

STATE OF CALIFORNIA
AIR RESOURCES BOARD

MEETING OF THE
RESEARCH SCREENING COMMITTEE

September 23, 2024
10:00 a.m.

California Air Resources Board
Research Division
Cal/EPA Building
1001 I Street
Sacramento, CA 95814
(916) 445-0753

California Air Resources Board

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Sacramento, CA 95814
(916) 445-0753

September 23, 2024
10:00 A.M

Agenda

- I. Approval of Minutes of Previous Meeting
 - May 2, 2024 *i-ii*

- II. Discussion of Research Proposals
 - 1. “Enhancing Health Impact Assessment in California: Integrating High-Resolution Air Quality Modeling and Community Characteristics,” University of California, Los Angeles, \$800,000 *1*

 - 2. “Dust on the Horizon: Assessing Current and Projecting Future Health Risks from the Shrinking Salton Sea,” University of California, San Diego, \$930,000 *6*

 - 3. “Residential Appliances in Diverse California Communities: Emission, Exposure, and Health Impacts of Toxic Air Contaminants (RESPECT),” University of California, Los Angeles, \$926,365 *13*

- III. Other Business
 - 1. Update on Research Planning

California Air Resources Board

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Sacramento, CA 95814
(916) 445-0753

May 2, 2024
10:00 A.M

Minutes

Research Screening Committee Meeting Members in Attendance via Teleconference

Dr. Aly M. Tawfik
Dr. Sam Silva
Dr. Roya Bahreini
Dr. Mary Johnson
Dr. Francesca Hopkins
Dr. Bryan Hubbell

I. Approval of Minutes of Previous Meeting

March 19, 2024

II. Discussion of a Research Proposal

1. "Characterization of Train Brake- and Wheel-Wear PM Emissions," University of California, Riverside, \$1,150,000

The Committee recognized that the proposal was comprehensive and included ambitious goals given the proposed budget. The Committee provided the following comments and suggestions for consideration:

- Characterize non-exhaust emissions for onboard passenger exposures and near-railway neighborhoods separately, where feasible.
- Collaborate with the U.S. Environmental Protection Agency's (EPA's) Office of Transportation Air Quality by inviting them to the project workgroup.
- Ensure a high degree of collaboration with railyards and train operators to best achieve the goals.
- The advancement of electric trains or high-speed rail results in different non-exhaust emissions from the baseline emissions that will be measured in this project. Consider incorporating the new technology advancement during the research investigation where possible.

Motion: Move to recommend that California Air Resources Board (CARB) accept the proposal, subject to the inclusion of revisions based on comments from staff and the Committee.

The Committee approved the motion.

III. Discussion of a Draft Final Report

1. "Remote Sensing Measurements of Light-Duty Vehicle Emissions at Multiple California Locations," Eastern Research Group, \$650,000, Contract No. 20RD001

The Committee considered the current version of the report to be of higher quality than the version its members reviewed for the previous Research Screening Committee (RSC) meeting on March 19, 2024, though the Committee continued to consider the quality to be below the general standard for the final reports of other CARB-sponsored studies. The Committee recommended that the report include clarification that the data collected in the project would be accessible to the public through a public medium such as a public website.

Motion: Move to recommend that CARB accept the draft final report, subject to the inclusion of revisions based on comments from staff and the Committee.

IV. Other Business

1. Update on Research Planning

Staff provided Committee members with an update on ongoing research efforts. This item did not require a vote.

Item No.: II.1
Date: September 23, 2024
Proposal No.: 2881-313

Staff Evaluation of a New Research Project

Title: Enhancing Health Impact Assessment in California: Integrating High-Resolution Air Quality Modeling and Community Characteristics

Contractor: University of California, Los Angeles

Subcontractor: University of Southern California

Principal Investigator: Yifang Zhu, Ph.D.

Budget: \$800,000

Contract Term: 24 Months

For further information, please contact Dr. Hye-Youn Park at (279) 208-7575 or Hye-Youn.Park@arb.ca.gov

I. Summary

There is a growing need to employ high-resolution, local-scale data to more accurately assess health impacts and better understand differential impacts between communities. This study will utilize high spatial resolution exposure assessment methods and health estimates (e.g., baseline disease rates) to develop local inputs that can be used for health impact analysis. This study will develop approaches for quantitative analysis of the health impacts of emission reductions at a more granular spatial scale than currently assessed by CARB and provide inputs for more accurate health analysis at the regional and statewide scale. This study aims to develop methodologies that incorporate socio-economic and community factors into health impact assessments, focusing particularly on estimating the health impacts on disadvantaged communities, such as the communities identified in SB 535.

II. Technical Summary

Objective

The main objectives of this project are to develop localized data for CARB health analysis in three key areas: exposure, health, and community factors. Researchers will develop an advanced exposure

assessment using high-resolution air quality models, such as CMAQ, to evaluate the exposure of overburdened communities to criteria pollutants, with a primary focus on PM_{2.5}, though other criteria pollutants may also be considered. The project will also establish a methodology for estimating fine-scale spatial baseline health data, accounting for limitations in data availability. Additionally, it will create an approach that considers the impacts of socio-economic and community characteristics on health outcomes to better understand how different populations are affected by air pollution. Communities will be selected for in-depth exposure analysis based on criteria that prioritize those with high pollution burdens and vulnerability, such as those in the top percentiles for cumulative impacts, as indicated by CalEnviroScreen scores. These selected communities will ensure the scalability of results to other comparable communities in the state and will serve as key sites for ground truthing pollution data. Ground truthing will involve consultation with community partners, use of portable monitoring equipment, saturation monitoring, and validation of air quality modeling data.

Background

CARB's current incidence-per-ton (IPT) methodology, which is based on measurements from monitoring stations, assesses the health impacts of PM_{2.5} in California at a regional level (e.g., air basin) and does not account for the disproportionate impacts experienced by communities or subpopulations. Background on CARB's health analysis methodology is available on the CARB website. Previous research has shown that the vulnerability of communities to air pollution health effects is influenced by multiple factors, including exposure, socio-economic conditions, and community characteristics. Moreover, the spatial resolution of health benefits analysis often lacks the granularity needed to capture the heterogeneity of air pollution exposure accurately. To assess health benefits more accurately, it is important to develop and incorporate inputs such as air quality, baseline disease rate, and community data at a local scale. Without this level of detail, there is a risk of biases that could limit the ability to identify and address the areas and populations most at risk, particularly within cities. This project will provide CARB with important health information to explore the local/community impact of its air pollution control efforts and could provide new approaches for informing and expanding health assessment.

Proposal Summary

To better quantify the health risks faced by overburdened communities in California, the Contractor proposes to develop refined health impact assessment (HIA) inputs that reflect community exposures and health conditions. The main goal of this proposed contract is to provide health, exposure, and community data inputs for health analysis at a fine spatial resolution, specifically targeting communities most burdened by air pollution and other stressors. The approach involves:

- Reviewing literature to evaluate the state of the science on modifiers of the air pollution-mortality relationship and methods to incorporate sociodemographic datasets in health burden analysis (Task 1);
- Developing a high-resolution exposure assessment framework using advanced air quality models to estimate PM_{2.5} and ozone levels across California and in overburdened communities for defined future policy scenarios (Task 3.1);
- Ground-truthing these air quality model outputs through established air quality monitoring networks and community-based data collection to produce refined exposure assessments (Task 3.2);
- Generating fine-scale spatial baseline health data that account for social, racial-ethnic, and other susceptibility factors (Task 4); and
- Integrating these refined baseline health data with refined exposure assessments and other community data to develop adjustment factors for community-specific characteristics that influence air pollution-related health outcomes (Tasks 5).

This project will provide CARB with localized data that could enable more comprehensive health analysis of emission reduction policies and incorporate conditions in overburdened communities. These efforts will help CARB to better understand the adverse health impacts of air pollution, particularly for California's most vulnerable populations.

III. Staff Comments

Dr. Zhu submitted the pre-proposal on June 7, 2024, followed by an initial proposal on July 24, 2024, and a revised version of the proposal on August 19, 2024. The pre-proposal was reviewed by one (1) staff member from the California Office of Environmental Health Hazard Assessment (OEHHA) and seven (7) staff members from CARB: three (3) from Research Division (RD), two from Air Quality Planning and Science Division (AQPSD), one (1) from Monitoring and Laboratory Division (MLD), and one (1) from the Office of Community Air Protection (OCAP). The full proposal was reviewed by four (4) CARB staff members, one (1) California Environmental Protection Agency (CalEPA) staff, and an OEHHA staff member. Reviewers' comments are summarized below. CARB staff and the research team met on August 13, 2024 to discuss the details of the contract, and the research team submitted the revised proposal on August 19, 2024.

Overall, the reviewers found the proposal well written and the proposed research sound. The reviewers noted the high degree of expertise in exposure assessment, epidemiology, and statistical modeling by Drs. Zhu, Jerrett, Connely, Zhang, Jin, and Banerjee. The reviewers expressed confidence in the ability of the researchers to conduct the project as presented in the proposal. The PI and several co-PI's, with the exception of Dr. Zhang, have previously participated in CARB contracts. The reviewers suggested adding more detail to certain sections of the proposal, such as the community ground truthing of the exposure assessment and the statistical modeling for estimating the community factor task (task 5).

In the August 19, 2024 revision, the investigators updated the proposal and responded to these suggestions by adding more details to the methodology for Task 5, clarifying details of the predictors that will be used to estimate the community factors in Task 5, and adding a summary of the statistical approaches for Tasks 4 and 5, along with a table of the intended parameters for estimation. CARB staff found that the revised proposal was improved compared to the initial version, and no additional changes were requested.

IV. Staff Recommendation

Staff recommends the RSC recommend that CARB approve this proposal for a total amount not to exceed \$800,000, subject to inclusion of any changes and additions specified by the Committee.

Item No.: II.2
Date: September 23, 2024
Proposal No.: 2882-313

Staff Evaluation of a New Research Project

Title: Dust on the Horizon: Assessing Current and Projecting Future Health Risks from the Shrinking Salton Sea

Contractor: University of California, San Diego

Principal Investigators: Amato Evan, Ph.D.
Alexandra Heaney, Ph.D.
William Porter, Ph.D.
Adeyemi Abebiyi, Ph.D.
Shu-Hua Chen, Ph.D.
Paolo D’Orico, Ph.D.
Eunha Hoh, Ph.D.
Jasper Kok, Ph.D.

Budget: \$930,000

Contract Term: 30 Months

For further information, please contact Dr. Patrick Wong at (279) 208-7295 or Pat.Wong@arb.ca.gov

I. Summary

Dust storms are common in the Imperial and Coachella Valleys, where the arid landscape conspires with frequently gusty winds to loft dust into the atmosphere. The shrinking Salton Sea is also driving an increase in dust emissions from the growing dried sediment (playa). This represents a unique challenge for the communities of the region, particularly since dust emitted from the playa may be enriched with contaminants from historical agricultural and industrial activity. Prior research by U.S. Geological Society and academic researchers has identified the presence of legacy contaminants such as organochlorine and organophosphate pesticides and heavy metals. People living in communities near Salton Sea report a high incidence of respiratory problems, including asthma, and there is growing concern about public health impacts from exposure to dust from Salton Sea. Dust emissions are predicted to further increase because of climate change impacts, including the likelihood of regional dust storms that could mobilize very large quantities of contaminated dust from Salton Sea playa. This research project will quantify the

amount of dust being emitted from different dust sources in the Salton Sea region, including desert, playa and agricultural emissions. The investigators will also collect and analyze playa and airborne dust for contaminants of concern and characterize the potential for health effects from exposure to Salton Sea dust during different wind events. These results will be extrapolated to provide information about possible effects from dust storm conditions statewide using computer models. Actions to reduce human exposure to dust will also be identified and discussed.

II. Technical Summary

Objective

In this project, the contractor will address the following objectives:

- Quantify dust emissions from different dust sources in the Salton Sea region using existing data sources and conducting air sampling;
- Model the transport of dust emissions under a variety of scenarios to predict impacts under different weather conditions, including dust storms;
- Identify and quantify chemical contaminants of dust and sediment from Salton Sea;
- Characterize the potential for human health effects from exposure to dust from Salton Sea under different environmental conditions;
- Assess potential human health impacts from exposure to contaminants in the dust from Salton Sea, including vulnerable population subgroups; and
- Identify actions people can take to mitigate dust exposures.

Background

Salton Sea is the largest lake in California and acts as an agricultural sump, receiving runoff from irrigated agricultural land in Riverside and Imperial counties. There is no outlet to Salton Sea, so chemical contaminants in the irrigation run-off have accumulated in the lake water and sediment. Over the decades, numerous sampling events have identified a wide range of chemicals in Salton Sea environmental media. Due to fertilizers in runoff entering Salton Sea, the pH of the lake water has risen

to the point where animal life is severely limited, with only a small number of species able to tolerate the extreme saline conditions. As such, periodic die-offs occur of migratory birds that visit Salton Sea during winter migrations. The environmental collapse of Salton Sea is affecting all who live in the region and calls to action have been repeatedly made over the last 10-15 years. One of those clarion calls is from residents and community-based organizations who are concerned about health impacts on families from breathing in dust from Salton Sea that is contaminated with pesticides and heavy metals. To date, there has not been a comprehensive study on this longstanding environmental health issue. This project is the first step towards providing community members with information about what's in the dust and how it could affect them over time, including under future environmental conditions caused by climate change impacts, as well as information on ways to reduce dust exposures and protect their children. In order to address community concerns and advance knowledge about dust emissions from the Salton Sea, the investigators will address the following research questions:

- Task 1: What is the current state of scientific knowledge about chemical contaminants in Salton Sea playa and dust, public health issues in Salton Sea-area communities, and regional dust emissions from multiple sources?
- Task 2: What do residents in Salton Sea-area communities want researchers to focus on, within the scope of the study, and how can residents provide input into the research methodology, including dissemination of the results of the study?
- Task 3: What are region-specific environmental and health data sources that could be accessed for this study? What chemical contaminants are in Salton Sea dust and playa?
- Task 4: How much dust are people living around Salton Sea exposed to, including under modelled dust storm conditions and environmental conditions resulting from climate change?
- Task 5: How does exposure to dust from Salton Sea relate to the number of Emergency Room visits for a range of conditions and is there an association between dust exposure and adverse birth outcomes, particularly in vulnerable communities? Do any of the chemicals detected in Salton Sea dust pose a concern for human health?
- Task 6: What actions can people take to mitigate dust emissions and reduce exposures? What research gaps remain and how could these be addressed?

Proposal Summary

Task 1: Assess Current Knowledge of Environmental and Public Health Issues in Salton Sea Area

The investigators will conduct a thorough literature review on meteorological conditions of the region, regional dust emissions, chemical contaminants in Salton Sea environmental media, and public health issues in Salton Sea-area communities. The results from this literature review will be used in Tasks 3-5.

Task 2: Community Engagement Plan

The research team will engage with a community-based organization in the Salton Sea area with the goal of mutual sharing of information about the research project, including project planning, development of public meetings, and creating informational materials. The research team will also identify other opportunities to present information about the research project to residents and other stakeholders in the Salton Sea region, including Assembly Bill B617 community meetings and local air district meetings.

Task 3: Data Acquisition

The research team will collect data covering numerous parameters, including meteorological and air quality, surface soil characteristics and regional dust emissions, emergency room visits, birth outcomes, and demographic and socioeconomic characteristics using multiple data sources, including direct dust and playa sampling. Dust and playa samples will be collected from at least eight (8) sites around Salton Sea and analyzed for pesticides, heavy metals, and other contaminants identified through the literature review.

Task 4: Estimating Dust Concentrations in Air of Salton Sea-area Communities

The research team will use chemical transport modeling (WRF-Chem) to track dust emissions and run simulations to derive spatially resolved dust emissions and human exposure estimates. Factoring in several key variables, the optimized model output will provide dust concentrations by receptor location at the zip code level, as well as initial dust origins – including future changes in dust emissions resulting from continued shrinking of Salton Sea and increased playa exposure.

Task 5: Health Impacts Assessment from Salton Sea Dust Exposure

Modeled air dust concentrations will be analyzed for association with emergency room visits and birth outcomes at a one (1) kilometer square resolution, incorporating sensitivity analyses. Communities most at risk of health effects from dust inhalation, including future dust exposures, will be identified, including vulnerable population subgroups within those communities. Potential health risks related to exposure to chemical contaminants in Salton Sea dust and playa will also be characterized.

Task 6: Actions to Potentially Mitigate Exposure to Salton Sea Dust, Knowledge Gaps Identified

In the final report and in public meetings, the research team will present information about steps local communities can take to reduce exposure to dust. Knowledge gaps will be identified, with future research objectives outlined. In addition, the investigators will provide training to CARB staff and management on use of the model, including how it can be adapted for use in other dust emitting parts of the state.

III. Staff Comments

This proposal was solicited by CARB in response to a research concept submitted by the primary Principal Investigator, Dr. Amato Evan (University of California, San Diego[UCSD]).

The initial proposal was reviewed by a committee that included staff and managers from RD, OCAP, AQPSD, Industrial Strategies Division, and OEHHA. RD staff and management met with the Principal Investigator (Dr. Amato Evan, UCSD) to convey and discuss the committee's comments and requests, and to answer questions.

The review committee agreed that the proposal meets CARB's intended goal of responding to Salton Sea community members' long-standing concerns about public health effects from exposure to dust from Salton Sea, including during future dust storm events precipitated by climate change impacts and the shrinking Salton Sea. The reviewers consistently commented that the proposal is comprehensive, and the research team appears highly qualified. This multi-campus collaboration showcases the wide-ranging

expertise of the research team, with access to the best laboratory facilities available in the University of California (UC) system.

Members of the research team are widely published in their respective disciplines, with Principal Investigator (PI) Dr. Evan a recognized expert in the physics of dust storms. Since 2019, Dr. Evan has operated a research station near the western shoreline of Salton Sea, where he monitors dust storm conditions. Dr. William Porter (UC Riverside) has conducted prior research on health outcomes and air pollution in the Salton Sea region and is very familiar with changing environmental conditions and ongoing dust issues related to the shrinking water body and exposed playa. This background and the connections between researchers provide the necessary expertise to undertake this multi-faceted research study.

CARB reviewers provided comments on various sections of the proposal, including requests for clarification about dust and soil sampling methodology and more information about emissions modeling. There was a general request that researchers share data with CARB at the end of the study and provide recommendations for where mitigating activities might be most useful for reducing human exposures to dust. Regarding the community engagement plan, there were questions about how the partnering Community Based Organization will be chosen and a recommendation that the PIs seek out “new voices”, as appropriate. There were also recommendations on how to communicate the results of the study to the public both during and at the conclusion of the project. Questions and concerns were expressed about the proposed method of characterizing health risks from dust exposure and recommendations were made on more appropriate approaches to take that will better account for cumulative exposures over time.

The investigators then submitted a revised proposal that sufficiently addressed comments and feedback from the review of the initial proposal. Overall, CARB RD staff and management are satisfied that the comments were adequately addressed and needed revisions made.

IV. Staff Recommendation

Staff recommends the RSC recommend that CARB approve this proposal for a total amount not to exceed \$930,000, subject to any changes and additions specified by the Committee.

Item No.: II.3
Date: September 23, 2024
Proposal No.: 2883-313

Staff Evaluation of a New Research Project

Title: Residential Appliances in Diverse California Communities: Emission, Exposure, and Health Impacts of Toxic Air Contaminants (RESPECT)

Prime Contractor: University of California, Los Angeles

Subcontractors: San Francisco Bay Physicians for Social Responsibility
Central California Asthma Collaborative

Principal Investigators: Jing Li, Ph.D.

Budget: \$926,365

Contract Term: 36 Months

For further information, please contact Dr. Patrick Wong at (279) 208-7295 or Pat.Wong@arb.ca.gov

I. Summary

In alignment with the 2022 Scoping Plan for Achieving Carbon Neutrality, CARB is in the process of developing and proposing zero-emission greenhouse gas standards for new space and water heaters sold in California. This effort will also reduce the emissions of other air pollutants such as toxic air contaminants (TACs), as initial studies have detected significant emissions of TACs from some residential fossil fuel appliances. To provide a systematic characterization of TACs from these appliances, this research will determine the emission rates of TACs for fuel leakage and combustion from appliances across California, assess their contributions to indoor and outdoor TAC levels and associated health risks, and evaluate the exposure and health impact disparity among communities. The results from this research will provide a better understanding of the impacts of TAC emissions from residential fossil fuel appliances used in California homes, facilitate the assessment of the co-benefits of zero-emission appliance standards to be developed, and inform possible future regulatory actions that limit TAC emissions from these appliances and protect public health.

II. Technical Summary

Objective

The objectives of this research are to:

1. Test a representative sample of residential fossil fuel combustion appliances, and determine the potential composition, concentration, and emission rates of TACs in fuel leakage and combustion exhaust sampling;
2. Assess the contributions of their TAC emissions on indoor and outdoor air quality, separately and combined;
3. Estimate the health impacts of indoor and outdoor exposures to TACs attributable to these appliances; and
4. Evaluate the exposure and health impact disparity among communities associated with TAC emissions from these appliances.

Background

Residential fossil fuel appliances emit a wide range of air pollutants, either through fuel leakage or as combustion byproducts. These air pollutants include criteria air pollutants (e.g. nitrogen dioxide, carbon monoxide, particulate matter, and sulfur oxide), greenhouse gases (e.g. methane, carbon dioxide), and TACs (e.g., formaldehyde, hydrogen cyanide, and benzene). These air pollutants have been linked to various acute and chronic health effects, including respiratory illness, cardiovascular disease, and premature death. Lower-income households may be at even higher risk of illness from exposure to these air pollutants. This is due to their smaller residential unit size, higher occupant density, insufficient ventilation, and use of gas ranges as heating sources; in addition, these households are often subjected to increased exposure from outdoor pollution sources such as traffic and industry.

While many studies have quantified the emissions of criteria air pollutants and greenhouse gases, studies measuring TACs from appliances are limited. These initial efforts have found significant emissions of TACs and potential health effects. Gas combustion of residential fossil fuel appliances was found to emit 0.09 to 20.3 $\mu\text{g}/\text{kJ}$ formaldehyde (Girman et al.,1989; Singer et al., 2009). A recent California study

(Kashtan et al., 2023) found mean benzene emissions from gas and propane burners on high and ovens set to 350° F ranged from 2.8 to 6.5 μ g/min. Such emissions raised kitchen benzene concentrations above the upper range of indoor benzene concentrations attributable to secondhand tobacco smoke and, in some cases, elevated bedroom benzene concentrations above the OEHHA chronic Reference Exposure Level (REL) for hours after the stove was turned off. Another California study (Lebel et al., 2022) found that TACs, such as benzene, toluene, ethylbenzene, and xylene, could continuously leak into indoor environments, even when gas ranges were off. In a small fraction of homes with an elevated leakage rate of benzene and a low ventilation rate, leakage from gas stoves could result in indoor benzene concentrations higher than the OEHHA chronic REL.

In alignment with the 2022 Scoping Plan for Achieving Carbon Neutrality, CARB is developing zero-emission greenhouse gas standards for new space and water heaters sold in California. These standards would also result in important reductions of other air pollutants from these appliances, including TACs, and support California's attainment efforts for State and federal air quality standards and achieve public health benefits. This research will systematically characterize the profile of TACs from residential fossil fuel appliances and associated impacts on air quality, public health, and environmental disparity. The result will assist policymakers in assessing the benefits of related policies that reduce TAC emissions from these appliances.

Proposal Summary

The contractor will conduct a literature review to summarize available information regarding residential fossil fuel appliances, their TAC emissions, and associated impacts on air quality and public health. The contractor will assemble a Technical Advisory Group to guide the study design and review interim deliverables and the final draft report. The contractor will work with three (3) community partners as subcontractors to assist in study design, home recruitment, and field measurements. Two (2) community partners, San Francisco Bay Physicians for Social Responsibility and Central California Asthma Collaborative, have been confirmed.

Working with community partners, the contractor will recruit approximately 15 homes in the Bay Area, 30 homes in San Joaquin County, and at least 20 homes in Los Angeles County. At least 50% of these homes will be in Disadvantaged Communities (DACs) designated by CalEPA for Senate Bill 535. Community partners will reach out to potential homeowners by phone calls to collect basic information about appliances to recruit homes eligible for testing, e.g., those with fossil fuel appliances that are representative of the appliance stock in California and accessible for testing.

The contractor will use Summa canisters to collect 20 - 30 second samples at the points of fuel leakage and combustion exhaust for each appliance. The contractor will also deploy diffusion tubes to measure concentrations indoors and in outdoor adjacent areas for two (2) weeks. These samples will be analyzed for TAC species using Gas Chromatography Mass Spectrometry according to the U.S. EPA standard methods. The contractor will also conduct surveys to gather comprehensive information on the demographic and household characteristics. Each home will be visited three times (3): an initial visit to obtain homeowners' consent and conduct appliance inspection, a second visit to collect Summa canister samples, set up diffusion tubes, and conduct the setup survey, and a final visit to collect the diffusion tubes and conduct the closing survey. Before the field measurements, the contractor will develop a standard operating procedure for sample collection and test the method in a pilot study. Training will be provided to the community partners for effective field measurements.

Based on the species and concentrations of TACs determined in the samples, the emission rates will be calculated for TACs in leakages and combustion exhaust. The contractor will use emission rates, as well as building geometries and parameters related to ventilation and activities as input for the Contaminant Transport Analysis Method model to simulate the indoor TAC concentrations attributable to these appliances. The measured TAC concentrations from diffusion tubes will be used to validate the modeling results.

Assuming a linear relationship between emission and ambient concentration of TACs, the contractor will estimate appliances' contribution to ambient TAC levels based on the ratio of TAC emissions from appliances vs. the emissions from other TAC sources. TAC emissions from appliances to outdoor environment will be calculated using TAC emission rates and the indoor-outdoor air exchange rates from

the modeling simulation, while emissions from other sources will be retrieved from the U.S. EPA National Emission Inventory. The ambient TAC concentrations will be obtained from the US EPA's Ambient Monitoring Archive for hazardous air pollutants.

The contractor will estimate the carcinogenic and non-carcinogenic risks attributable to TAC emissions from these appliances for indoor and outdoor exposures separately. The estimate will be based on the U.S. EPA methods as well as compared to OEHHA's Proposition 65 relative risk factors.

For disparity analysis, the contractor will compare various metrics between DACs and non-DACs, including TAC emissions, indoor and outdoor concentrations attributable to these TAC emissions, and health impacts. The comparisons will be conducted at different geographic levels, e.g., the statewide, air basin, and county, and by subgroups of demographic and household characteristics.

III. Staff Comments

The proposal was reviewed by CARB staff in RD, OCAP, and the Sustainable Transportation and Community Division. The proposal was also reviewed by California Energy Commission staff.

The reviewers expressed support for the project and had no major concerns about the proposal. Most comments they made were for clarification, particularly regarding technical information and approaches. Examples include clarifying health impact assessment will be conducted for indoor and outdoor exposure separately, adding detailed description about the method to estimate contributions to outdoor air quality from these appliances, and elaborate the parameters for exposure and health disparity analysis. The investigators have addressed these comments in the current proposal.

The reviewers also recognized the high degree of expertise in indoor air quality measurement and modeling, health impact assessment, disparity analysis, and community engagement that the research team has. Drs. Li and Zhu have previously participated in CARB contracts which were successfully completed. The two (2) community partners confirmed are experienced working with overburdened communities. The reviewers expressed confidence that these researchers could conduct the project as presented in the proposal.

Staff believes that the investigators' expertise and work on indoor air quality monitoring and modeling, health assessment and community engagement research make them qualified for this research project.

IV. Staff Recommendation

Staff recommends the RSC recommend that CARB approve this proposal for a total amount not to exceed \$926,365, subject to any changes and additions specified by the Committee.