

Public Health and Environmental Justice Analysis of Air Quality Impacts in Overburdened Communities Highly Impacted by Pollution

Felipe Rodriguez-Flores (DOH) &

Trischa Lohr Barlet (ECY)

Agenda

- **Background**
- **Greenhouse Gas Emissions**
- **Criteria Air Pollution**
- **Health Impacts**
- **Community Perspectives**
- **Key Takeaways**



Background

WA State Climate Commitment Act

Established the Cap-and-Invest Program, a market-based system, to reduce carbon pollution and achieve greenhouse gas limits set in state law.

Aligns with the requirements of the HEAL Act and includes provisions to ensure WA communities that are disproportionately impacted by climate change and air pollution benefit from cleaner air.

Directs ECY to reduce criteria air pollutants – such as ozone and particulate matter – in overburdened communities highly impacted by air pollution (RCW 70A.65.020).

RCW 70A.65.020 Environmental Justice Review

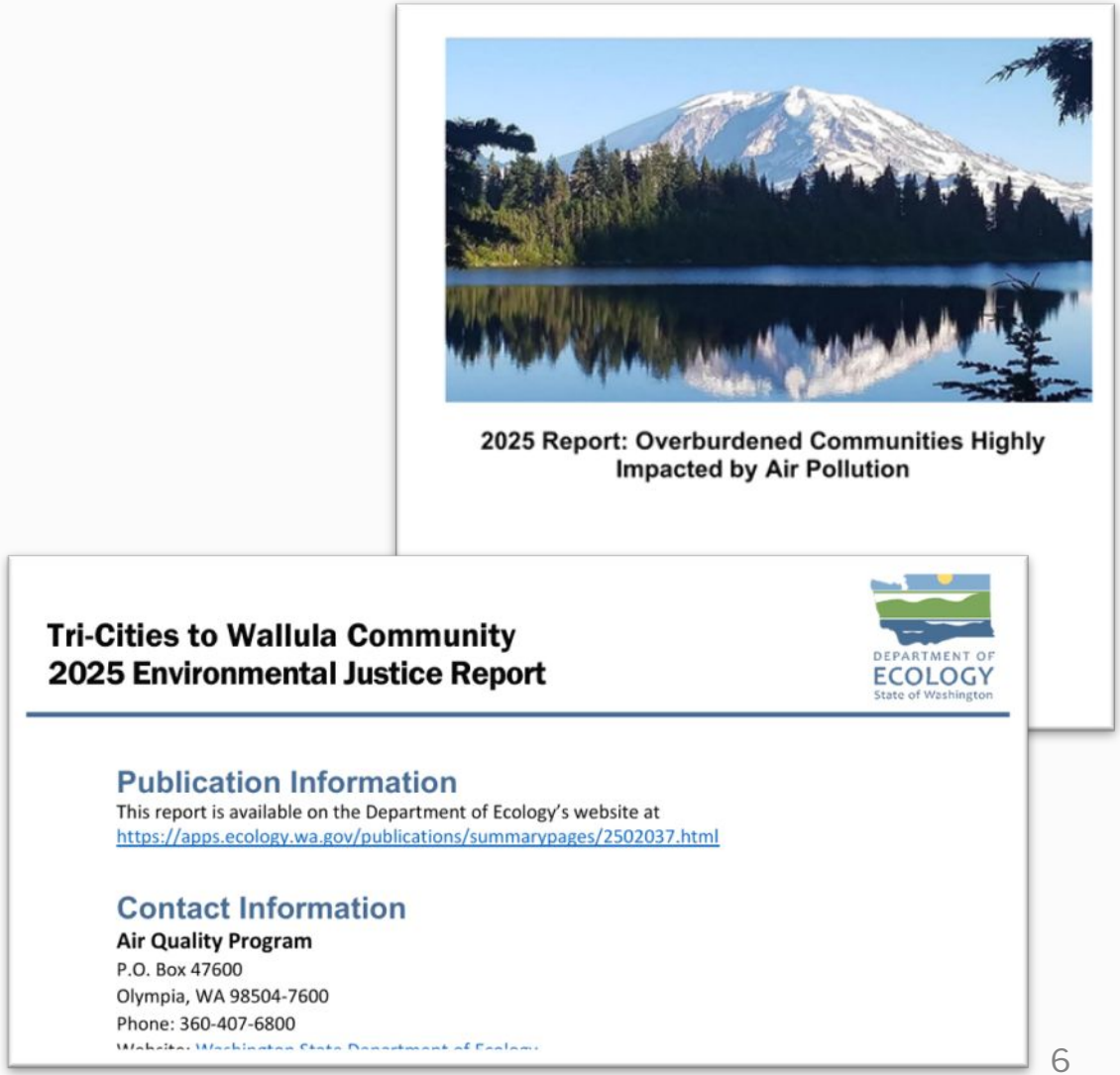
Identify Communities	Biennial Report
Expand Air Monitoring	Grants
Engagement	Rulemaking
Emissions Reduction	



Biennial Reports

Report Contents:

- Greenhouse Gas Emissions
- Criteria Air Pollution
- Health Impacts
- Community Information



2025 Expanded Reporting

- ECY and DOH Data
- Health Impacts of $PM_{2.5}$ and Ozone
- Demographics
- Listening Sessions

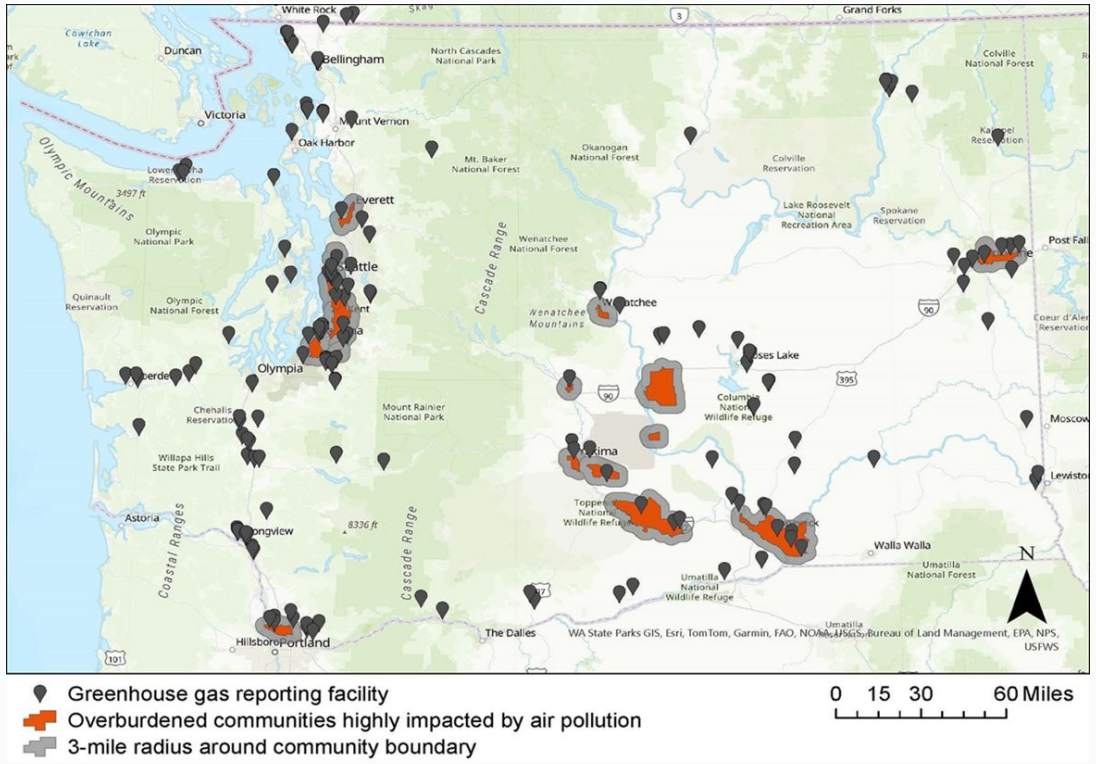




Greenhouse Gas Emissions

Data Sources & Methodology

Washington's Greenhouse Gas Reporting Program



National Emissions Inventory (NEI), WA State Greenhouse Gas Emissions Inventory, Washington Census

Estimates provided for 2020 & 2021

County emissions
(MT CO_2e)

↓

Community emissions
(MT CO_2e)

↓

Community emissions per capita
(MT CO_2e/capita)

Results

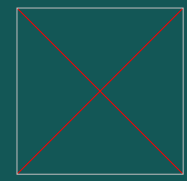
30% of WA CCA reporting facilities are in or near OBCs

20% decrease in greenhouse gas facility emissions, 2020-2023

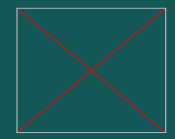
15% of modeled mobile source emissions come from OBCs

5.4% decrease in modeled mobile source emissions, 2019-2021

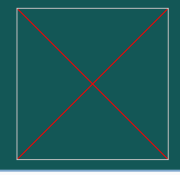
Greatest facility emissions:
Tri-Cities to Wallula
South Seattle
Vancouver



Greatest facility emission reductions:
Tri-Cities to Wallula
South and East Tacoma



Greatest mobile source emissions:
South Seattle
South King County
Tri-Cities to Wallula





Criteria Air Pollution

Criteria Air Pollution (CAPs)

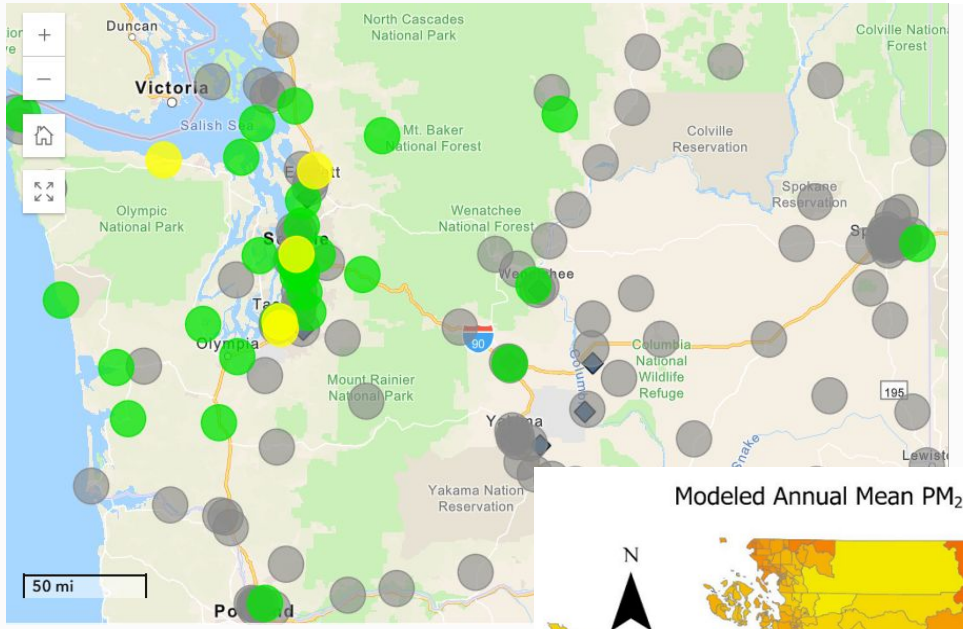
Class of six pollutants regulated by the EPA

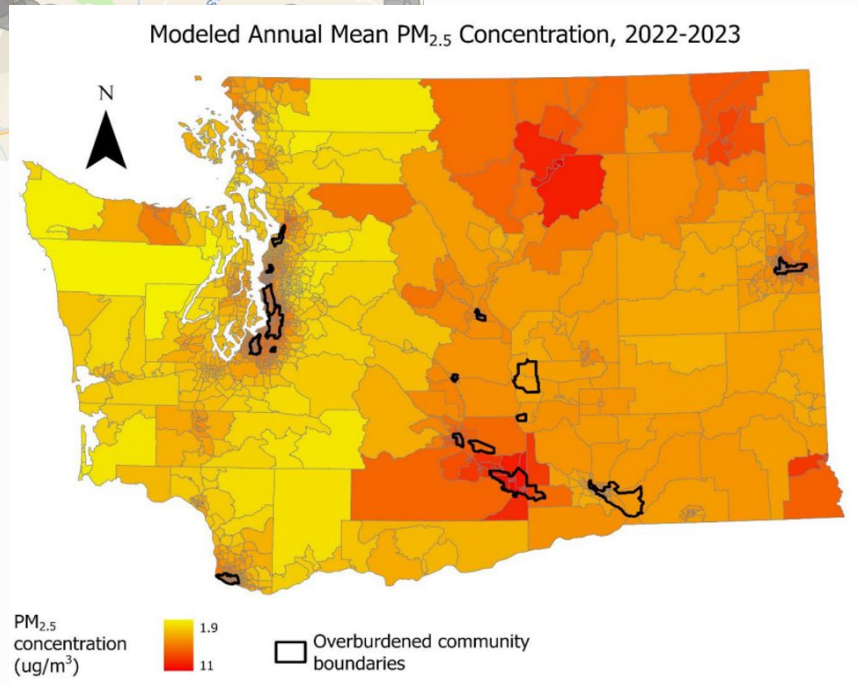


- All 16 communities identified as overburdened, are impacted by $PM_{2.5}$
- Many of the communities are also impacted by cumulative pollution, primarily driven by $PM_{2.5}$, with some contribution from O_3 & NO_2

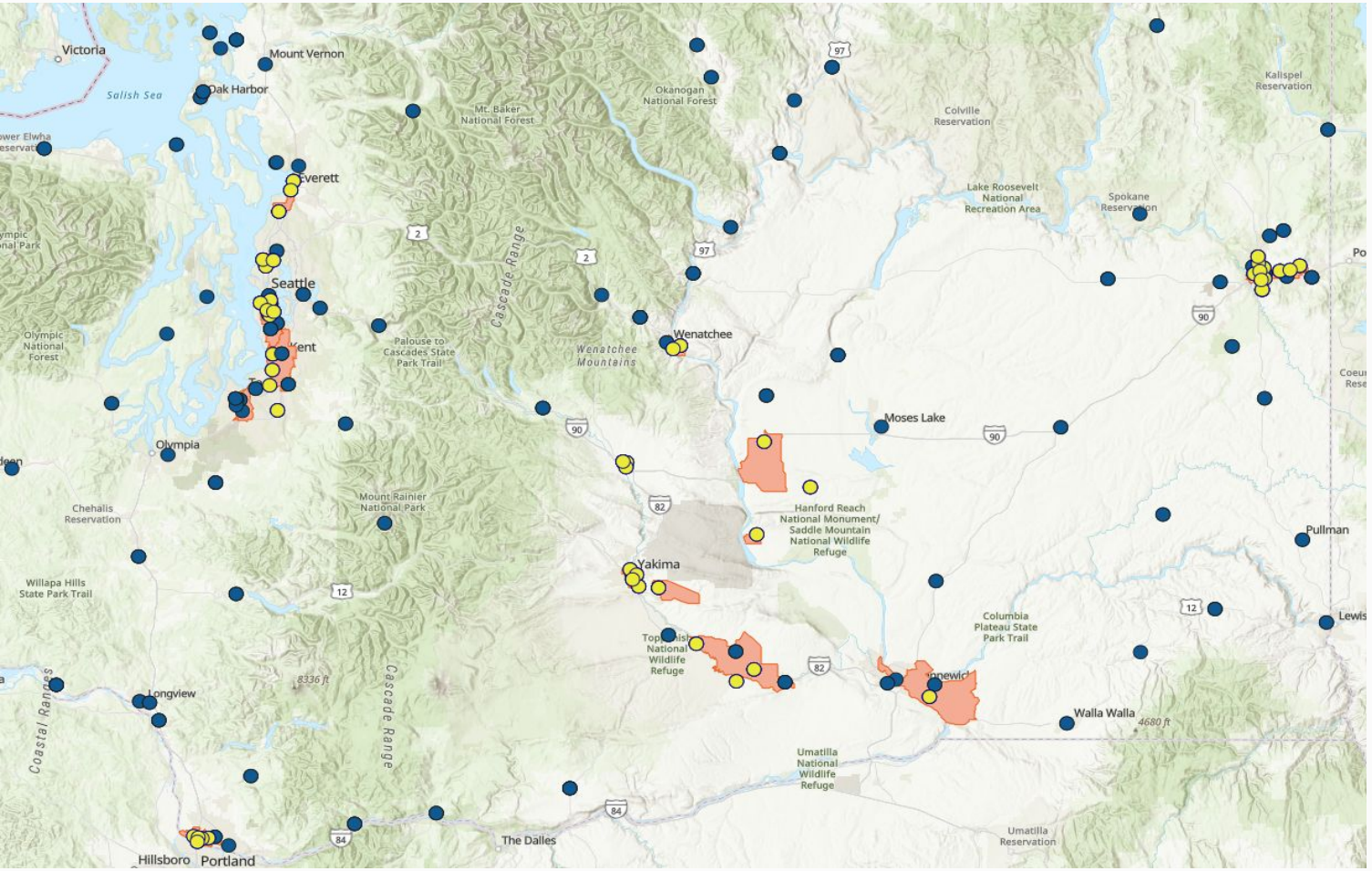
Data Sources & Methodology

- WA Air Monitoring Network
  - FRM/FEM, non-regulatory, Tribal, SensWA (sensors)
  - $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2, CO
- EPA's National Ambient Air Quality Standards (NAAQS)
  - 2024 design values (2022-2024 data)
- WA-Fuse, an Ecology modeling tool





Washington Ambient Air Monitoring Network



CCA Funded Sites

Other

Overburdened Communities Highly Impacted by Air Pollution

- 55 monitors installed in OBCs since 2023
  - $PM_{2.5}$ (52), PM_{10} (2), NO_x (1)
  - At least one $PM_{2.5}$ monitor or sensor in each OBC
- 72 total monitors in OBCs
- High-resolution mobile monitoring planned

Results

Between 2022-2024:

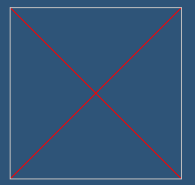
2.9 average annual days of unhealthy air

39% average decrease in daily $PM_{2.5}$

All CAPs **below** EPA standards*

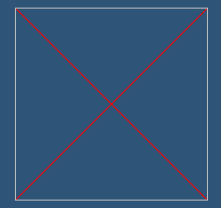
Highest short-term $PM_{2.5}$ pollution:

East Yakima
Lower Yakima Valley
Wenatchee & East Wenatchee
South & East Tacoma



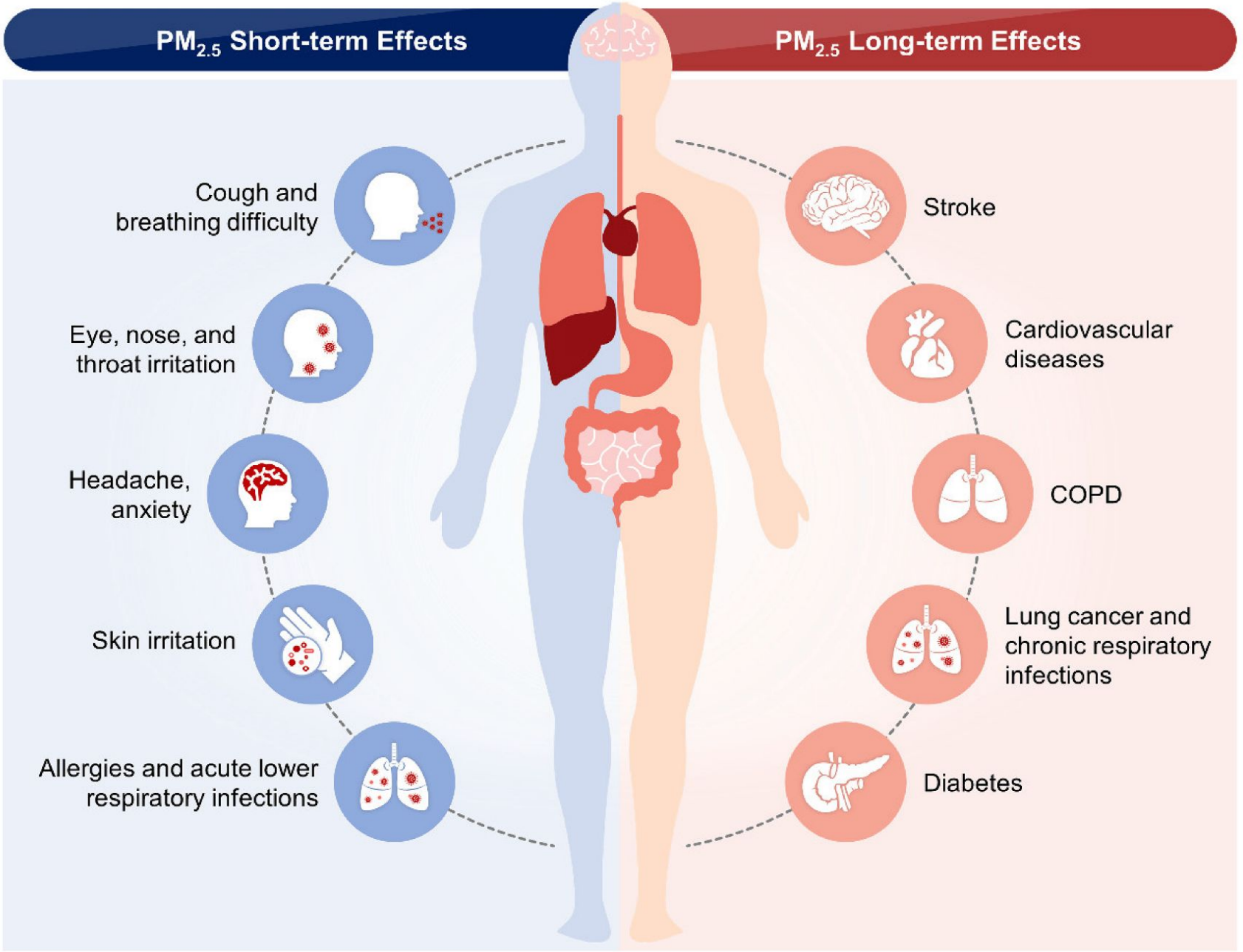
Highest long-term $PM_{2.5}$ pollution:

Spokane & Spokane Valley
East Yakima
Lower Yakima Valley
South Seattle



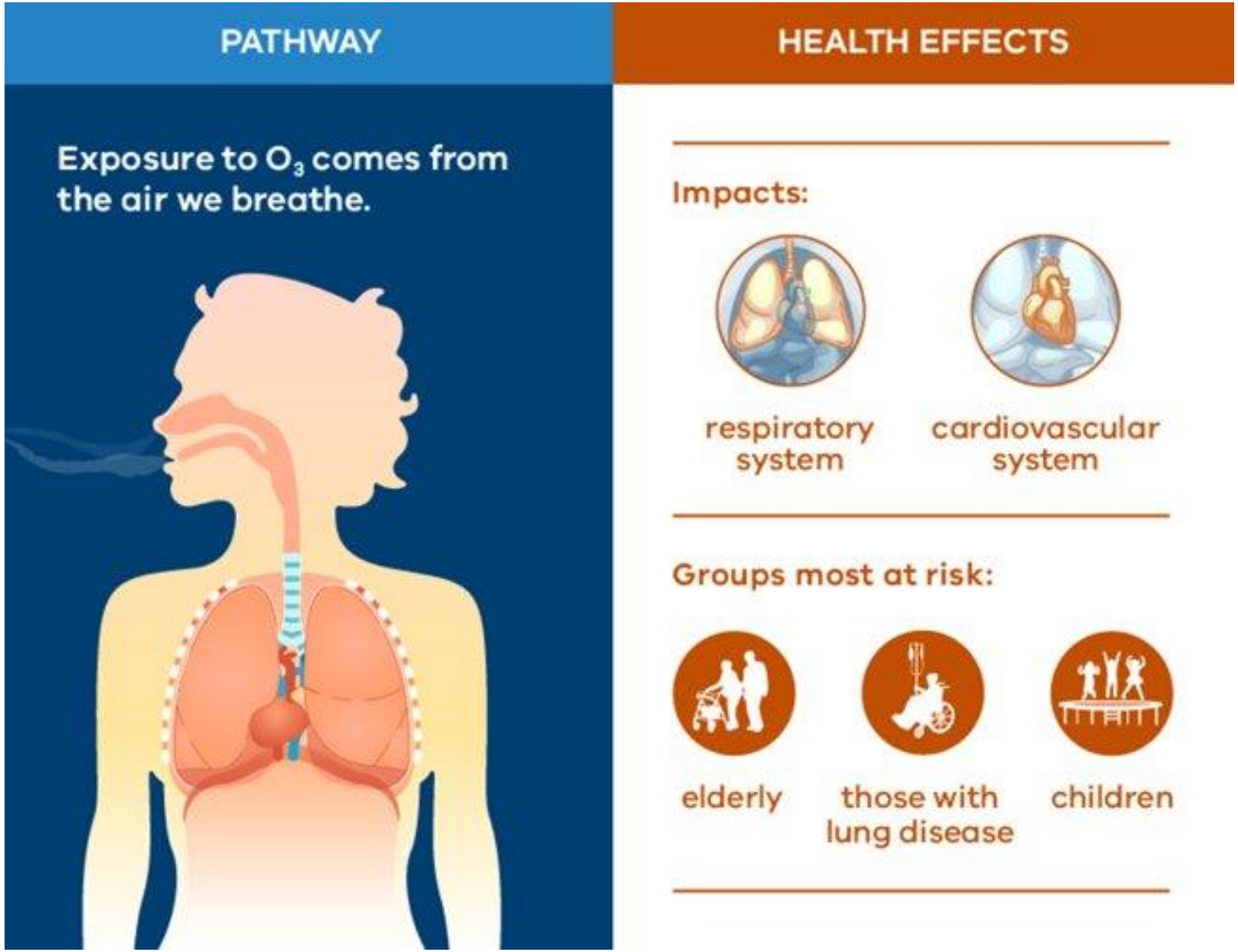
Health Impacts of Criteria Air Pollution

Health Impacts of $PM_{2.5}$



"The Impact of Fine Particulate Matter 2.5 on the Cardiovascular System: A Review of the Invisible Killer," *Nanomaterials 2022*

Health Impacts of Ozone



© Copyright State Government of Victoria

Photo by Environment Protection Authority Victoria | CC-BY-4.0

Health Impacts Data

Pollutants

- **$PM_{2.5}$**: Yearly and daily
- **O_3**: Yearly (during heat season) and daily

Health Outcomes

- **Mortality**: All-cause, Ischemic Heart Disease, Cardiovascular, Respiratory, Lung cancer
- **Hospitalization**: Myocardial infarction, Respiratory, Asthma
- **Emergency Dept. Visits:** Asthma
- **Diagnoses:** Lung cancer

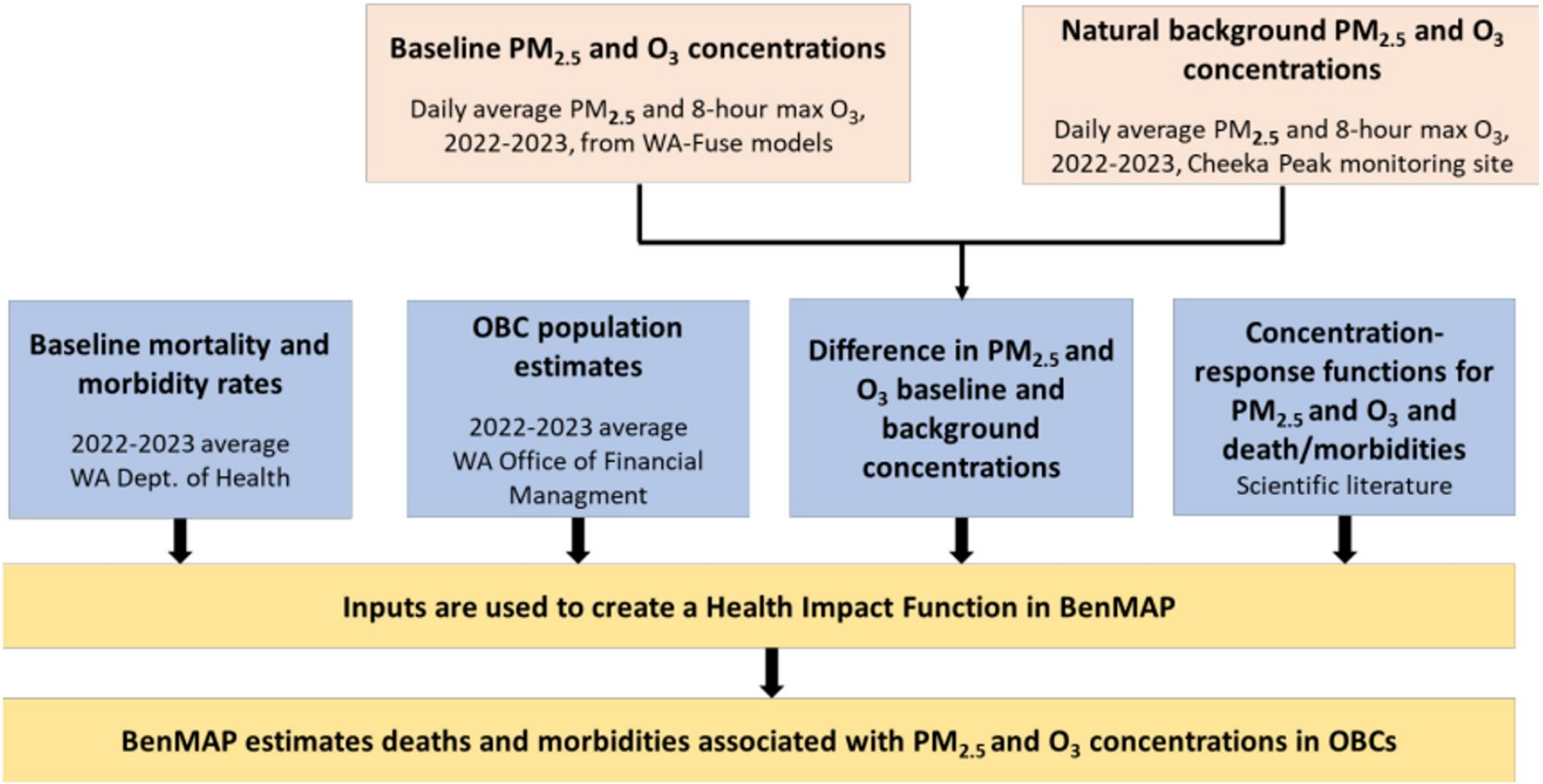
Methods

Environmental Benefits Mapping and Analysis Program - Community Edition (BenMAP-CE)

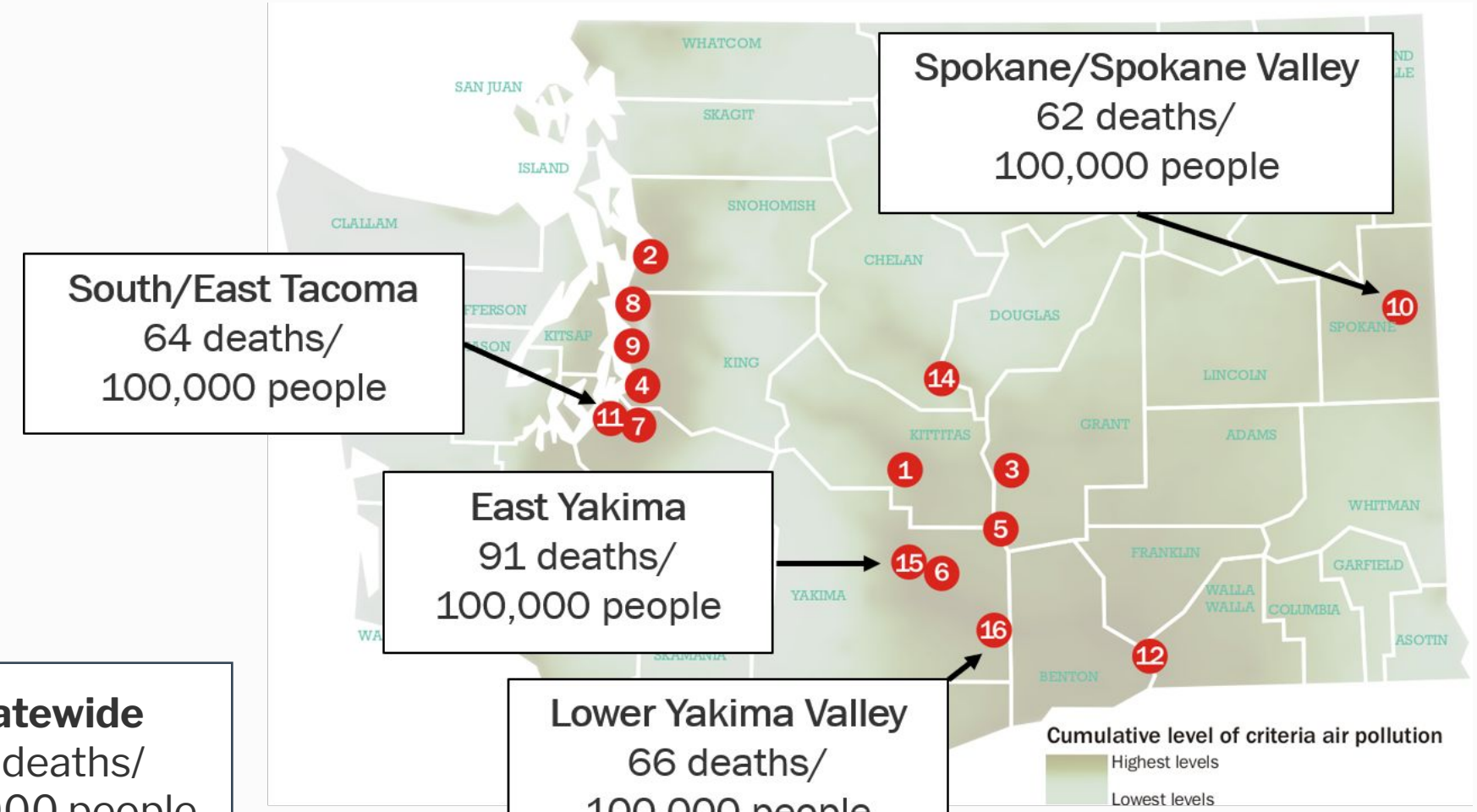
- Open-source EPA program
- Models the number/cost of air pollution-related deaths & illnesses
- Users can load their data or use pre-loaded datasets
- Pre-loaded datasets include:
  - Air quality
  - Demographics
  - Economic values
  - Concentration-response relationships



Estimating Health Impacts in BenMAP-CE



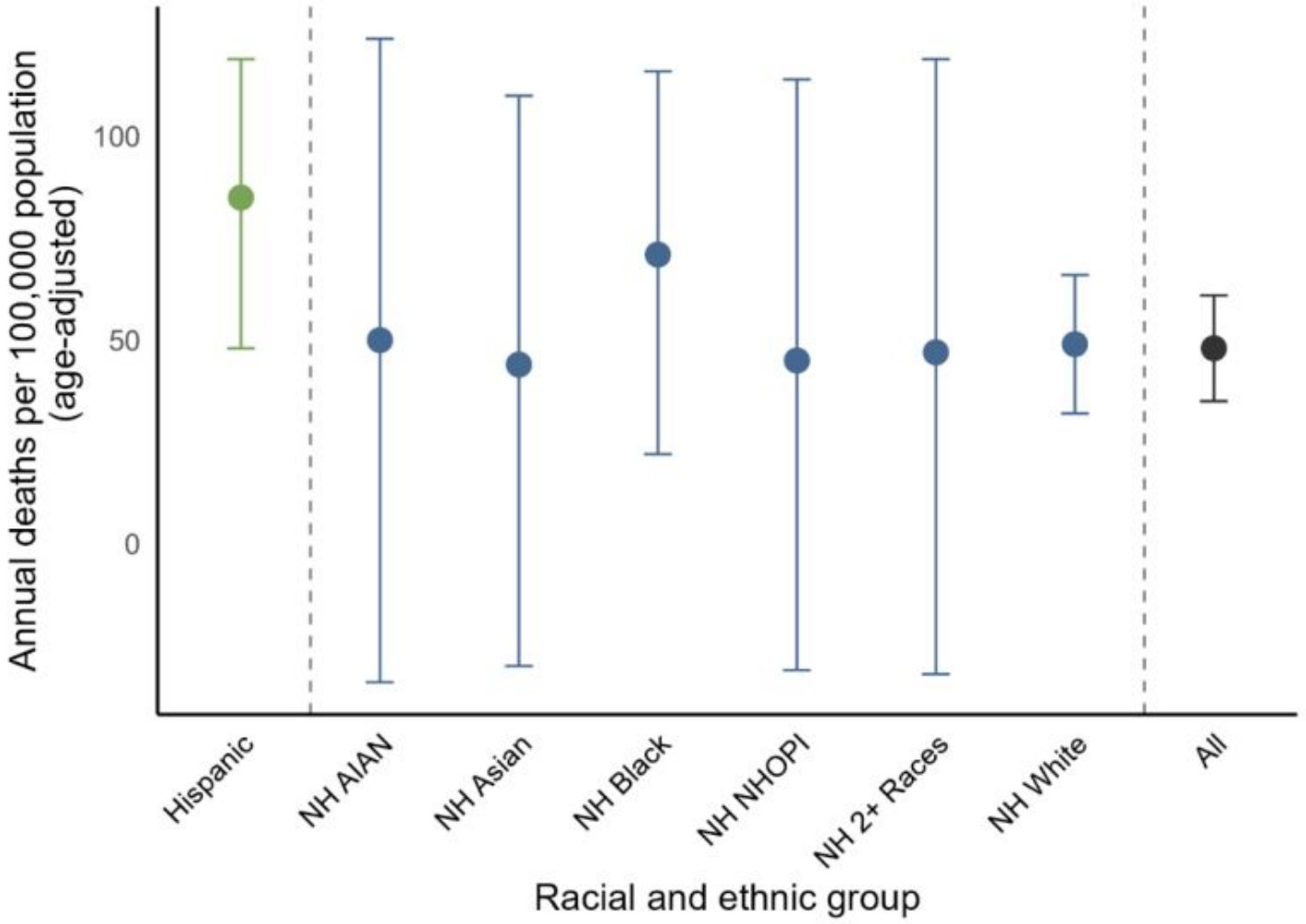
Highest Age-Adjusted $PM_{2.5}$-Related Mortality Rates



Statewide
27 deaths/
100,000 people

Estimated Race and Ethnicity Stratified Mortality Associated with $PM_{2.5}$

Most impacted populations:
Hispanic and non-Hispanic Black community members



Health Outcomes Associated with Yearly $PM_{2.5}$

We estimated (OBCs combined):

430 adult deaths

126-204 heart disease deaths

21-31 lung cancer deaths

340 youth asthma-related ED visits

Highest $PM_{2.5}$ mortality:
East Yakima
Lower Yakima Valley
Spokane & Spokane Valley

Most impacted populations:
Hispanic and Black community members

Health Impacts Associated with Yearly O_3

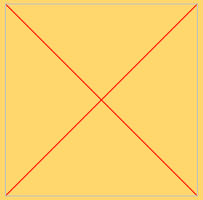
We estimated (OBCs combined):

67 older adult deaths

689 asthma-related ED visits

290 respiratory hospital admissions among older adults

Highest O_3 mortality:
Spokane & Spokane Valley
Tri-Cities to Wallula
East Yakima



Limitations and Uncertainty

Air Quality Data: $PM_{2.5}$ and ozone data come from WA-Fuse models

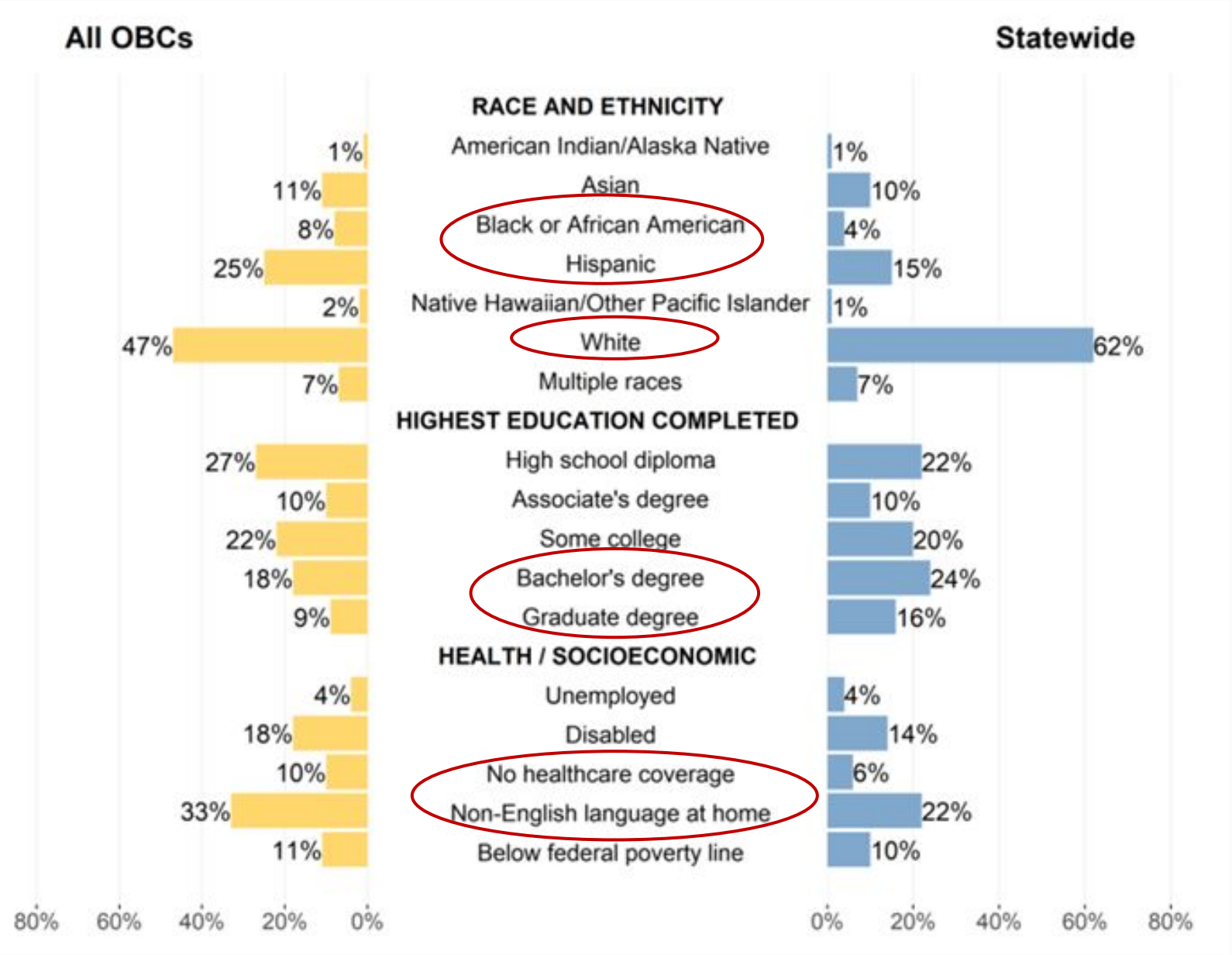
Health Data: Inaccuracies in addresses and small numbers with death and morbidity data

Concentration-Response Functions: Effect estimates based on national studies, not specific to the PNW



Community Perspectives

OBC Demographics



Engagement and Language Access

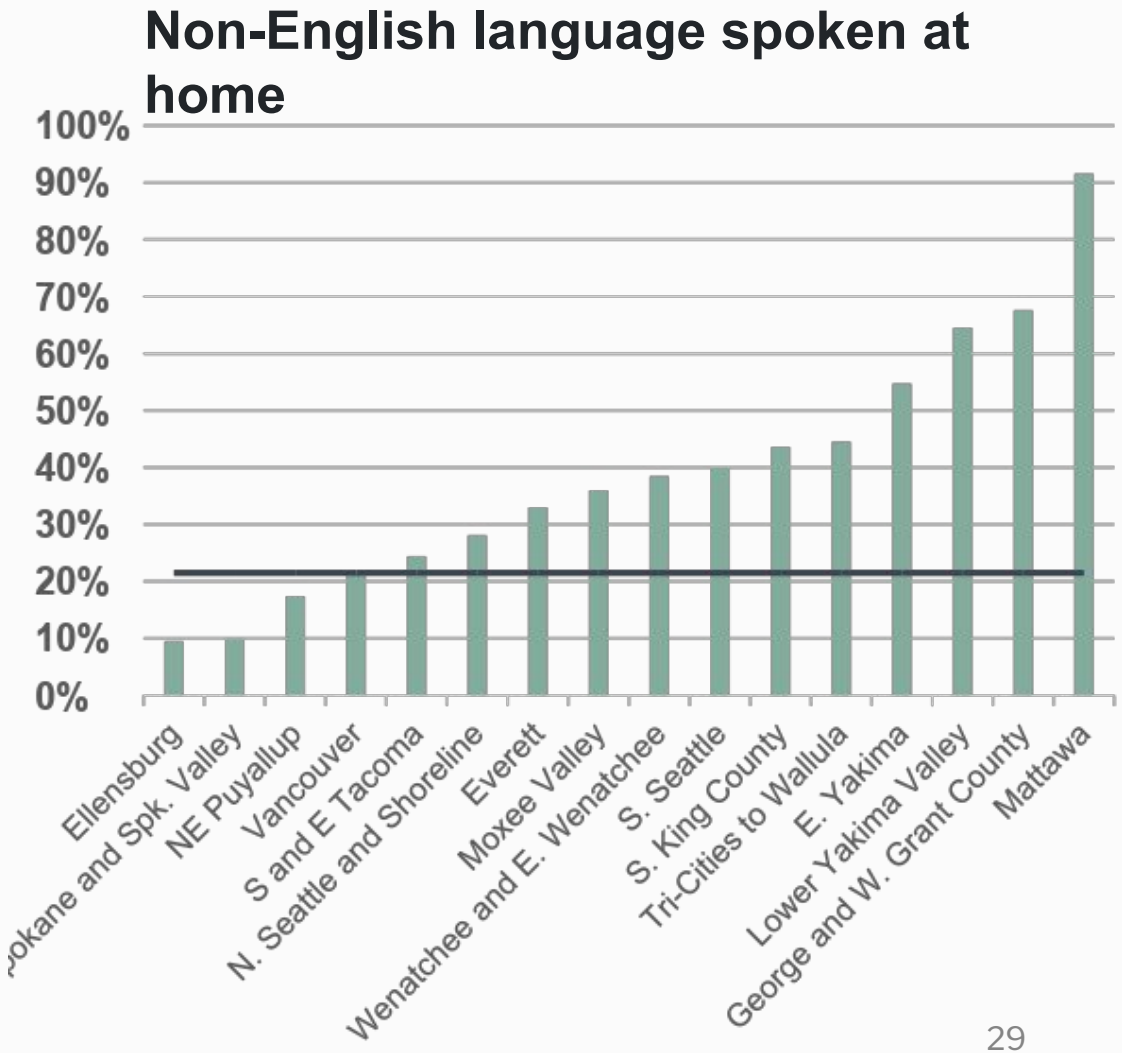
RCW 70A.65, Section 3
(CCA EJ Review)

(4)(a) The department must create and adopt a supplement to the department's community engagement plan developed pursuant to chapter 70A.02 RCW. The supplement must describe how the department will **engage with overburdened communities and vulnerable populations** in:

(i) **Identifying emitters in overburdened communities**; and

(ii) **Monitoring and evaluating criteria pollutant emissions** in those areas.

(b) The community engagement plan must include **methods for outreach and communication with those who face barriers, language or otherwise**, to participation.



Listening Session Pilots

- Four pilots hosted June 2025
- Two online LS with 15 staff of Local Health Jurisdictions
- Two in-person Spanish LS
  - South Seattle: 22 participants
  - Lower Yakima Valley: 15 participants
- Summary in main report and two community





LHJ participants and communities

- Public Health: Seattle-King County
  - North Seattle and Shoreline, South Seattle, South King County
- Benton-Franklin Health District
  - Lower Yakima Valley, Tri-Cities to Wallula
- Walla Walla County Department of Community Health
- Grant County Health District
  - North Seattle and Shoreline, South Seattle, South King County
- Yakima Health District
  - East Yakima, Lower Yakima Valley,
- Tacoma-Pierce County Health Dept.
  - South and East Tacoma, NE Puyallup
- Chelan-Douglas Health District
  - Wenatchee and East Wenatchee
- Spokane Regional Health District
  - Spokane and Spokane Valley
- Clark County Public Health
  - Vancouver
- Snohomish County Health Dept.
  - Everett
- Kittitas County Public Health
  - Ellensburg

Ethical Considerations

Questions to Consider When Using Human Participants in Public Health Assessment and Evaluation

1. What is the **purpose** of the project? Does the purpose justify the use of human subjects? What question(s) are you trying to answer? How will the information be used? Who is the audience for the results?

2. What **methods** will you use to gather data? Are these methods appropriate for the question(s) you're trying to answer? Are you using a validated data collection instrument? If not, how will you pre-test your questions? What sample size and response rate is needed to make good inferences from the data?

3. What **population group** are you seeking for the project? How will you access/locate people to participate? Consider the principle of justice: why are you collecting/using data from this group?

4. What are the potential **risks** and burdens of the project to participants? Consider time, stress, possible intrusion into personal or sensitive issues, emotional discomfort, breach of confidentiality, etc.

5. What are the potential **benefits** of the project? To participants? To the health department? To the community? Do the benefits outweigh the risks to participants?

6. How will you handle **confidentiality** of personal or sensitive information? Will participation be anonymous, confidential, or neither? How will data be stored? Who will have access to data and for how long? Are personal identifiers needed? For what purpose? When will they be removed from assessment information and destroyed?

7. How will you obtain **informed consent** from people to participate in the project? A consent form should be simply worded (at a reading level appropriate to the audience) and cover the following elements:

- Informed consent
- Voluntary participation
- Lived experience compensation
- Language access

Human Subjects and Public Health Practice: Guidelines for Ethical Data Collection

Washington State Institutional Review Board, 2018

Air Quality Community Concerns

- Pesticides
- Fertilizers
- Agricultural burning
- Dairies
- Wildfires
- Roadways
- Industrial facilities
- Airports
- Garbage
- Wood stoves

"Close to South Park is an industrial zone; in Georgetown, a cement factory is constantly emitting gases into the sky. In the morning, afternoon and evening, there are days during the cold season where you can see how the cloud goes up and stays there."

– Burien LS participant

Health Concerns

Health Concerns

- Shorter life expectancy
- Asthma, aggravated by air pollution
- Eye irritation, allergies, other respiratory issues
- Colds, coughs, rashes, headaches, stomach aches, nosebleeds
- Mental health impacts
- Financial costs from health care, missed employment

Sensitive Populations

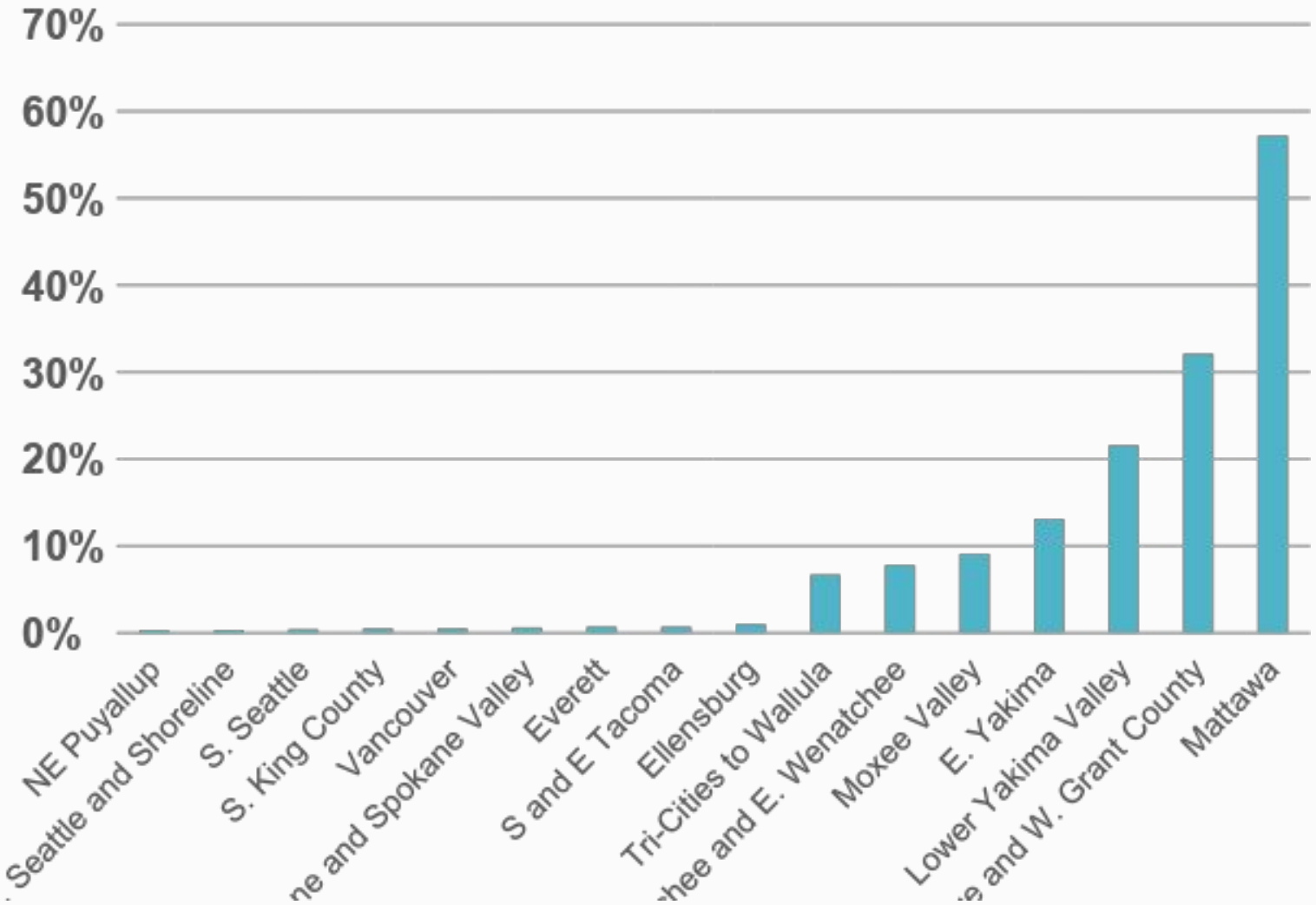
- Children
- Older adults
- People with chronic diseases

Highly Exposed Groups

- Outdoor workers
- Public transit and commercial drivers
- People living near industrial sites
- Unhoused individuals

Occupational Vulnerability

Workers in Agriculture and Related Industries

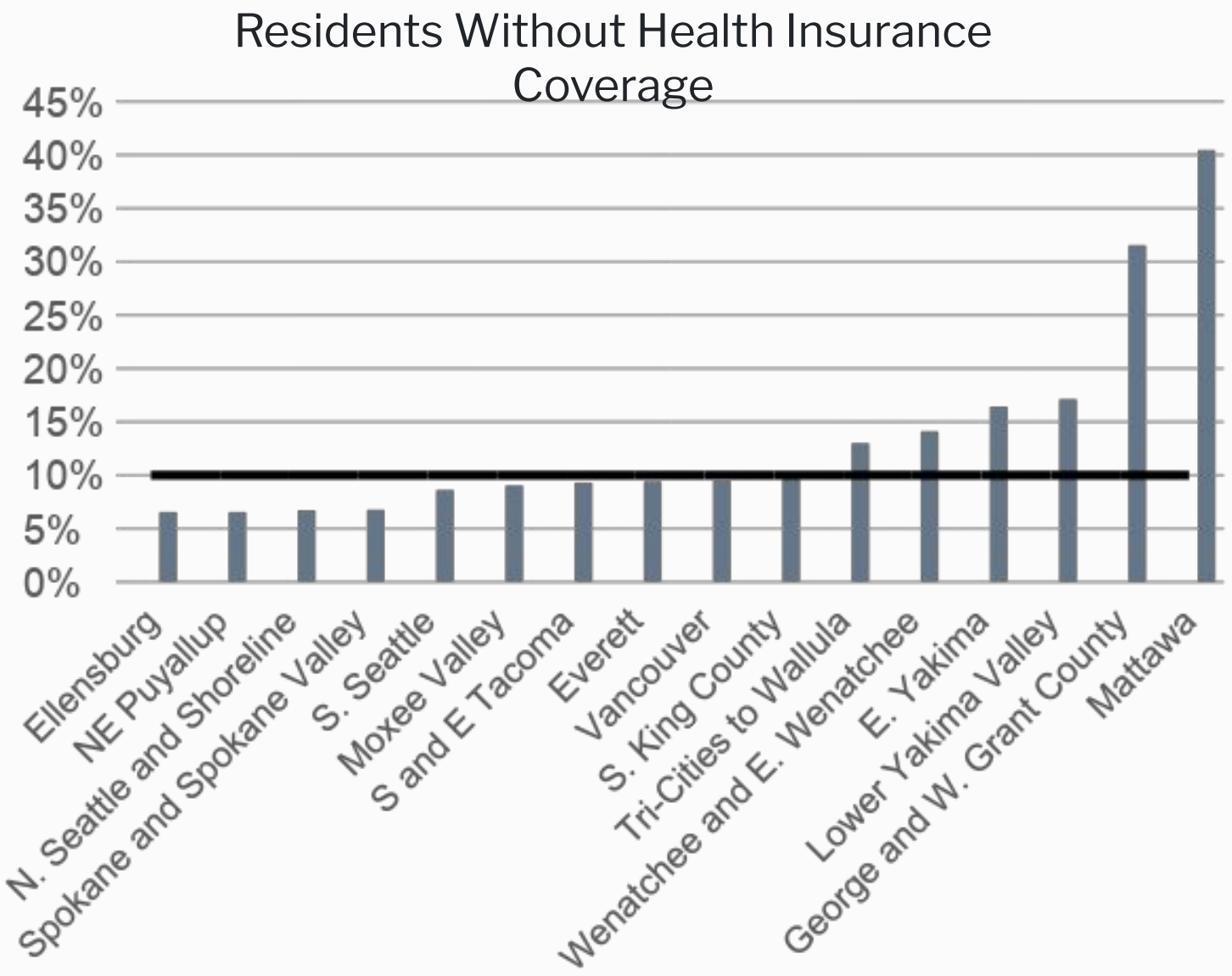


"About 3 years ago, I worked in the field and there was a strong wind that kicked up a lot of dust. At that time, I had asthma and by midday, the wind was still blowing.

So, what happened? My nose started bleeding. So yes, definitely, all that dust and the polluted air get to you."

– *Sunnyside LS participant*

Health Care Access



"In the winter, I got sick with an asthma attack, and I just went (to the hospital) one night for a little while. The bill came back at almost $4,000.

Do you think I'm going to earn that in one day working, to pay for all that? Now, those of us who suffer from that… an inhaler costs $100 or $125 and a person who's already affected by that spends on four inhalers in one month. Imagine that."

– *Sunnyside LS participant*

LHJ Activities and Resources

Distributing Resources

- N95 masks and information
- Box fans, filters, DIY kits

Community Partnerships

- Libraries and churches: clean air sites, cooling centers
- Health care providers, CHWs, community navigator programs

Public Health Messaging

- General and focused (e.g. for schools)
- DOH and NWS guidance
- Social media, radio, print
- Notices during smoke events
- Air quality flag program
- Multilingual communication

Information Needs

"We don't see a lot of educational material. So that is one top goal of mine, how we can educate our community in the most simplified way because a lot of people get confused…

If it's using fancy words or a lot of information cramped in one page, they tend to throw it away or just ignore it."

- LHJ listening session participant

- Health impacts of air pollution
- How to protect oneself, loved ones from air pollution
- Actions individuals can take to reduce pollution
- Resources and programs to mitigate pollution
- How to find & interpret air monitoring data
- How to report harmful pollution
- Current government actions to reduce air pollution



Key Takeaways

Key Takeaways

Air monitoring has expanded across all 16 overburdened communities

Disproportionate health impacts of criteria air pollution in OBCs

Community-engaged research leverages lived priorities and experiences in ECY's work





Questions?

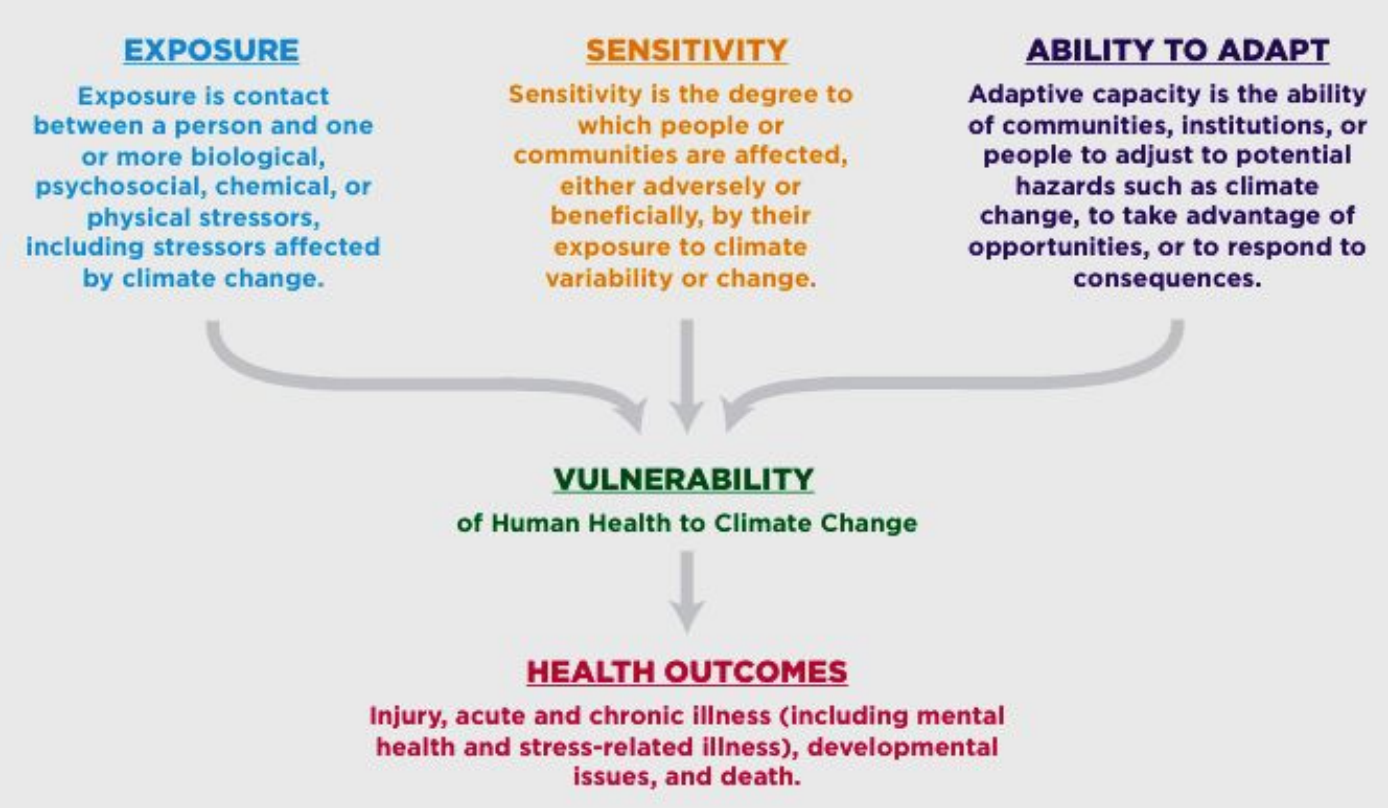
Felipe Rodriguez-Flores
felipe.flores@doh.wa.gov

Trischa Lohr Barlet
trischa.lohrbarlet@ecy.wa.gov



Additional Resources

Overburdened Communities and Vulnerable Populations



Determinants of Vulnerability

Climate Change Indicators in the United States, fourth edition (U.S. EPA, 2016)

RCW 70A.65, Section 3 (CCA EJ Review)

(2)(a) Beginning in 2023, and every two years thereafter, the department must conduct a review to determine levels of criteria pollutants, as well as greenhouse gas emissions, in the overburdened communities identified under subsection (1) of this section. This review must also include an **evaluation of initial and subsequent health impacts related to criteria pollution** in overburdened communities. The department may conduct this evaluation **jointly with the department of health**.

Background: Units

Global Warming Potential (GWP)

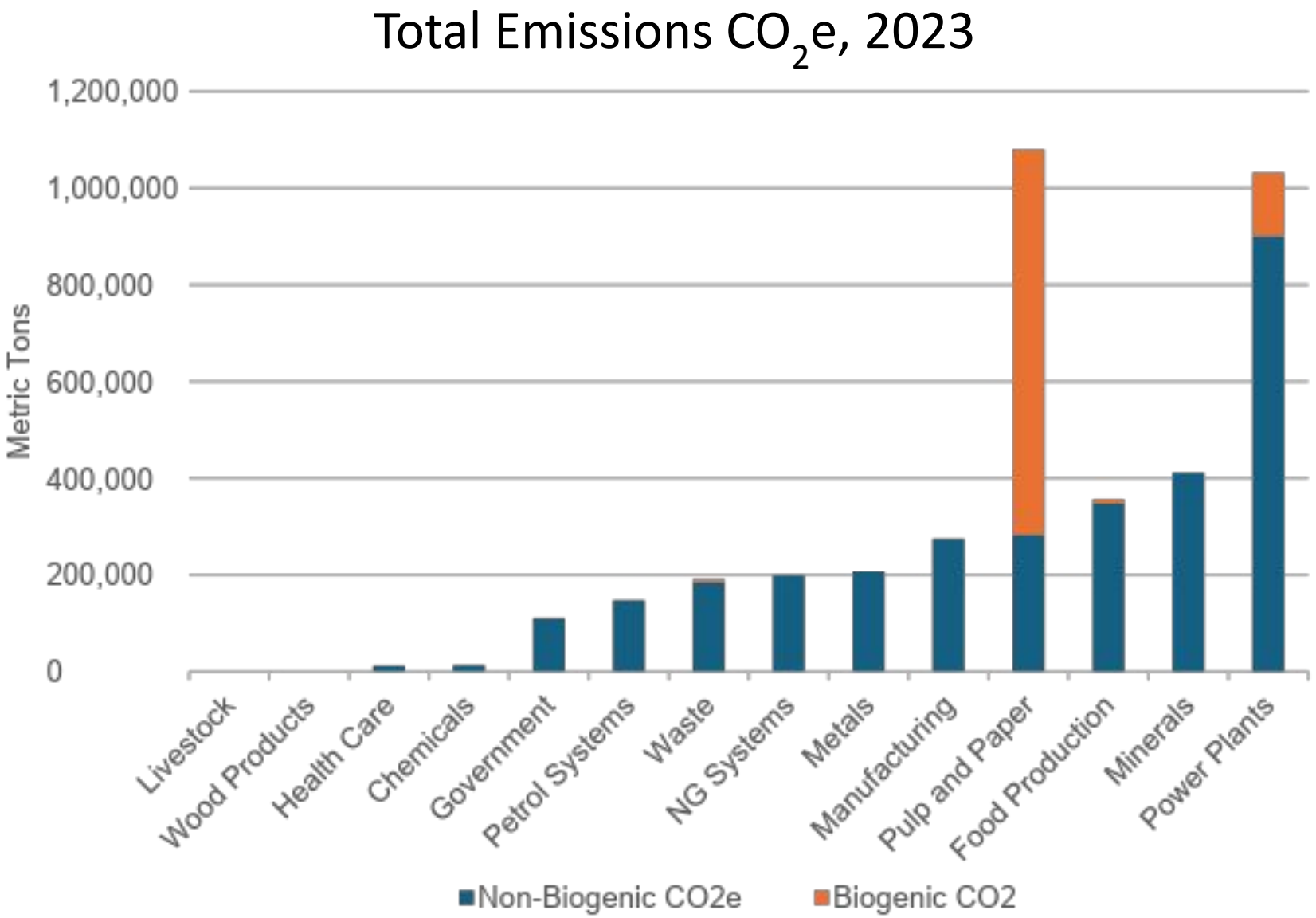
Each greenhouse gas uses a conversion factor to convert emissions into CO_2e based on its heat-trapping potential relative to CO_2 over a given time horizon (100 yrs).

Carbon Dioxide Equivalent (CO_2e)

Represents cumulative effects of all greenhouse gases in terms of their global warming potential relative to CO_2.

1 lb. of SF_6 warms the planet as much as over 10 tons of CO_2!

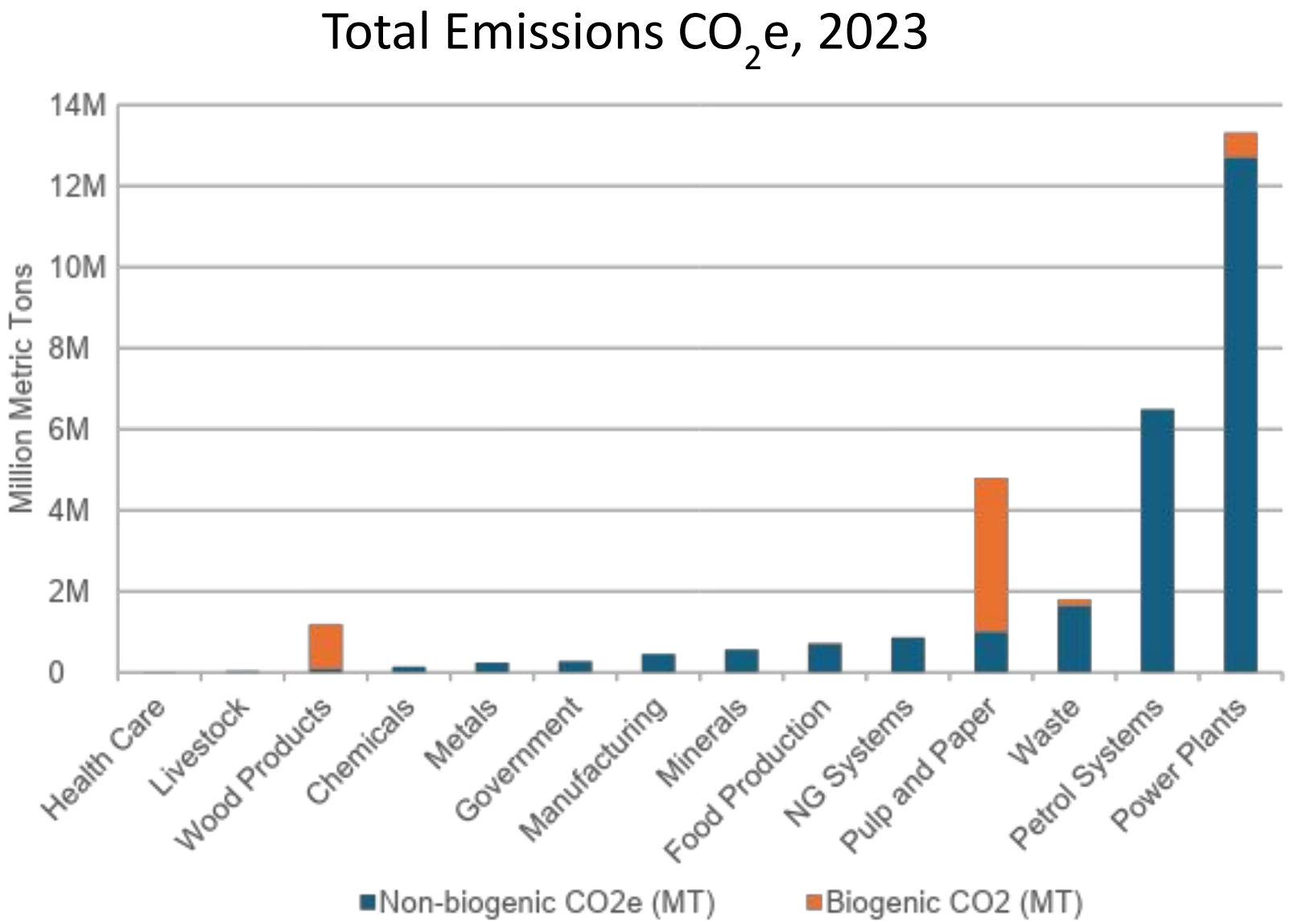
Results: All OBC Facilities



Greatest Sector Emissions in OBCs

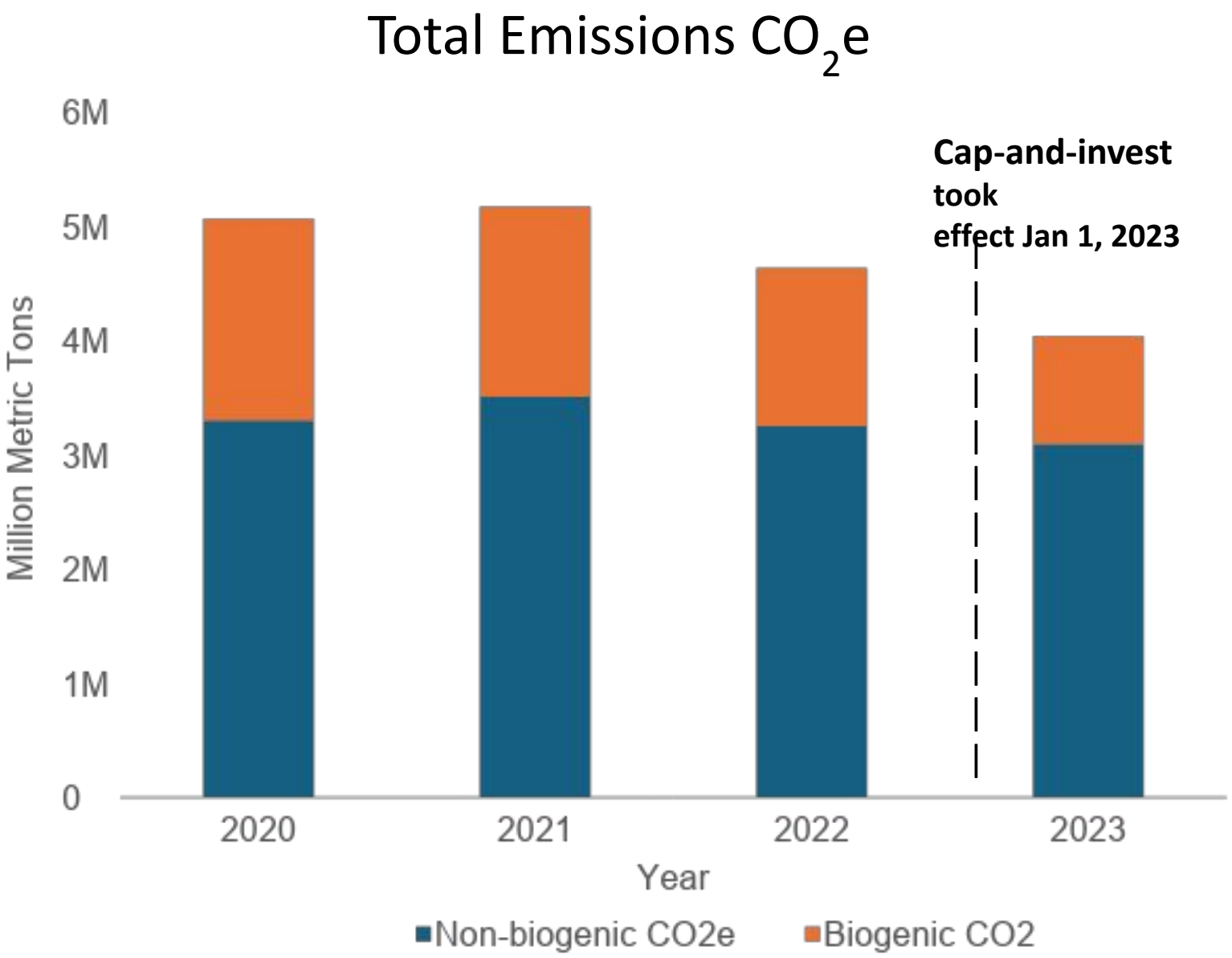
- Electric power generation (natural gas)
- Minerals (cement production)
- Food production
- Kraft Mills

Results: Statewide Facilities



Greatest Sector Emissions Statewide

- Electric power generation (coal)
- Petroleum Systems (Refineries)
- Waste (landfills)
- Kraft Mills



Results: Facilities

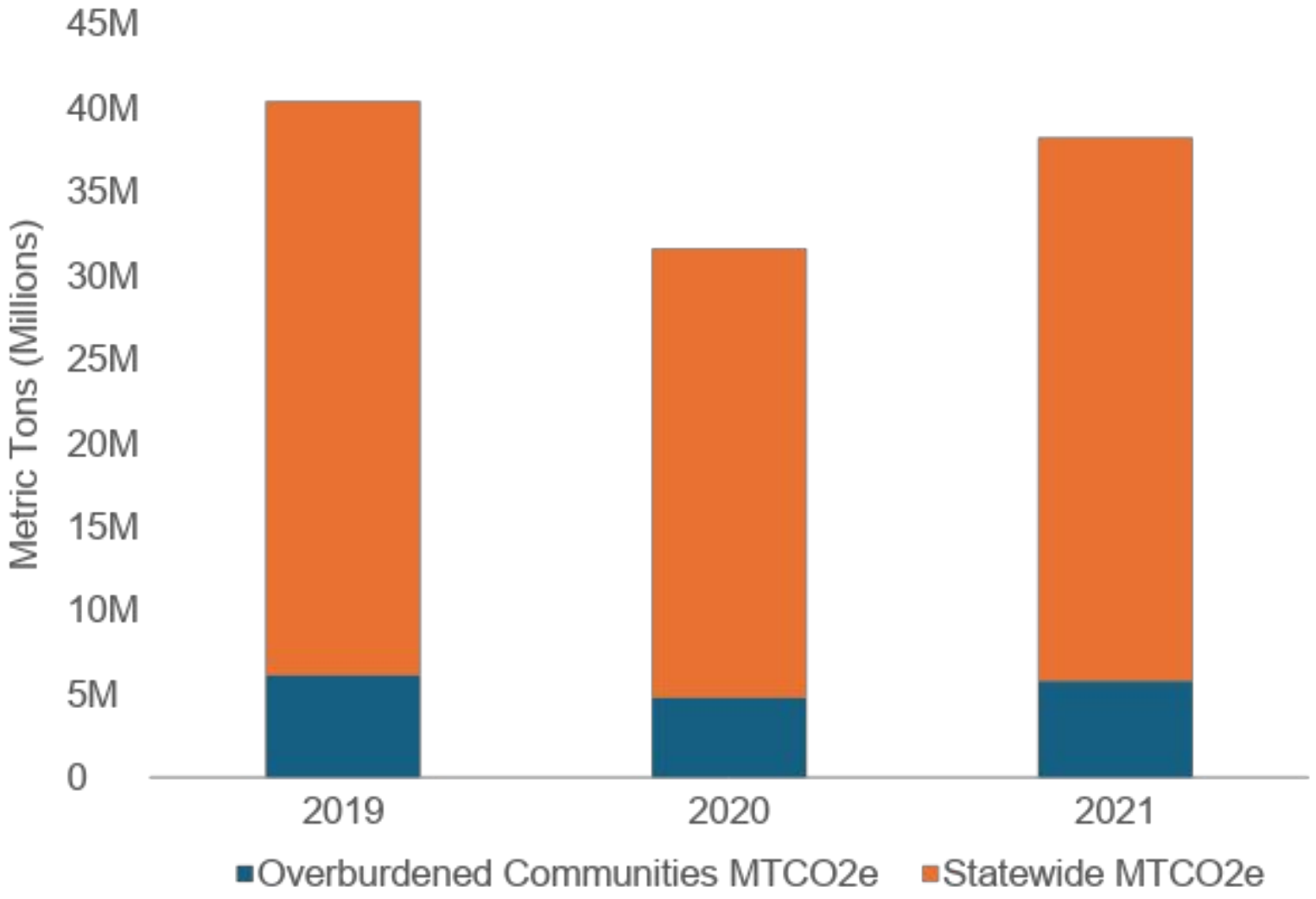
- ⇩ 12% from 2022-2023
- ⇩ 20% since baseline report

- 49 facilities (2022 & 2023)
  - 22 covered under the CCA
  - 21 emit GHGs *and* CAPs

Cause for greatest reductions:

- Temporary shutdowns and permanent closures
- New equipment installation

(South and East Tacoma, Tri-Cities to Wallula)



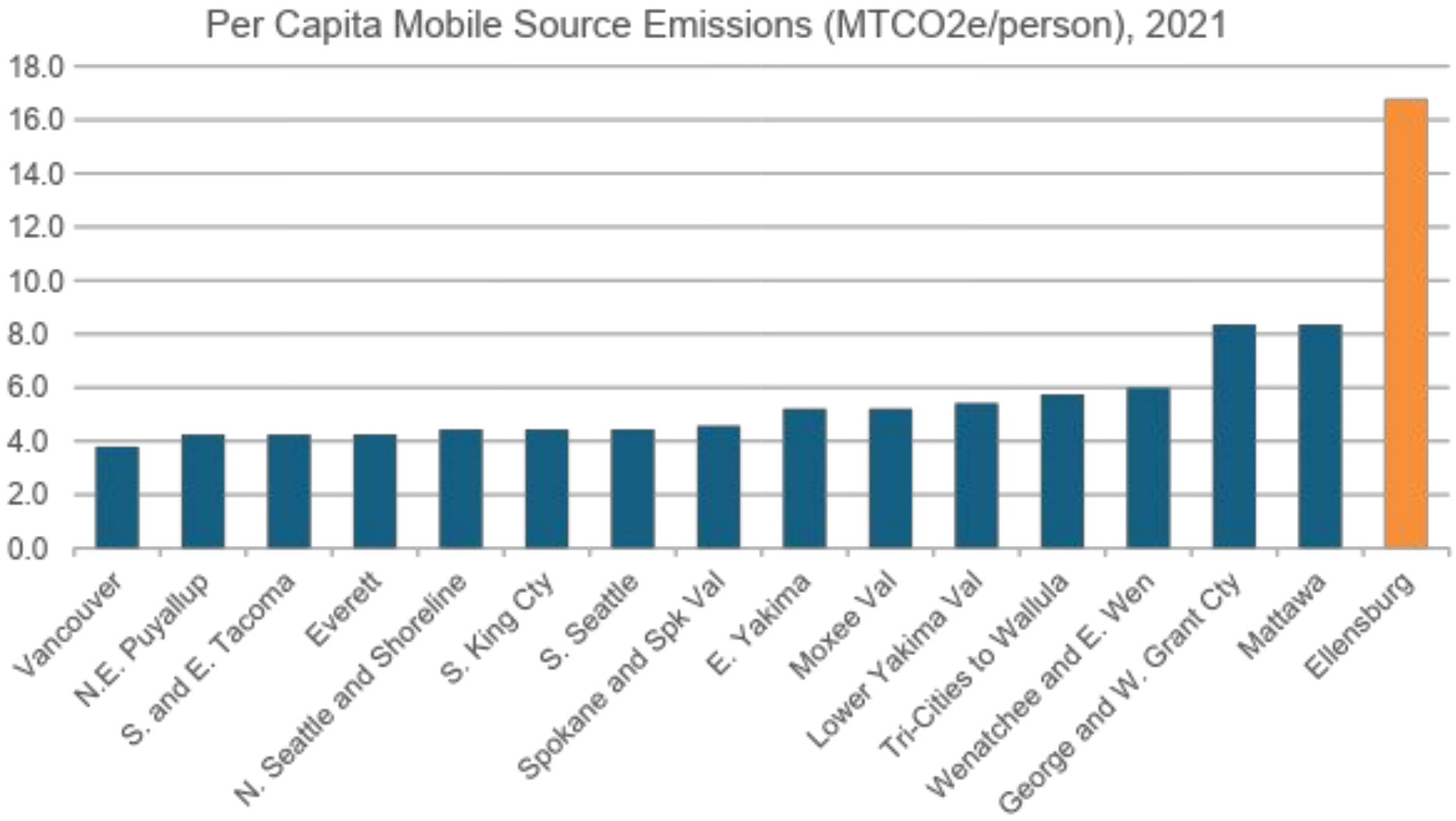
Results: Mobile Sources

↓ 5% in OBC modeled mobile emissions from 2019-2021

Greatest emissions:

- South Seattle
- South King County
- Spokane and Spokane Valley

Results: Mobile Sources





Method: Days with Unhealthy Air Quality

- Annual number of days when max daily AQI > 100
- “Unhealthy air quality days” = days with unhealthy for sensitive groups or worse AQI
- In OBCs with multiple monitors, we selected the site and pollutant with the highest AQI for each day
- Averaged annual number of unhealthy days 2022-2024

Method: Design Values and Summary Statistics

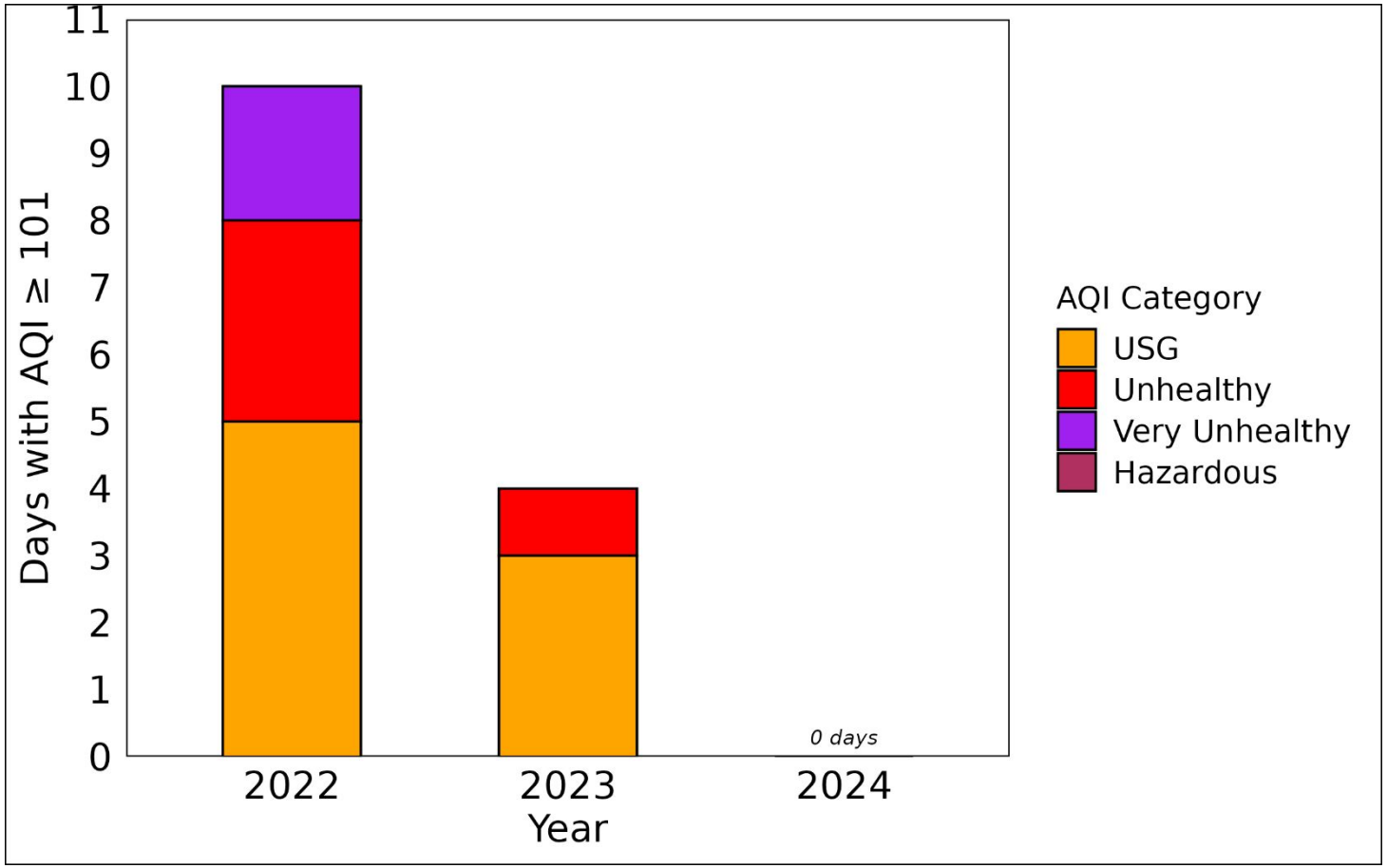
- **Data source**: WA Air Monitoring Network
- **Monitors/sensors:**
  - Within ~500 m of OBC
  - O_3: representative of OBC
- **Reporting years**: 2022-2024
- **Reported:**
  - Annual summary statistics
  - Design values (DVs)
  - Estimated DVs
- $PM_{2.5}$ wildfire smoke exclusions

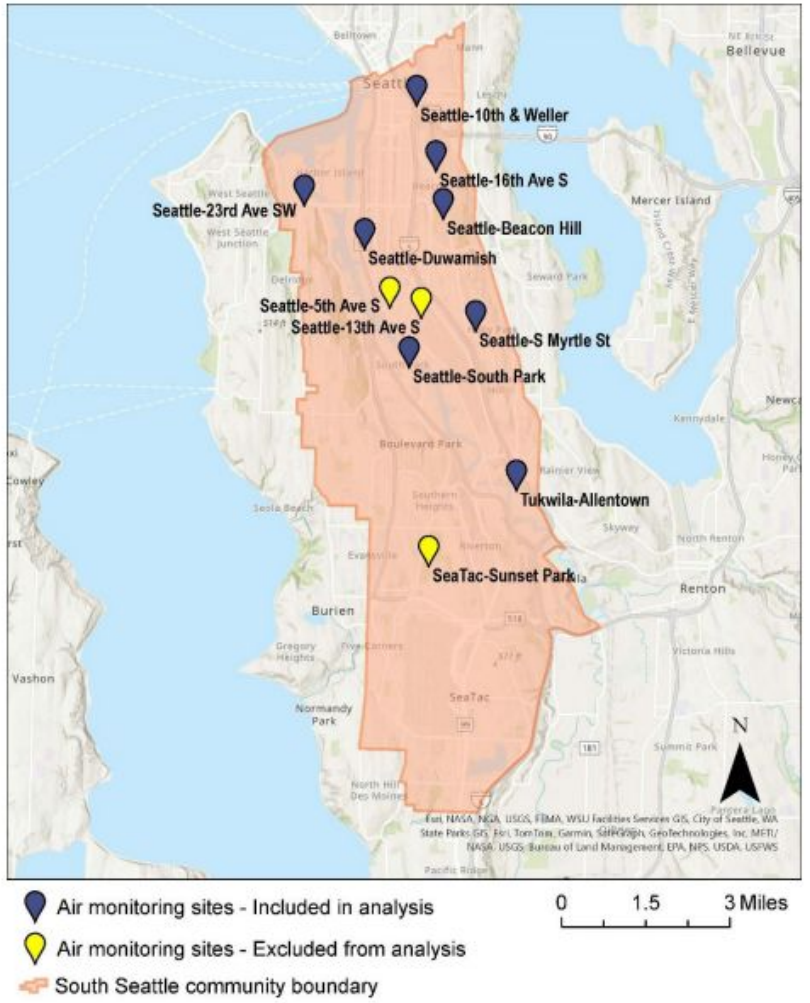
CAP	Monitor	Number
$PM_{2.5}$	Regulatory; non-Regulatory; SensWA	45 (21)
PM_{10}	Regulatory	8
O_3	Regulatory	4
NO_2	Regulatory	3 (1)
SO_2	Regulatory	1
CO	Regulatory	2

() = Monitored installed after Nov 2024, not included.

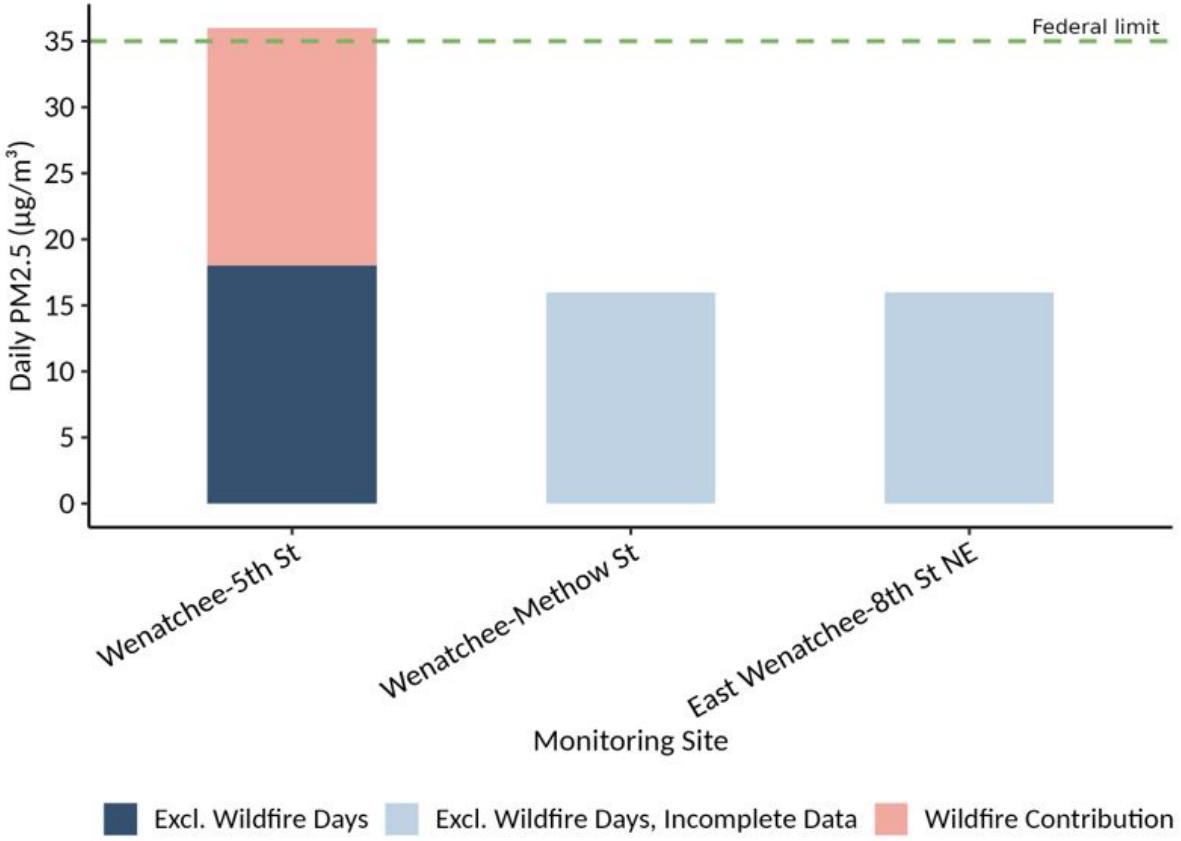
Results: Unhealthy Air Quality

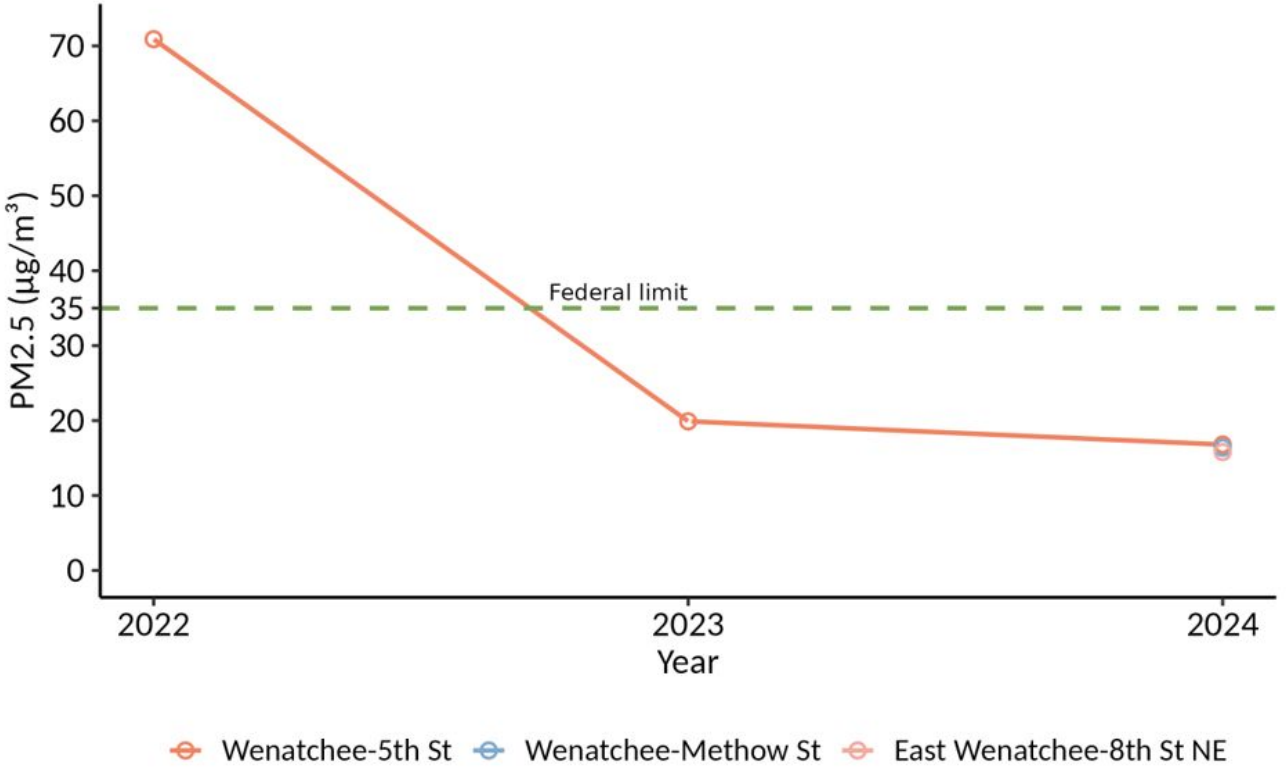
- Number of days with unhealthy air quality in South Seattle community
- Includes days impacted by wildfire smoke, 2022-2024





Results: Design Values





Methods: BenMAP-CE



Allows you to work with data at different geographic resolutions

Methods: BenMAP-CE



$$\Delta Y = (1 - e^{-\beta * \Delta AQ}) * Yo * Pop$$

Table 8. Estimated annual deaths by any cause associated with yearly $PM_{2.5}$ exposure among 18–84-year-olds in all 16 overburdened communities highly impacted by air pollution by racial and ethnic group, 2022–2023 (based on effect estimates in study by Pope, et al., 2019).

Racial[147] and Ethnic Group	Population[148] (18-84 year-olds)	Annual Number of Deaths [95% CI][149]	Annual Deaths Per 100,000 Population [95% CI]	Age-Adjusted[150] Annual Deaths Per 100,000 Population [95% CI]
All	1,027,215	430 [310 to 544]	42 [30 to 53]	48 [35 to 61]
Hispanic	215,569	94 [53 to 132]	44 [25 to 61]	85 [48 to 119]
Non-Hispanic AIAN	10,763	5 [-3 to 11]	42 [-29 to 105]	50 [-34 to 124]
Non-Hispanic Asian	116,527	47 [-32 to 119]	40 [-28 to 102]	44 [-30 to 110]
Non-Hispanic Black	79,896	43 [13 to 71]	54 [17 to 89]	71 [22 to 116]
Non-Hispanic NHOPI	16,258	4 [-3 to 10]	25 [-17 to 63]	45 [-31 to 114]
Non-Hispanic 2+ races	57,464	17 [-11 to 42]	29 [-20 to 73]	47 [-32 to 119]
Non-Hispanic White	530,739	279 [182 to 371]	53 [34 to 70]	49 [32 to 66]

AIAN: American Indian and Alaska Native; CI: confidence interval; NHOPI: Native Hawaiian and Other Pacific Islander; $PM_{2.5}$: Particulate matter with diameter 2.5 micrometers or less

PM2.5 associated all-cause mortality