

TITLE: Total Exposures to Air Pollutants and Noise in Disadvantaged Communities

PRIME CONTRACTOR: University of California, Berkeley

SUBCONTRACTOR(s): University of California, Merced

PRINCIPAL INVESTIGATOR(s): Elizabeth Noth, Ph.D.

CONTRACT TYPE: Interagency Agreement

BUDGET: \$800,000

CONTRACT TERM: 24 Months

For further information, please contact Dr. Jeffery Williams (jeffery.williams@arb.ca.gov)

I. SUMMARY

Exposure to particulate and toxic air pollutants such as PM_{2.5}, ultrafine particles, and Volatile Organic Compounds (VOCs) is associated with adverse health effects including asthma, respiratory disease, cardiovascular disease, lung cancer, and poorer neurodevelopmental outcomes in children. CalEnviroScreen, a geographically-based mapping tool that ranks communities by potential exposure, vulnerability, and social economic indicators, shows that many low income and disadvantaged communities (DACs) in California experience higher air pollution and consequent health impacts compared with more affluent neighborhoods. In addition to higher pollutant exposures, DACs are subjected to higher levels of ambient noise, which is also known to negatively impact health. While numerous studies have shown that DAC's are subjected to disproportionate exposures to air pollutants and noise, there is less known about the direct impact of different sources, activities, and residential spaces on the total air pollutant and noise exposures for individuals.

This research will use indoor and outdoor field studies along with personal monitoring conducted in DACs in Northern California and the San Joaquin Valley to assess exposures to pollutants and noise. DACs will be selected based on the potential for a

wide range of air pollutant sources and different types of residential spaces. The expected results will address knowledge gaps about exposures in DACs by providing information on how personal behaviors and external factors such as building characteristics (housing stock, ventilation and filtration systems, etc), modes of transportation, or participant location contribute to pollutant and noise exposure and indoor air quality (IAQ). The results from this study will be used to assess potential health risks for DAC residents and support the goals of California Assembly Bill 617 (AB 617) by identifying the top localized sources and personal activities that are most responsible for air pollutant and noise exposure in DACs. This study will also provide CARB with data to inform policies for decarbonization.

II. TECHNICAL SUMMARY

Objectives

The objectives of this research are to characterize the exposure patterns of people living in DACs to particulate and toxic air pollutants such as PM_{2.5}, ultrafine particles, and VOCs, as well as noise both outdoors and indoors and to identify potential sources that may contribute to higher exposures. In addition, survey data will be used to determine whether factors such as housing stock, consumer product choices, social and environmental factors or other factors may be responsible for elevated exposure to certain air pollutants and risks for adverse health effects. This research will address knowledge gaps by providing information on how behaviors (cooking, cleaning, etc.) and other determinants (building characteristics, types of appliances, ventilation and filtration, etc.) affect personal and total pollutant exposures. One particular focus of the study will compare diesel exhaust exposures along interstate highways where large trucks are not permitted versus heavy truck transportation corridors. Finally, associations will be examined between environmental exposures and participant health, including respiratory health and family stress, sleep habits, and, for children, behavioral challenges. Results from this study will help inform whether elevated risk to particular air pollutants necessitate more stringent regulations/standards as well as optimal exposure mitigation strategies for the protection of residents in DACs.

Background

Since the passage of the US Clean Air Act in 1970, air quality has continued to improve; however, these improvements have not benefitted everyone equally. Disparities persist for both exposure to harmful air pollutants and incidence of adverse health effects in the United States. Decades of public health research clearly shows that people living in DACs experience higher than average exposures to airborne pollutants, with increased rates of asthma, heart disease, and premature mortality as compared to people not living in DACs.

Ambient noise is an environmental stressor that disproportionately affects people living in DACs and commonly emanates from mechanized sources (cars, planes, rail), industry, construction, and power generation. The stresses related to environmental noise are correlated with hearing loss, annoyance, sleep disturbance, increased occurrences of hypertension and cardiovascular disease, and impaired cognition in school age children. The current environmental justice literature suggests that in general, noise levels during the day and at night are higher for census block groups that had a higher proportion of non-white and low SES residents.

This study will be the first in California to measure indoor and outdoor noise levels concurrent with air quality and develop cumulative exposure metrics characterizing exposures to mixtures of air pollutants and noise. This study will also provide information to CARB staff to help identify the top sources of air pollutant and noise exposures in DACs which could inform future mitigation strategies. This research is essential to provide guidance and best practices for reducing total exposure to air pollution and noise in DACs, and possibly guide the development of building-related regulations to improve public health.

Proposal Summary

To assess total exposures to air pollutants and noise in disadvantaged communities, the primary aims and methods for this study are:

1. *Complete Literature Reviews*

Methods: A literature review will be conducted of population and community studies examining air pollution exposures nationally and in California DACs and non-DACs. The review will summarize information on disparities based on CalEnviroScreen scores, historical information on pollution trends by region in California, and the impact of regulatory approaches to reduce disparities, such as diesel emission regulations. Investigators will also review literature on noise exposures and health impacts nationally and in California, and the distribution of exposures by social-economic factors. They will also examine the utility of the national Geographic Information System (GIS) noise-mapping tools and how they might be used in relation to studies planned for this study.

2. *Identify vulnerable communities for air monitoring and noise exposure studies in the San Francisco Bay Area (SFBA) and the San Joaquin Valley (SJV)*

Methods: Potential study partners in the SFBA and SJV will be identified, as well as AB 617 selected communities to focus the study activities. Other locations based on CalEnviroScreen air pollution scores and study logistics will be considered. The studies will likely focus on neighborhoods along the I-880/80 corridor and the Shafter and South-Central Fresno AB 617 selected communities to include both rural (agriculture) and urban locations.

3. *Conduct studies assessing total exposures to air pollutants and noise in DACs*

Methods: Existing home-inspection survey instruments from prior Center for Environmental Research and Children's Health (CERCH) air quality studies will be adapted for the current study. The inspection forms will be reviewed by CARB and other interested stakeholders, and piloted in the SFBA and SJV.

Field measurements will be conducted in the SFBA and SJV to assess exposures to air pollutants and noise in disadvantaged communities. Ninety to 120 participants will be enrolled (approximately 30 households in each of four locations). Based on the timeline and sample collection over warm and cold seasons, field monitoring will occur over nine months (summer 2021-winter 2022), which will require approximately 13 participants a month. The studies will utilize real-time sensors to monitor PM_{2.5}, black carbon (BC), and criteria pollutants both indoors and outdoors. Exposures to key VOCs including formaldehyde will also be measured. A subset of participants will also

be asked to carry a backpack to collect personal exposure measurements for both particles and noise. Passive sampling devices will be tested for collecting PM samples to characterize ammonium nitrate in agricultural and non-agricultural communities and identify particle sources based on methods developed by the California Department of Public Health (CDPH).

4. *Identify sources of exposure and other determinants that affect pollutant levels and exposure* (e.g., building characteristics, appliance types, and personal behaviors)

Methods: Participant responses to the questionnaires will help identify sources of VOCs and particulate matter exposure in the home (e.g., cooking behaviors, wood burning, hobbies, etc.) and proximity of the home to ambient sources of VOCs and noise pollution such as auto, truck, buses, and other traffic. We will also collect information about sources and determinants of exposures in occupational settings, including work Standard Industrial Classification (SIC) codes, specific tasks, chemicals used at work, use of tools and equipment, and whether work is inside or outside.