



Engaging communities and study participants to develop tools that promote environmental health literacy and move science to action

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Food for thought: Community and participant engagement in research translation and tool-making promotes the 3 Rs



Photo: Communities for a Better Environment

Rigor: In design, data collection, ground-truthing, interpretation, etc.

Relevance: Emphasize causes of exposure & opportunities for action

- ✓ Collective
- ✓ Individual

Reach: Disseminate knowledge to advance policy change

Balazs CL, Morello-Frosch R. *Environmental Justice* 2013

Today's Roadmap:

1. Spatial cumulative impacts screening tool
2. Online tool to visualize sea level rise threats to EJ communities
3. Digital report-back of biomonitoring results to individual study participants

While research and scientific discovery is slow...
communities and participants want information now

Tools can leverage existing scientific evidence to facilitate
timely interventions and inform decision-making

Online mapping tools:

- Highlight communities of potential regulatory concern
- Inform targeted and holistic strategies that reduce harmful exposures and advance environmental justice

Digital tools for individual report-back of exposures:

- Promote environmental health literacy
- Elucidate opportunities for exposure reduction



Cumulative impact mapping tool



Choose indicators of cumulative impact that:

- Reflect current research on environmental and social determinants of health.
- Are transparent and relevant to policy-makers, regulators, and communities

Applicable for:

- Land use planning
- Funding allocations
- Regulatory decision-making and enforcement
- Community outreach/engagement

Engages communities in ground-truthing and iterative feedback



Five Categories of Cumulative Impact



Proximity to hazards & sensitive land uses

- Point and area emissions sources
- Land uses associated with sensitive populations

Health risk & exposure

- State and national data sources

Social & health vulnerability

- Based on epidemiological literature on social determinants of health
- American Community Survey/Census Data
- State data sources

Climate change vulnerability

- Based on climate change and health literature
- Heat islands, temperature, social isolation

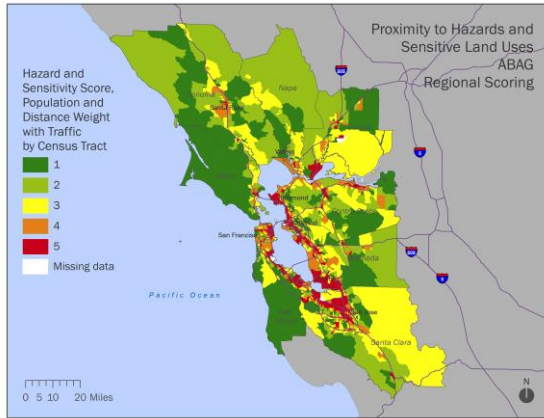
Drinking water

- Based on potential contaminant exposures
- Technical, managerial capacity of system/domestic well

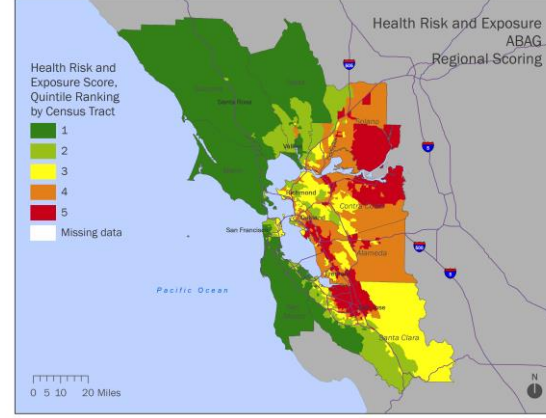


Environmental Justice Screening Method

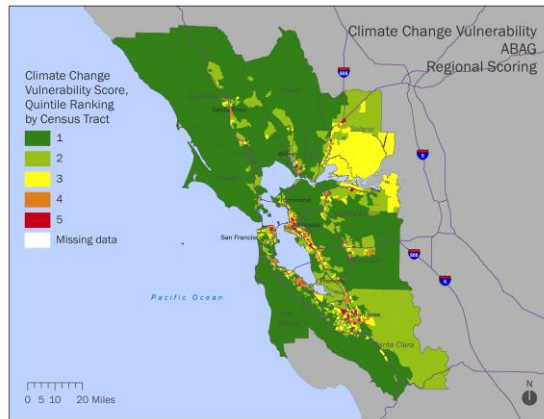
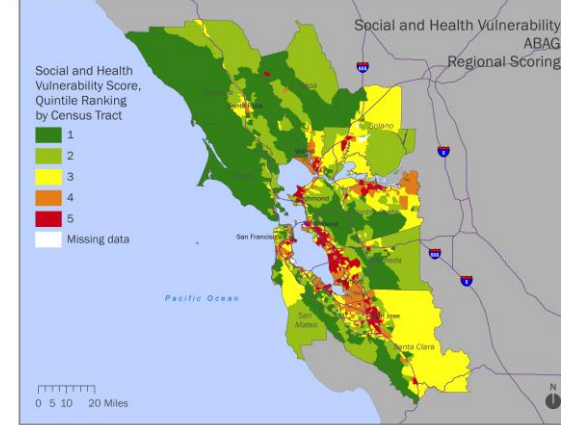
Proximity to Hazards



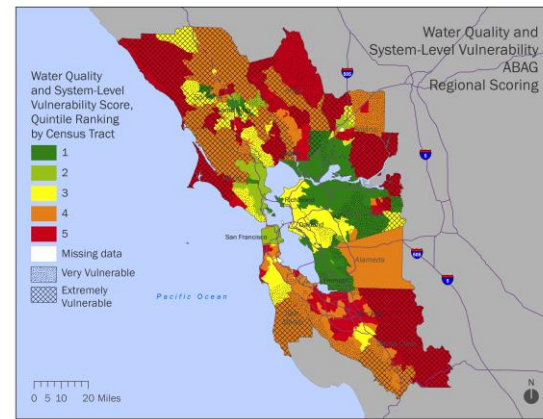
Health Risk and Exposure



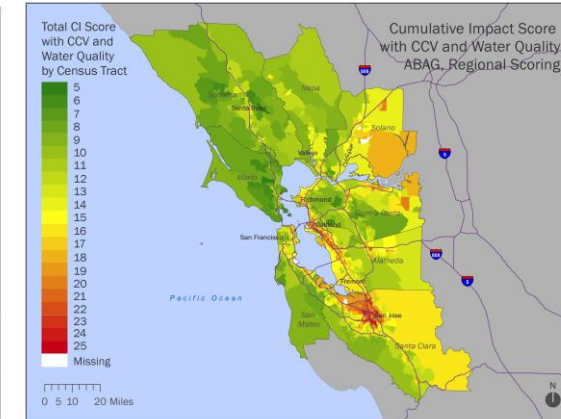
Social and Health Vulnerability



Climate Change Vulnerability



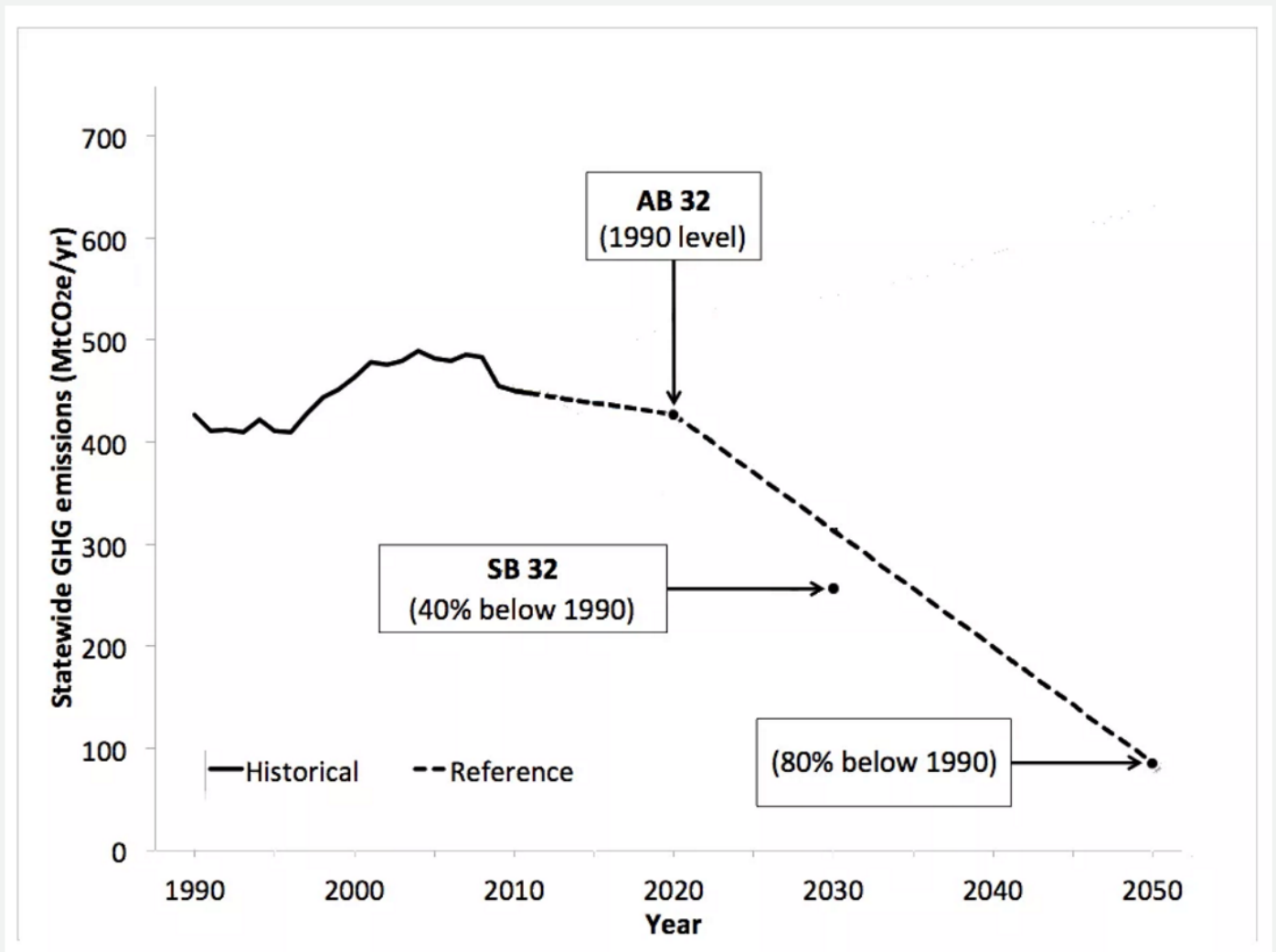
Drinking Water



Cumulative Impact Score



AB 32 & SB 32 – California’s Global Warming Solutions Act: Health and Equity Benefits?



California's historical emissions and targets under AB 32 and SB 32. (Adapted from Greenblatt, 2015)

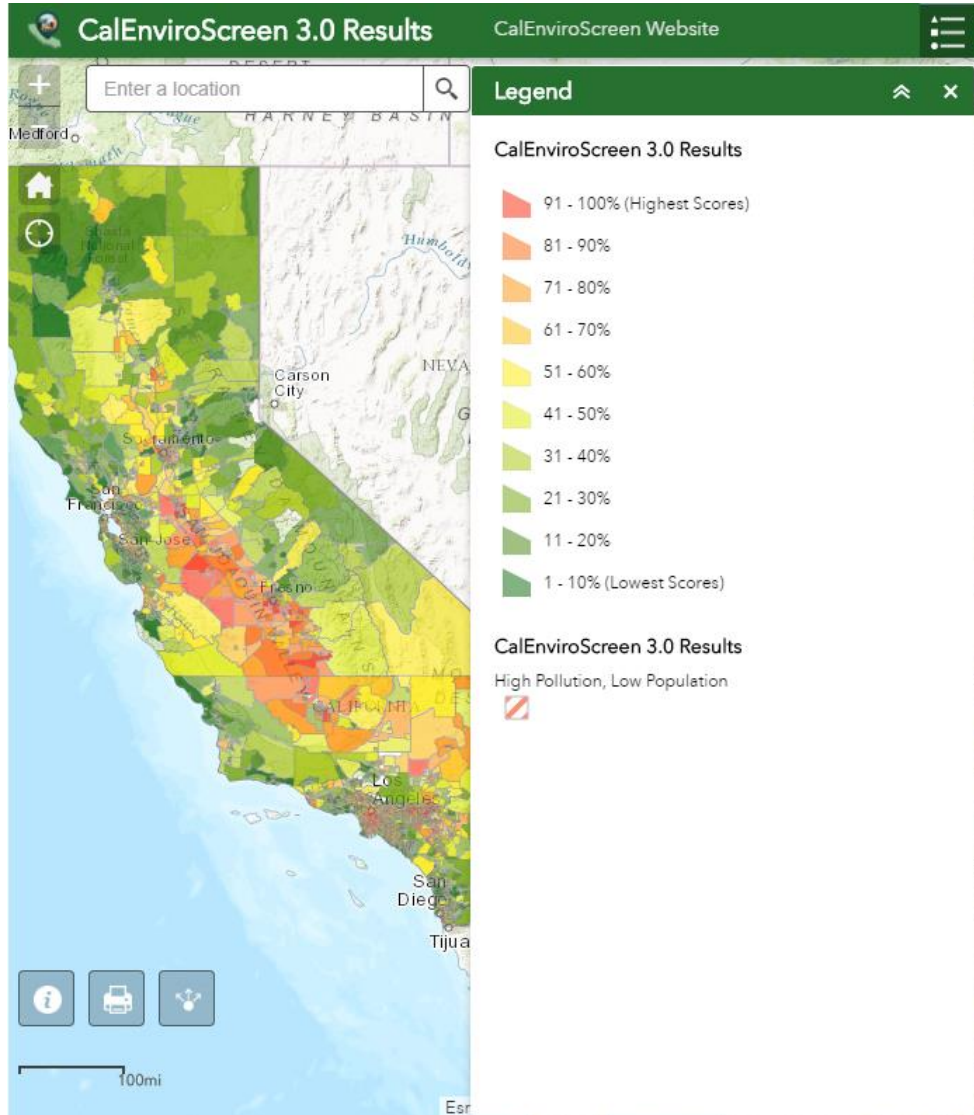
Integrating Equity and Sustainability Goals in CA's Climate Policy-- Greenhouse Gas Reduction Fund

Revenue from regulation of industrial greenhouse gas emissions targeted for investment in projects that:

- Reduce pollution and greenhouse gas emissions in disadvantaged communities
- Enhance co-benefits of GHG reductions
 - 35% of funds to benefit vulnerable groups
 - 20% invested in vulnerable neighborhoods directly



Cal-EPA's - Cal-Enviro Screen - <http://oehha.ca.gov/ej>



About

The Office of Environmental Health Hazard Assessment, on behalf of the California Environmental Protection Agency, announces [CalEnviroScreen 3.0](#). CalEnviroScreen is a screening tool used to help identify communities disproportionately burdened by multiple sources of pollution and with population characteristics that make them more sensitive to pollution. To learn more about CalEnviroScreen, go to the [OEHHA website](#).



Community engagement in tool development

Greenhouse Gas Reduction Fund Investments

\$11 billion dollars appropriated to date

2020



Affordable Housing and Sustainable Communities, Riverside

The Mission Heritage Plaza project is using \$16.8 million to help local partners build 71 new energy-efficient, affordable homes in downtown Riverside. The project will also plant over 200 new trees, provide two miles of new bike lanes, and create a multi-modal transit hub that links local and regional transit systems in one convenient location.



Climate Adaptation and Resiliency Program, Contra Costa

The Contra Costa County Flood Control and Water Conservation District (CCFCWCD) received a grant of \$1,250,000 to restore 400 acres of coastal wetlands and adjacent habitat at the mouth of Walnut Creek and its tributary, Pacheco Creek.



Transformative Climate Communities, Fresno

The Transform Fresno initiative, with \$66.5 million in Transformative Climate Communities (TCC) investments, allowed a broad group of stakeholders to collaborate on an integrated suite of projects meant to reduce disparities in these neighborhoods.



Technical Assistance, UC Agriculture and Natural Resources

In a partnership with the Strategic Growth Council and the California Department of Food and Agriculture (CDFA), the University of California Agriculture and Natural Resources (UC ANR) is providing outreach, education, and technical assistance to farmers and ranchers across California



Climate Change Research Program, Toxic Tides Project

The Toxic Tides research project, led by the University of California (UC), Berkeley Sustainability and Healthy Equity Laboratory is working to better understand how vulnerable communities living near hazardous sites may be affected under different sea levels rise scenarios.



Sustainable Agricultural Land Conservation, Brazelton ranch in Vacaville

The Brazelton family, in partnership with the Solano Land Trust, will ensure the Brazelton ranch in Vacaville remains intact in perpetuity by placing their property under a conservation easement. Conservation of farmlands that surround urban areas helps promote infill development, avoid GHG emissions, and maintain a viable



Transit and Intercity Rail Capital Program, Sonoma and Marin Counties

Sonoma and Marin Counties received an \$11 million grant to help pay for four newly manufactured rail passenger vehicles to complete the SMART Rail Car Capacity Project. Together with a newly launched 43-mile SMART passenger rail service across Marin and Sonoma Counties, these rail cars will connect communities, provide a transit



Climate Ready Program, Pauma Band of Luiseño Indians

The Pauma Band of Luiseño Indians are scaling up their carbon farming operations on Pauma Tribal Farms. This project includes funding for on-farm practices such as cropping, compost application, hedgerow installation, no-till, and a transition from row crops to trees for 35 acres of farmland.

Toxic Tides: Sea Level Rise, Hazardous Sites, & Environmental Justice in California



The coming change

Climate change & rising sea levels



The hazards

Facilities with toxic chemicals near tideline



The people

Poor communities and communities of color are more likely to live near hazardous sites

Approach

flood extent

facilities

vulnerability



Iteratively consult an advisory committee of EJ experts to inform study design & dissemination strategy



Identify the input variables of concern:

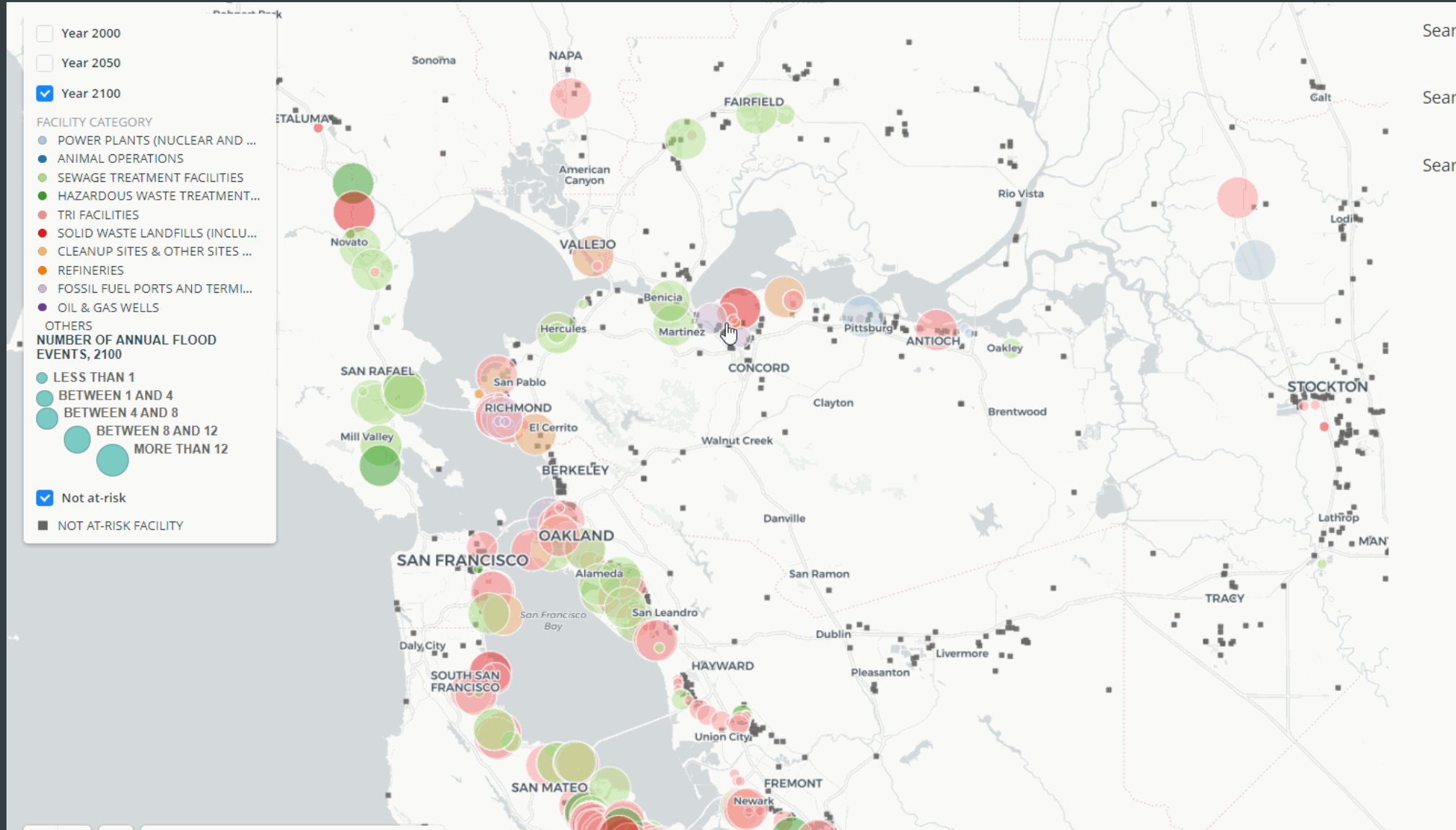


What are the numbers and types of hazardous facilities threatened by flooding due to SLR?

What are the baseline characteristics of populations in proximity to at-risk sites?

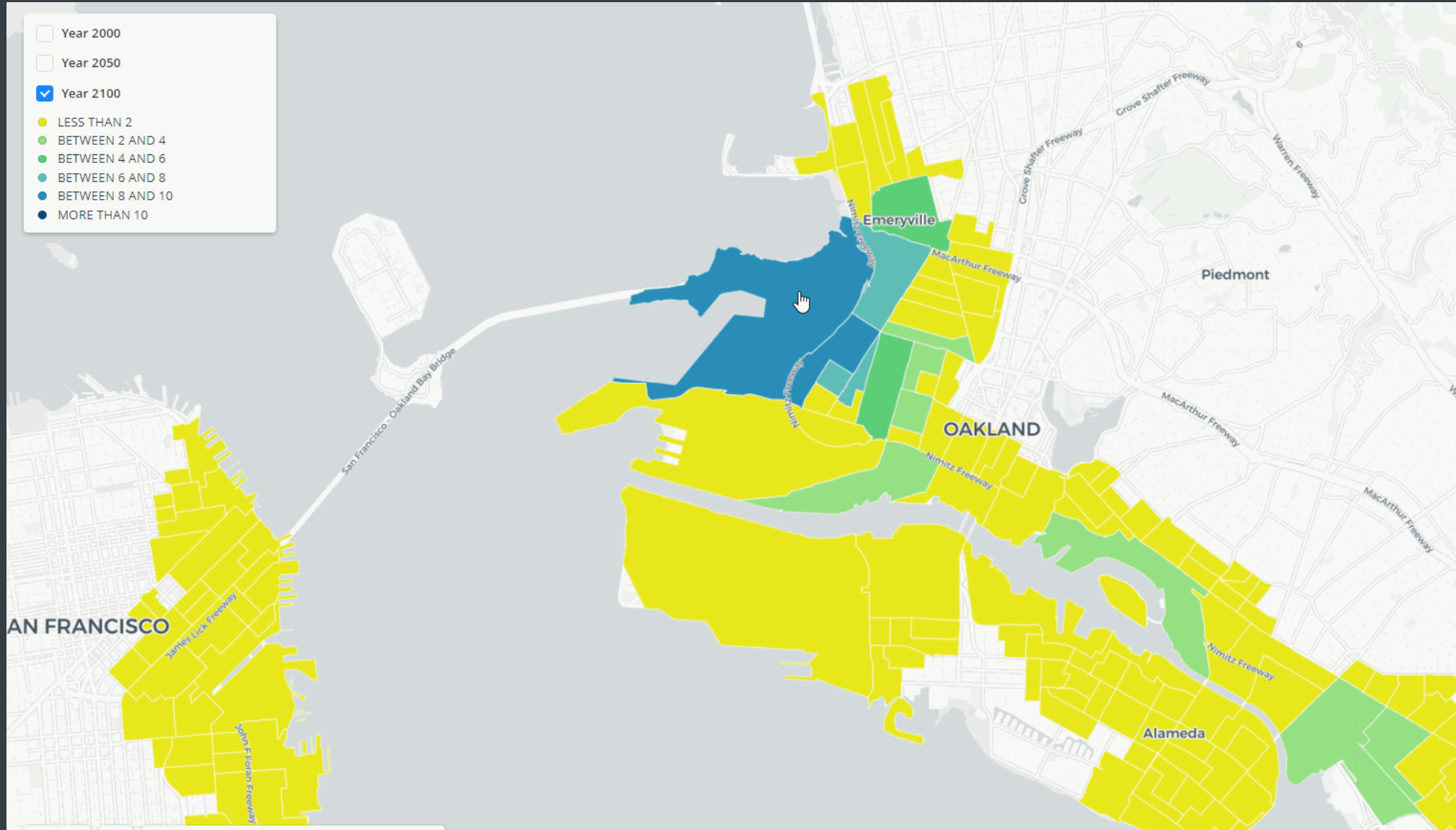
Toxic Tides:

Sea Level Rise, Hazardous Sites, and Environmental Justice in California



Toxic Tides:

Sea Level Rise, Hazardous Sites, and Environmental Justice in California



Women Firefighter Biomonitoring Collaborative



COMMONWEAL

Study Aims:

1. Characterize chemical exposures among women firefighters
2. Assess potential impacts on upstream biomarkers of effect



Office Workers



Firefighters



Exposure after a fire event

Reporting back biomonitoring results to study participants

What do participants want
to know?

- What did you find?
- How much?
- Is that high?
- Is it safe?
- Where did it come from?
- What should I do?



This website provides your study results
from the NCFF Study. It includes:

- + The levels of chemicals found in your samples.
- + How your levels compare with other people.
- + Where these chemicals come from.
- + How they could affect health.
- + Some ways that could help reduce exposures to these chemicals.

[Start Here](#)

Context

Firefighters are exposed to chemicals related to their jobs—at the fire ground, at the fire station, and from some firefighting equipment, gear, and foams. Like all of us, firefighters are also exposed to chemicals from consumer products, food, and other everyday sources.

The Northern California Firefighters (NCFF) Study was launched to measure some of the chemical exposures experienced by firefighters who responded to the 2017 Tubbs wildfire. The study also included a small number of firefighters who were not at the Tubbs fire as a comparison group. In addition, the study compares chemical levels in firefighters to levels measured in other Californians.

Chemicals in the study

Urine and blood samples collected for this study were tested for metals (antimony, cadmium, lead, manganese, and mercury), PBDE (polybrominated diphenyl ether) flame retardants, and PFASs (perfluoroalkyl and polyfluoroalkyl substances), which are used in water- and grease-resistant coatings and certain firefighting foams.

This website

This secure website, which can only be accessed by you and the NCFF Study team, includes the results of the chemical measurements that we did on your samples. By clicking through the website, you can learn more about where these chemicals come from, their links to health effects, and possible ways to reduce your exposures at work and at home.



Digital Exposure Report-back Interface (DERBI)

- ✓ A software framework that generates personalized exposure reports for PDAs, computers and print
- ✓ Scalable to studies of all sizes

Boronow et al. 2017 EHP

This web site provides your study results from the Women Firefighters Biomonitoring Collaborative Study. It shows:

- + The levels of chemicals found in your samples.
- + How your levels compare with other people.
- + Where these chemicals come from.
- + How they can affect health.
- + How you can reduce levels of these chemicals in your body, your home, and at work.

[Start Here](#)

Context

Firefighters are exposed to chemicals every day — at the fire ground, at the fire station, and in some firefighting equipment. [Read more](#)

Chemicals in the study

Your blood samples were tested for chemicals used in flame retardants, non-stick or stain-resistant surfaces, and products of combustion (burning). [Read more](#)

This website

This website includes the results of the chemical measurements we did with your samples. By clicking through the website, you can learn more about where these chemicals come from, their links to health, and how to reduce exposures in your home and community. [Read more](#)

[Landing page](#)

[Home](#)[Your Results](#)

- [Flame retardants](#)
- [PFASs](#)

[Overall Study Results](#)[Methods](#)[Reducing exposures for firefighters at work](#)[Table of Your Results](#)[Print Report](#)[Sign Out](#)

Results Summary

We found chemicals in every person we tested. Some people may want to make changes to reduce their chemical levels. We hope these results will help you make informed decisions.

Chemicals We Found In You

Your sample had one of the highest levels of [a flame retardant](#) in the study.

[Learn about actions that could help reduce your exposure](#)

Your sample had a higher level of [a PFAS](#) than most others in the study. Your levels of other PFASs were lower or similar to others in the study.

[Learn about actions that could help reduce your exposure](#)

All your results: [Flame retardants](#) / [PFASs](#) /

Health Concerns

The Women Firefighters Biomonitoring Collaborative is studying exposures to chemicals in firefighters and office workers to learn more about how women are exposed to chemicals in the workplace. If your level of a chemical is higher than other peoples', you may be able to reduce your level.

Everyone in the U.S. has chemicals in their body that could affect health. Having a chemical in your blood or urine doesn't mean you will get sick. We don't yet know whether exposure levels found in people are above or below levels that affect

Overall Study Results

The WFBC tested for 8 flame retardants. Firefighters had higher levels of flame retardants than office workers. For one chemical, BDCPP, firefighters' levels were five times higher on average. This chemical is listed as a carcinogen on California's Proposition 65 program. [Read more](#)

Firefighters may be exposed to some chemicals on-the-job. Firefighters who were recently engaged in fire suppression had somewhat higher levels of flame retardants than those who were not. [Read more](#)

Flame retardants can interfere with thyroid hormones. Participants who had higher levels of BDCPP tended to have lower levels of thyroid hormone. Thyroid hormones can affect metabolism and brain development. [Read more](#)

WFBC also did a broad screen of blood samples for over 700 chemicals to look for exposures to emerging chemicals that have not been measured in many studies before. [Read more](#)

We previously provided you with results for per- and poly-fluoroalkyl substances (PFAS) in the first report you received. PFAS are used in grease- and water-resistant coatings applied to fabric and food packaging and in certain firefighting foams. [Read more](#)

DERBI Chemicals page

(computer interface)

Personal headline →

Your Results: PFASs

Highly fluorinated chemicals



Your sample had a higher level of PFDoA than most others in the study. [Scroll down to see all of your results.](#)

Sources →

Where do these chemicals come from?

PFASs help products resist grease and water. They are applied to stain-resistant textiles (like carpets, furniture, and clothing), waterproof outdoor gear, and grease-repellent food packaging (such as fast food wrappers and microwave popcorn bags). PFAS chemicals are used to produce polytetrafluoroethylene (PTFE or "Teflon"), used on nonstick pots and pans and in some dental flosses and beauty products. PFASs are found in certain firefighting foams, called aqueous film forming foam (AFFF). Some drinking water supplies are contaminated by PFASs.

Health effects →

Why might these chemicals be a health concern?

PFASs tend to persist in the body and the environment. Exposure to these chemicals can affect:

- **Lipid metabolism.** PFASs can alter how the body breaks down and stores fats, which can affect energy, metabolism, and body weight and composition. PFAS exposure is associated with high cholesterol in humans.

Exposure reduction tips →

How can I reduce my exposure?

At home

- **Wash hands frequently.**
- **Avoid spray treatments** that make rugs, furniture, or other textiles stain- or water-resistant.

During and after a fire incident

- **Use a self-contained breathing apparatus (SCBA) from initial fire attack through the completion of overhaul** at structure, car, and dumpster fires, and whenever AFFF is used.
- **Use wet wipes to clean hands, neck, jaw and face** immediately after being engaged in fire suppression activities, overhaul, or other exposure to smoke.

Personal results graphs

(continued from Chemicals page)

Your Results

Legend

● your chemical level

○ A firefighter's chemical level

○ An office worker's chemical level

● A firefighter that didn't have a detectable amount of the chemical in their blood

● An office worker that didn't have a detectable amount of the chemical in their blood

ng/mL: nanograms of the chemical per milliliter of blood.

Tip: Mouse over your graphs to learn how to read them.

PFDA



PFOS



PFOA



PFUnDA



Scroll down to individual results graphs

- Graphs use visual abilities to communicate “gist”
- Identify outliers for additional exposure history

Your Results

Graph legend

● your chemical level



median chemical level for [other Americans](#)

$\mu\text{g/L}$: micrograms of the chemical per liter of blood

○ other participants' chemical levels



95th [95th percentile](#) chemical level for [other Americans](#)

Your results are shown on a [logarithmic scale](#).

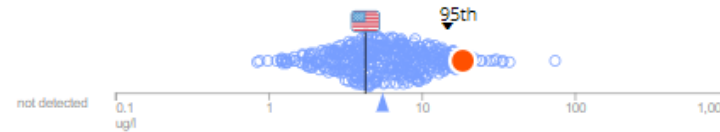
○ participants for whom the chemical was [not detected](#)



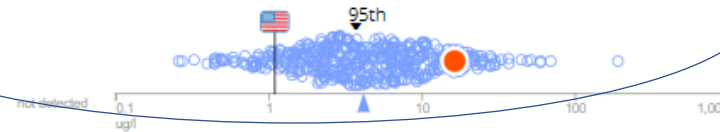
[median](#) chemical level for this study

Tip: Mouse over your graphs to learn more.

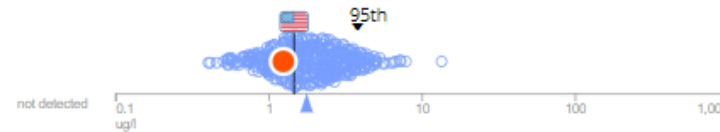
PFOS (perfluorooctane sulfonic acid)



PFHxS (perfluorohexane sulfonic acid)



PFOA (perfluorooctanoic acid)



Environmental Chemicals, Chronic Stress & Fetal Growth/Neurodevelopment in Offspring

ECHO/Chemicals in Our Bodies (San Francisco) & IKIDS (Champaign-Urbana)

Prenatal Chemical Exposures

Per- Poly- fluorinated chemicals (PFASs) & PBDEs and phenols

Chronic Stress Exposures

- Maternal perceptions of chronic stressor exposures
- Neighborhood Stressors
- Biomarkers of stress response
 - Maternal Corticotrophin Releasing Hormone (CRH)
 - Telomeres in maternal and cord blood leukocytes

Fetal Growth and Developmental Outcomes

Association of chemical and stress exposures (and their potential interactions) and:

- effect biomarkers (telomeres and CRH)
- perinatal outcomes
- neurodevelopment (7-8 months/2 years/4 years)



Focus group questions

- Reasons for participating in cohort
- Environmental health literacy and chemicals of specific concern
- Individual action
- Collective action
- Barriers to action
- Case scenarios regarding actions to reduce exposures
- Information needs/wants

PARTICIPATION: “I think that it’s a form of prevention, helping other people. Because not everybody else is in the study, not everybody else gets informed about the consequences of a toxic substance. So, giving them the information can help them with prevention, for the use of certain products both for themselves as well as for their children. ...so that they can make good decisions in the future.”

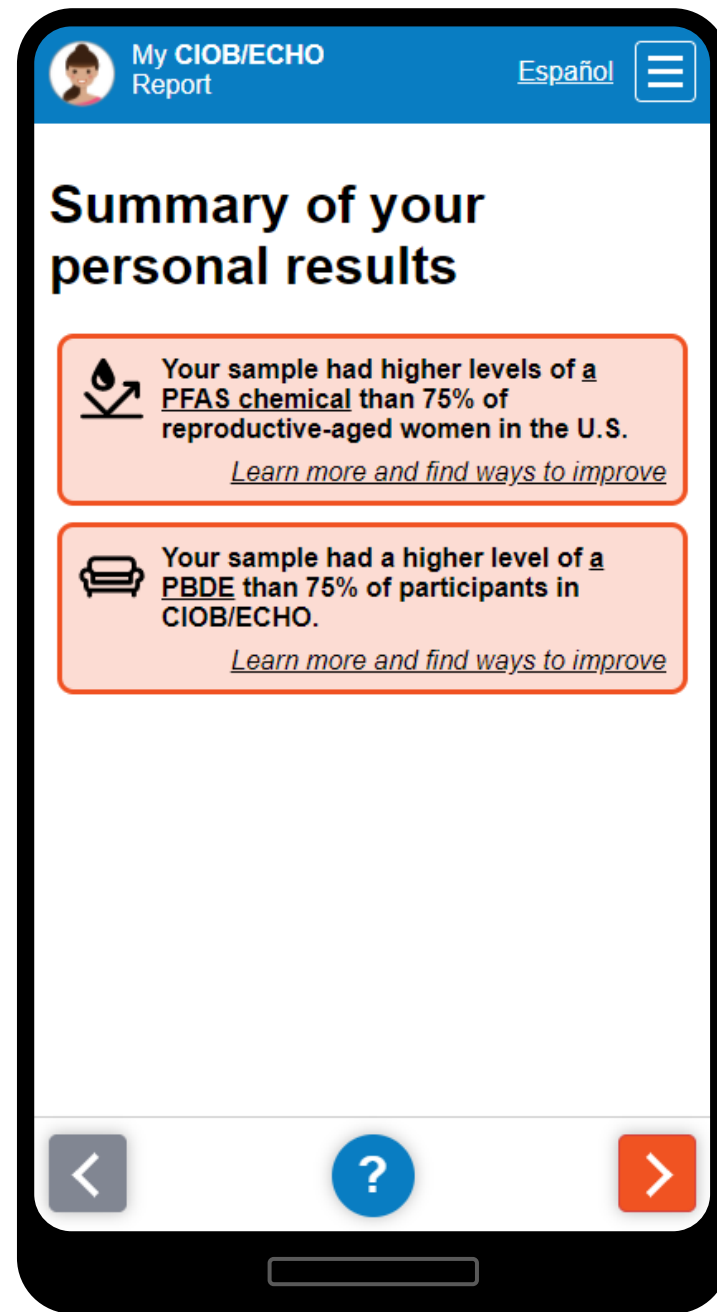
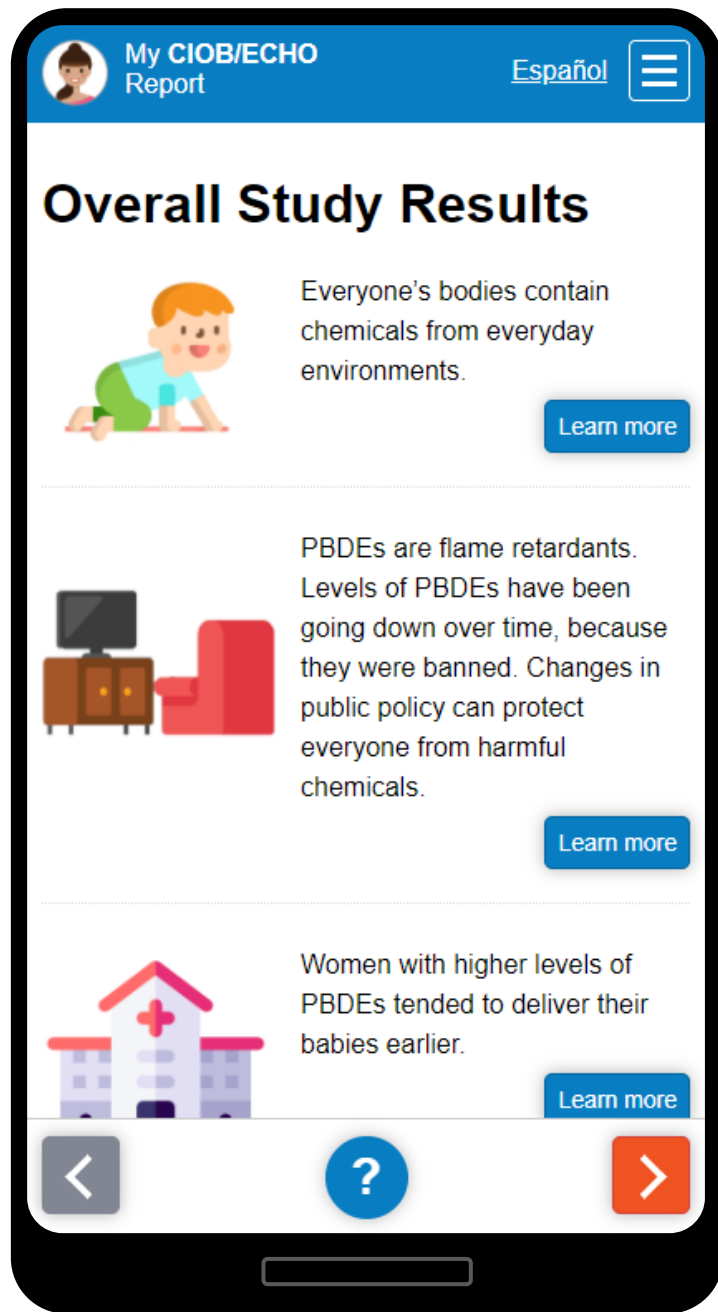
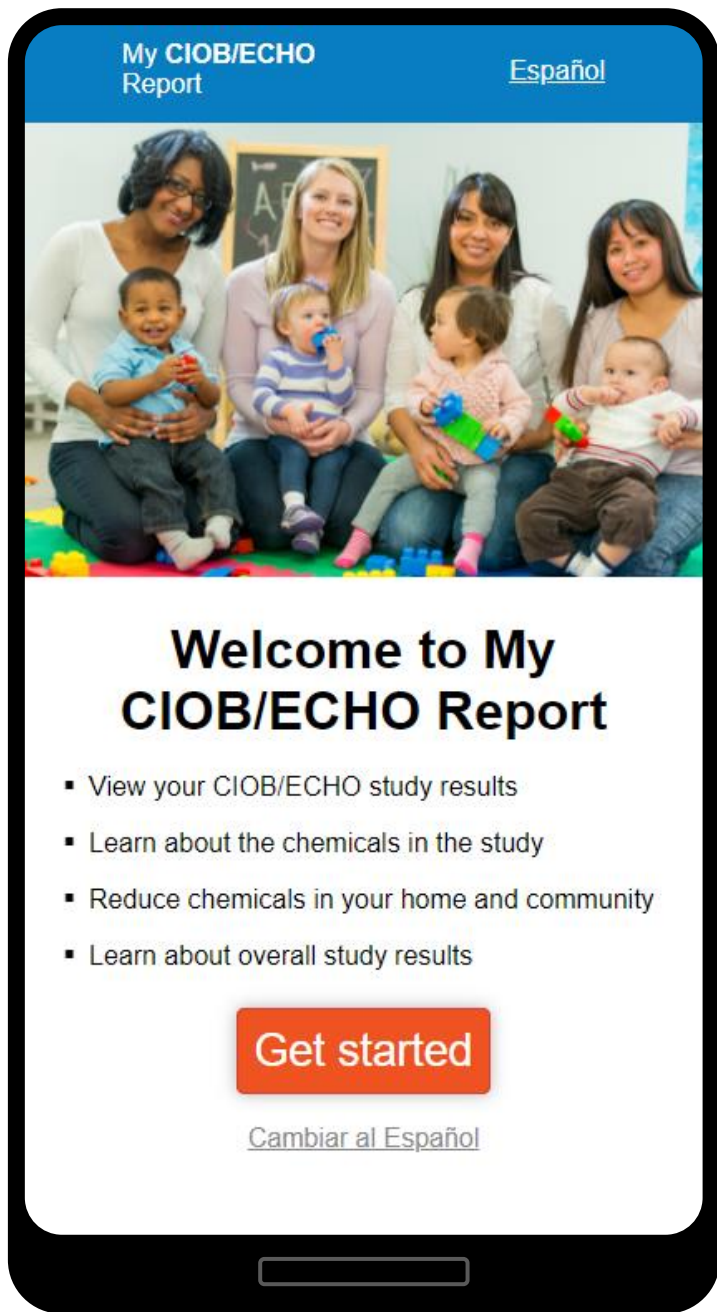
Chemicals in Our Bodies Participant (Sp)



Photo does not depict actual study participants

TAKING ACTION: “...collectively, I think we have an opportunity to make a difference such that we don’t have to keep having these shameful discussions of, ‘Oh, I feel like a bad mom because I have to feed my kids, and I don’t have room in my day to actively research every single product that we’re interacting with.’ That is, I think, a specific type of messaging we’ve been indoctrinated with to keep us overwhelmed and feeling like we can’t change anything.”

IKIDS Participant





PBDEs



Your sample had a higher level of PBDE 153 than 75% of participants in CIOB/ECHO.

↓ [Jump to tips to lower your exposure](#)

What are PBDEs?

PBDE (polybrominated diphenyl ether) flame retardants were widely used in furniture foam from 1960 until 2004, and in electronics like TVs, computers, and cables until 2013. Chemical flame retardants are one way of making it harder for products to catch fire. PBDEs were phased out of use in the U.S. due to health concerns, but people can still be exposed to PBDEs from products made before the phase-out. Also, because many PBDEs take years to be eliminated from the body, PBDE levels may reflect exposures from a long time ago.

Although PBDEs are no longer added to products, manufacturers sometimes use other types of flame retardants, some of which also have serious health

Back to Summary



Your Results

We tested your sample for 18 PBDEs. Your results for 12 PBDEs are in the graphs below. Another 6 PBDEs were not detected in anyone in the study. These are not shown in the graphs.

Legend



Your result



Typical U.S. woman 20-39 years old



Other women in CIOB/ECHO



Women in CIOB/ECHO who did not have the chemical detected in their sample

ng/g lipid nanograms of the chemical per gram of lipid (fat) in your blood

Click on any graph to see an expanded version with more details.

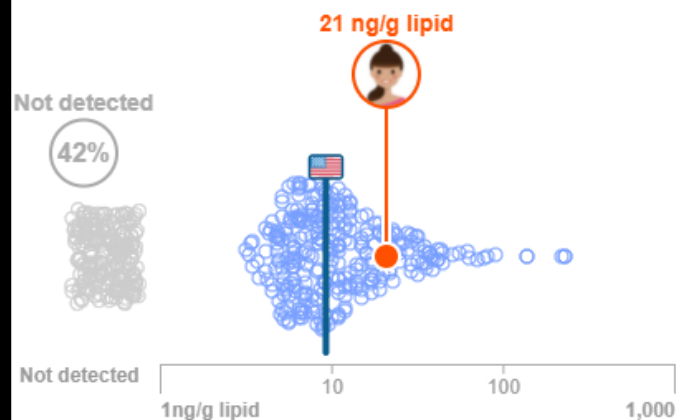
> PBDE 153



Back to Summary



▼ PBDE 153



Tap each part of the graph to learn more

> PBDE 99



> PBDE 47



> PBDE 100

Back to Summary



> PBDE 183



Not detected 1ng/g lipid 1,000

> PBDE 66



Not detected 1ng/g lipid 1,000

Click on any graph to see an expanded version with more details.

What can I do?

- **Wash your hands often**, especially before preparing or eating food.
- **Keep dust levels low.** Wipe surfaces with a damp cloth, use a wet mop, or vacuum with a HEPA (high-efficiency particulate air) filter. Each of these methods helps prevent dust from being recirculated into the air.

Show More ▾

Back to Summary



Community Action



Laws and community policies can protect **everyone** from harmful chemicals. By working together, Californians have led the way in demanding laws that limit harmful chemicals.

- In 2014, California revised a law to make it possible to sell furniture without flame retardants.
- In 2018, the City of San Francisco voted to ban PFAS in single-use food service ware, like take-out containers and disposable bowls or plates used in restaurants.

Your voice is important! Will you commit to taking at least one of these actions to keep toxic chemicals out of homes, schools, and workplaces?



> PBDE 154

Common Questions

Do you want help interpreting your results?
Call us at **(415) 580-0352** or email us at ucsfechostudy@ucsf.edu

- > Did the chemicals in my body affect my pregnancy or my child?
- > Is there a safe level of exposure for these chemicals?
- > How was I exposed to these chemicals?
- > Why do I have different levels of each PBDE or PFAS?
- > How do I get these chemicals out of me?
- > What does “not detected” mean?
- > What does “ng/g lipid” mean?
- > What does “ng/mL” mean?
- > What is the “typical” level and why are you showing it for U.S. women?
- > Why do I only have results for one chemical group?
- > What organizations are part of the CIOB/ECHO study?

Close

Community-engagement in environmental health tools development

Transform the scientific enterprise by engaging communities and/or participants tool design:

- **Elevates community and participant knowledge**, challenges traditional power dynamics in the research process and can directly benefit the communities involved.
- **Democratizes science** from a top-down, extractive process to one of co-learning and co-production.
- **Improves EH Literacy and facilitates research translation** to improve policy and regulation.

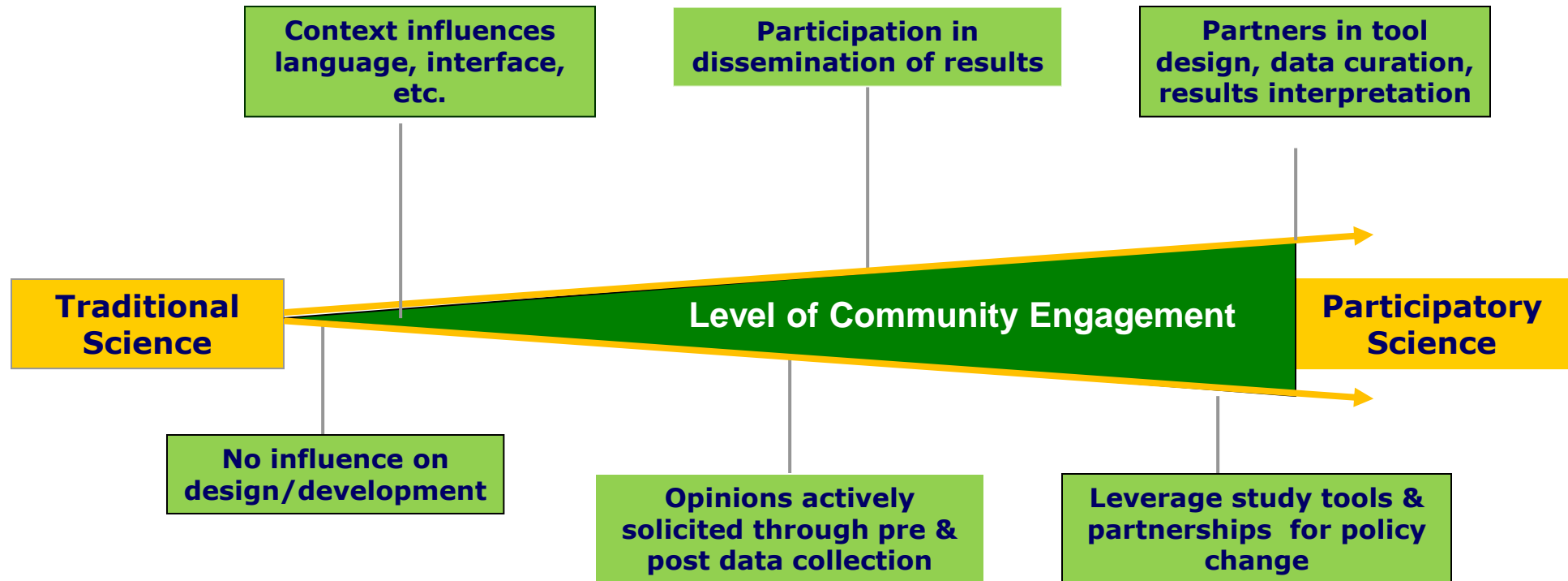


Photos: J. Brody & R. Morello-Frosch

Continuum of community engagement

From *Translational* Research...

...to *Transformational* Research





Thanks to our team & funders



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 @rmfrosch



UC Berkeley: Kathy Tran, Nick Depsky, Clare Pace, Jessica Trowbridge, Cassidy Clarity, Anthony Nardone, Katie Wolf, Bill Jesdale, Seigi Karasaki, Yang Ju

Columbia University: Joan Casey

UCLA: Lara Cushing

UCSF Program on Reproductive Health and the Environment: Tracey Woodruff, Erin DeMicco, Stephanie Eick, Dana Goin, Cynthia Melgoza Canchola, Aileen Andrade, Susan Fisher, Jue Lin, Lynn Harvey, Cheryl Godwin de Medina, Amy Padula, Marya Zlatnick, Aolin Wang, Dimitri Abrahamsson

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- NIEHS P01 ES022841

NIH ECHO Program (UG3OD023272 and UH3OD023272)

California Strategic Growth Council (CCRP0022)

NIEHS Superfund Research Program (P42ES004705)

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Centers for Disease Control and Prevention (5U38EH000481)

U.S. EPA Science to Achieve Results Fellowship (91744701-01)

California Breast Cancer Research Program (#19BB-2900)

