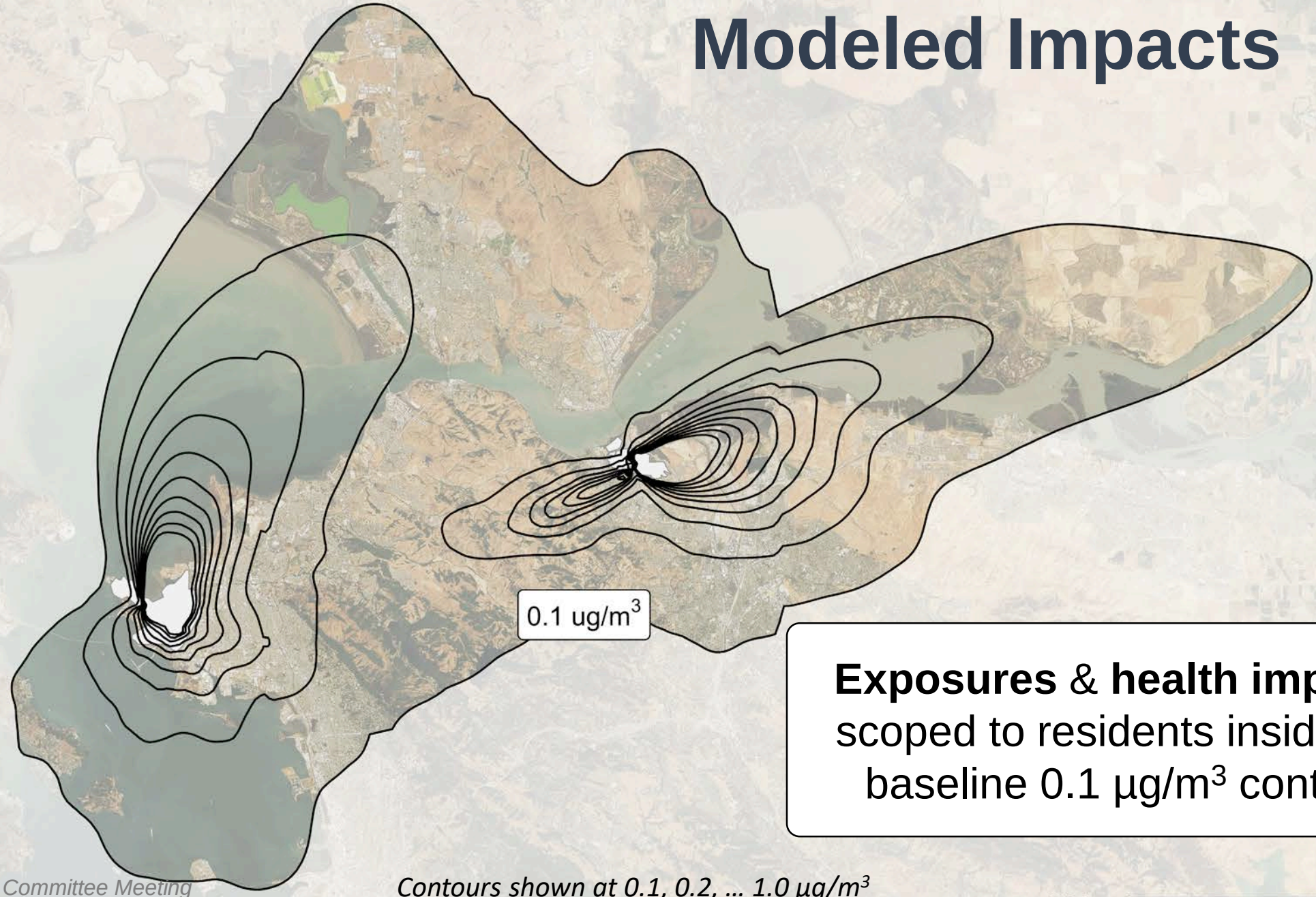
Context: measured total ambient $PM_{2.5}$ is 8–10 µg/m³

* Total ambient (not just from refineries)

** 8–13 µg/m³ if including 2017–18 wildfires

Contours shown at 0.1, 0.2, … 1.0 µg/m³

Modeled Impacts

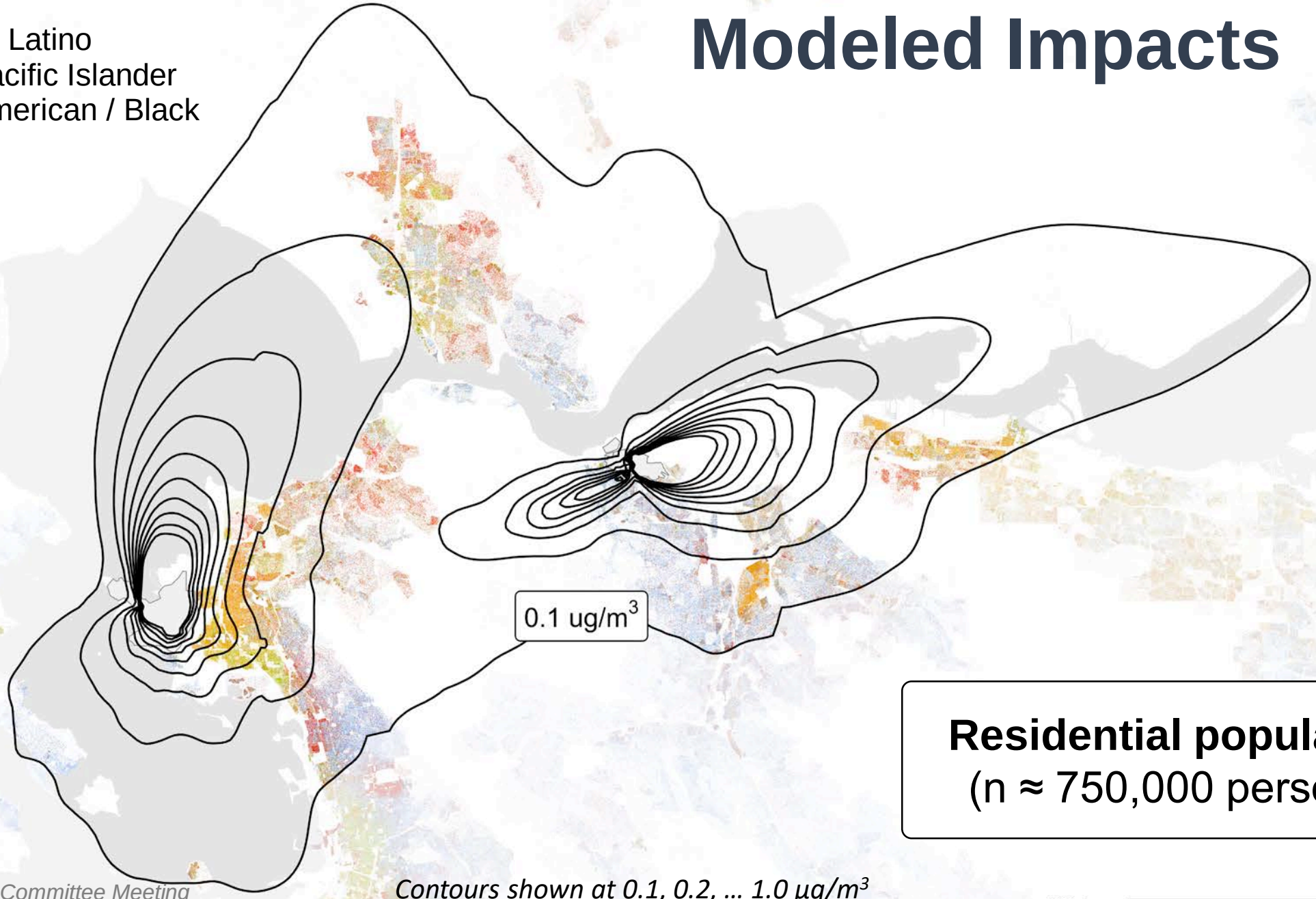


Exposures & **health impacts** scoped to residents inside the baseline 0.1 µg/m³ contour

Contours shown at 0.1, 0.2, … 1.0 µg/m³

Modeled Impacts

- White
- Hispanic / Latino
- Asian / Pacific Islander
- African American / Black
- Other



Residential population
(n ≈ 750,000 persons)

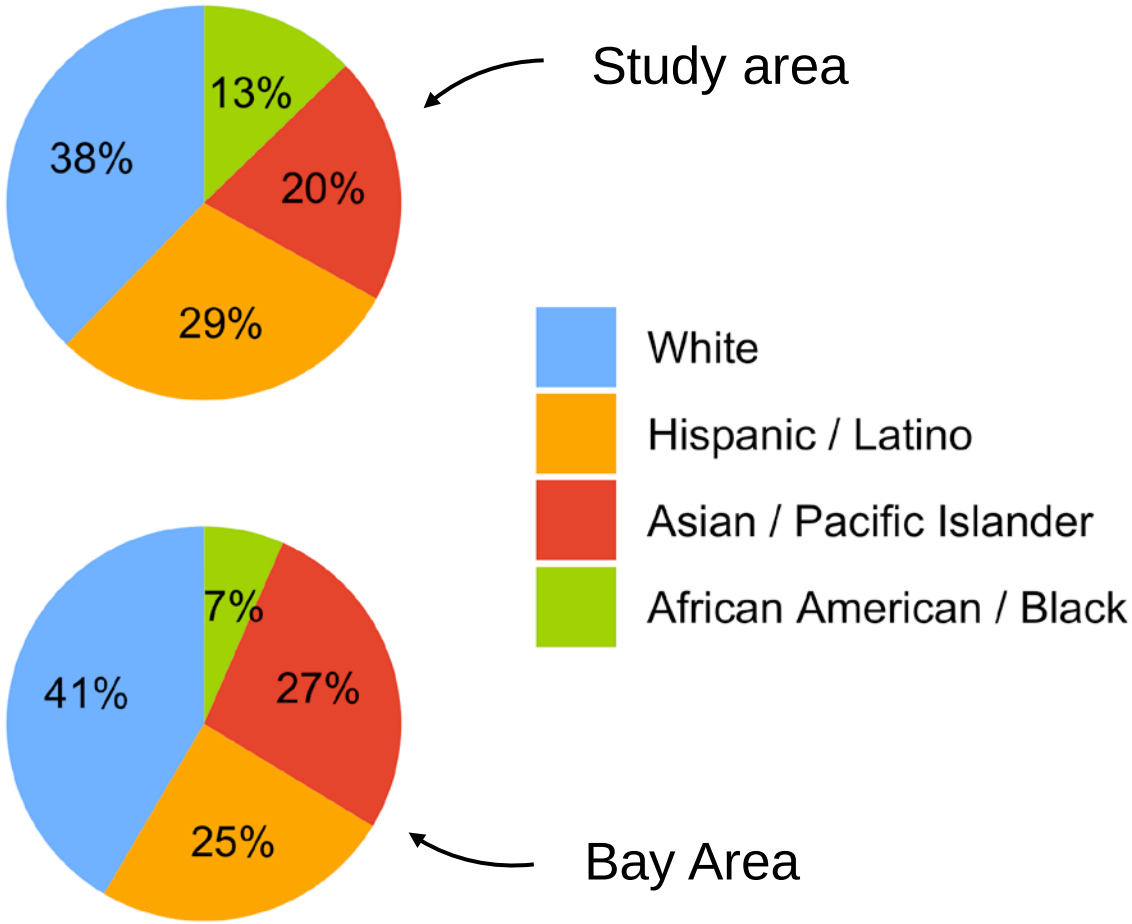
Contours shown at 0.1, 0.2, … 1.0 µg/m³

20 km

Demographics

About 750,000 people reside in the study area

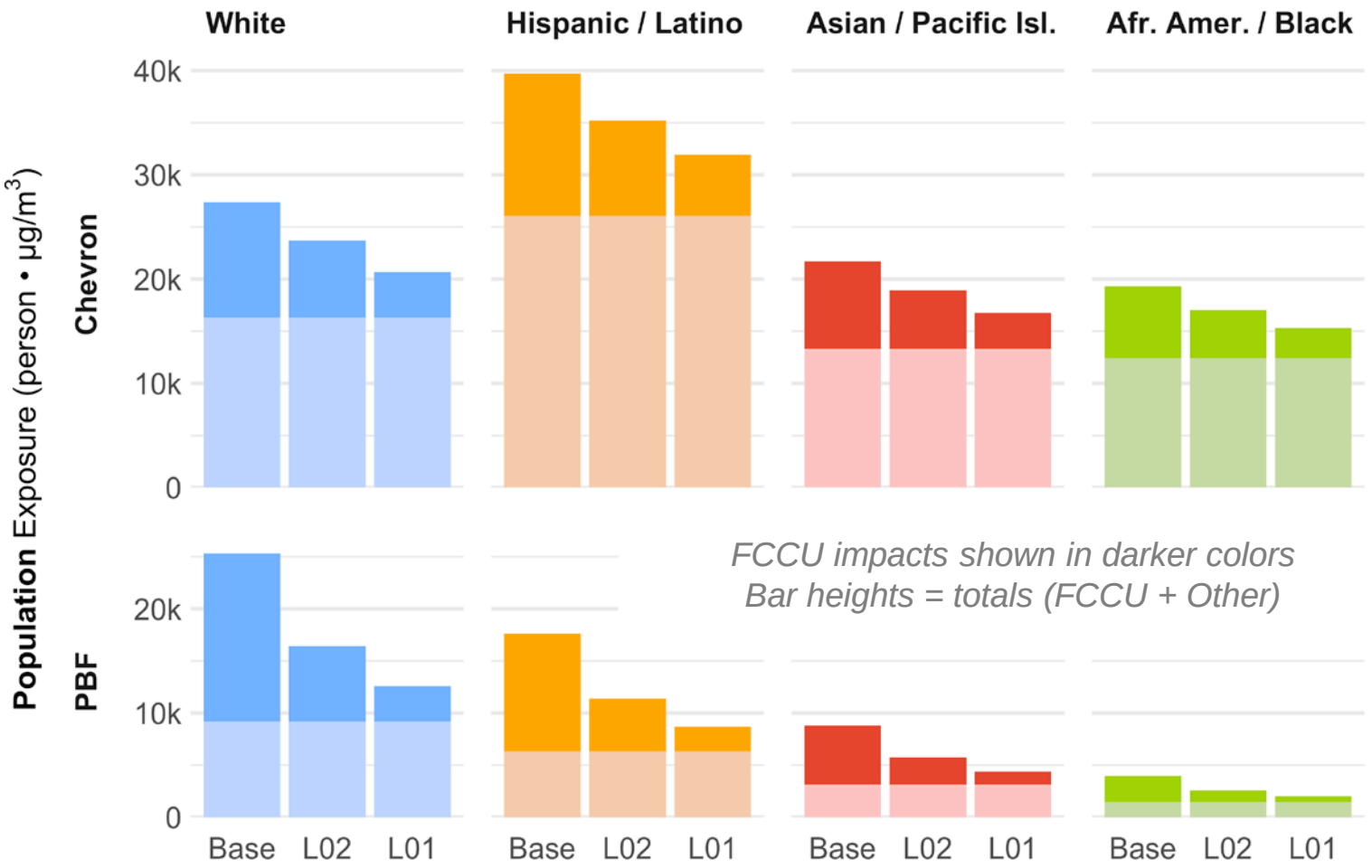
- Higher-than-average % African American/Black and Hispanic/ Latino
- Lower-than-average % White and Asian/Pacific Isl.
- About 0.3% Native American/ Alaska Native (same as Bay Area)



Population Exposures

Chevron Impact ≈ Twice PBF

- Baseline $PM_{2.5}$ emissions are similar
- But more residents coincident with plume leads to more impact
- Chevron closer than PBF to more residents, more of whom are non-White
- PBF impact largest for White & Hispanic/Latino residents



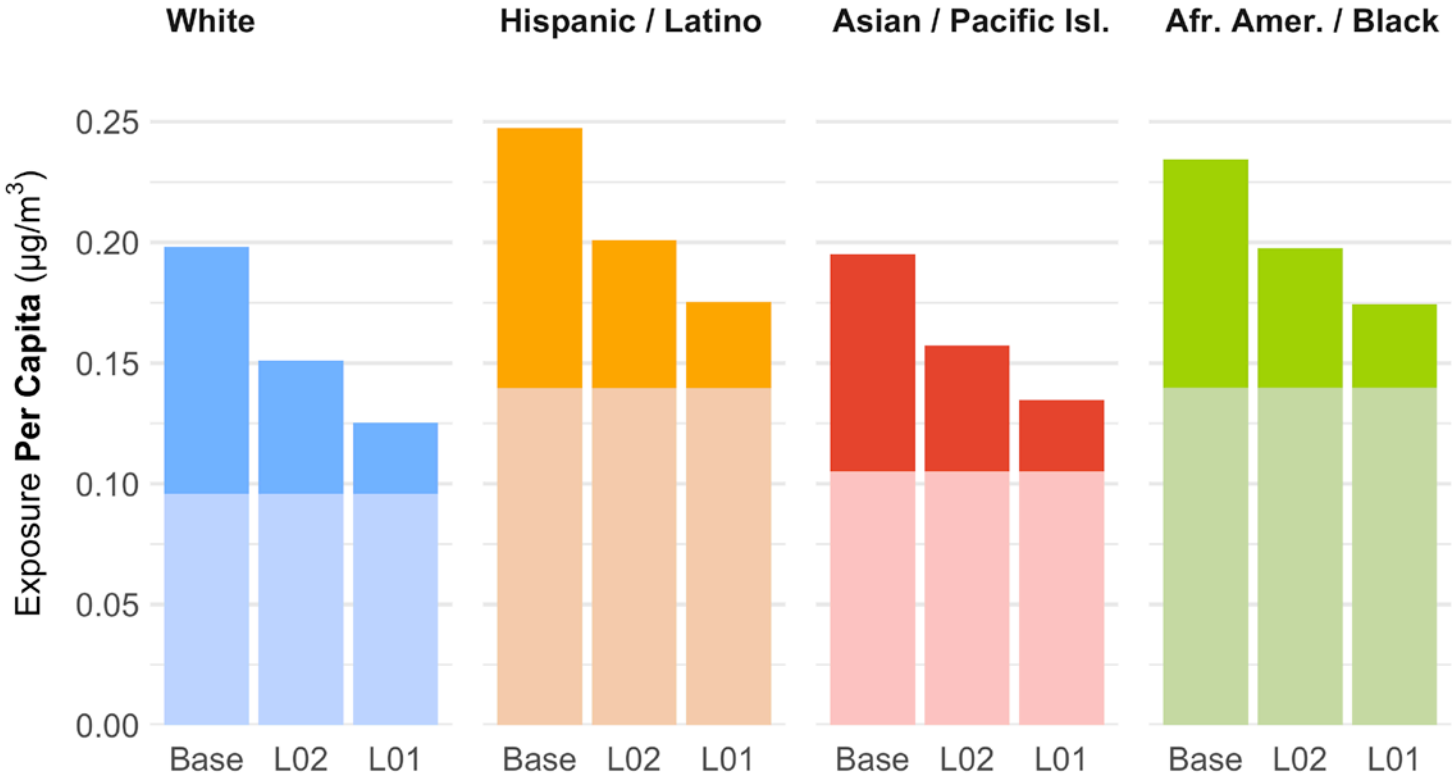
Exposure Per Capita

Combined Impacts

- Per capita, Hispanic/Latino and African American/Black residents exposed to more $PM_{2.5}$ from Chevron + PBF

Non-FCCU Sources

- Drive these disparities
- Remain significant

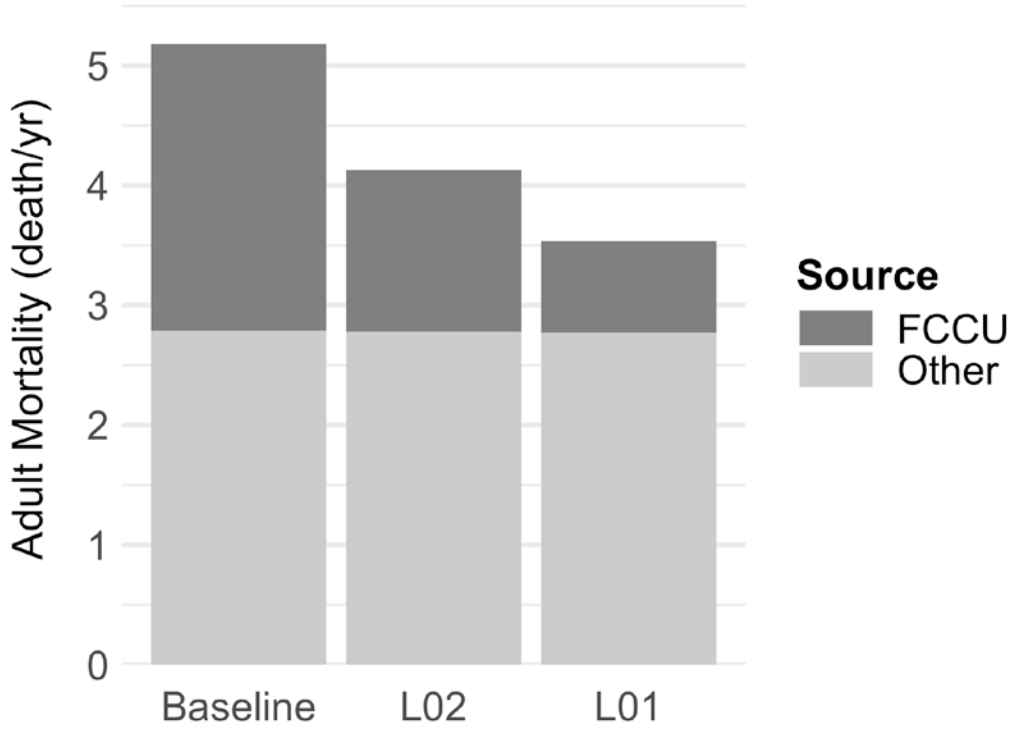


FCCU impacts shown in darker colors
Bar heights = totals (FCCU + Other)

Health Impact

Adult Mortality

- Well-known outcome of $PM_{2.5}$ exposure
- Primary driver of health valuations
- Average effect size in United States is about 50 death/yr per million adults per 1 $\mu g/m^3$
- Within the modeled footprint, there are 470,000 adult (age ≥ 30) residents
- Context: all-cause mortality in Bay Area is 9,000 death/yr per million adults



FCCU impacts shown in dark gray
Bar heights = totals (FCCU + Other)

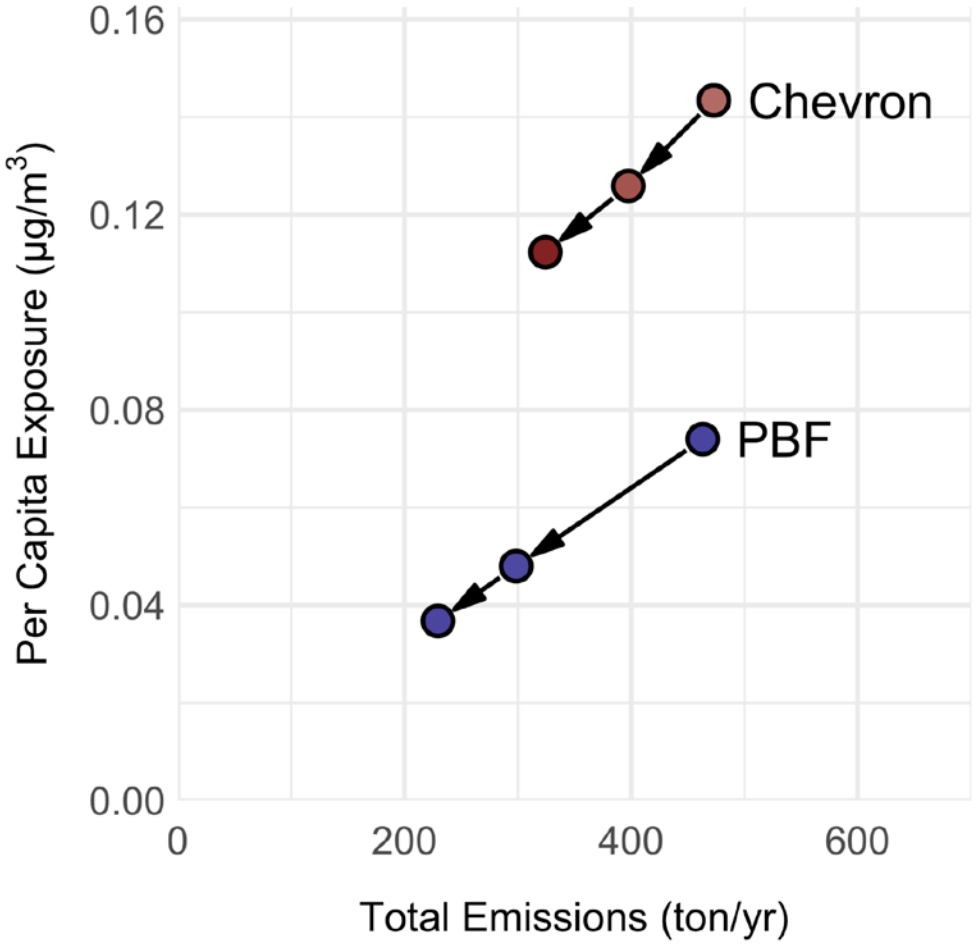
Impact Per Ton

Figure: Impact vs Emissions

- Y = impact; X = emissions
- Arrows connect scenarios: Baseline → L02 → L01

Differences by Facility

- Baseline emissions are comparable, but Chevron exposures are twice as large
- PBF reductions are larger, in particular the step from Baseline to L02



Key Insights: Exposure

Over the Entire Study Area

- Per capita, $PM_{2.5}$ exposure from Chevron + PBF is comparable to what the Port of Oakland is for West Oakland residents
- Twenty-five times as many people are exposed to this level of impact (in the study area, vs in West Oakland)

For Residents Near Chevron

- Impact of Chevron is comparable to West Oakland highways + Port combined

Source	$PM_{2.5}$	Population
• Chevron + PBF combined	0.2 µg/m^3	Study area (750,000)
• Port of Oakland • I-880, 980, 580	0.1 µg/m^3 0.4 µg/m^3	West Oakland (30,000)
• Chevron alone (all sources)	0.5 µg/m^3	Near Chevron (30,000)

Key Insights: Equity

Exposures Are Not Distributed Equally

- In all scenarios, Hispanic/Latino and African American/Black residents are exposed to more $PM_{2.5}$ from these two facilities combined
- Chevron is closer to more residents, more of whom are African American/Black or Hispanic/Latino, who are also exposed to $PM_{2.5}$ from sources other than the FCCU
- Exposures attributable to Chevron are about twice those of PBF, even though baseline emissions are comparable (~450 ton/yr $PM_{2.5}$)

Key Insights: Benefits

As modeled, the proposed limits would result in:

	Limit	
Reductions	**0.020 gr/dscf**	**0.010 gr/dscf**
$PM_{2.5}$ emissions from PBF + Chevron FCCUs	-45%	-72%
$PM_{2.5}$ emissions from PBF + Chevron	-26%	-41%
$PM_{2.5}$ exposure from PBF + Chevron	-20%	-31%
Mortality (death/yr)	-1.1	-1.7

Next Steps

Ongoing Work

- Assess impacts of non-FCCU sources in more detail
- Document methods and results
- Incorporate results into Richmond/San Pablo Community Emissions Reduction Plan
- Continue modeling study of $PM_{2.5}$ impacts from other major industrial sources