Addendum II – Proposed Research Projects for Fiscal Year 2023-2024

Introduction

On March 25, 2021, the Board approved the Fiscal Years 2021-2024 Triennial Strategic Research Plan (Plan). The Plan provides details on past and current research activities, as well as remaining research needs that serve as a guide for the development of future research projects that will support the Board's mission. Staff will present a list of proposed projects that continue to fulfill the research needs presented in the Plan, including CARB's goal to operationalize racial equity in CARB research.

For Fiscal Year 2023-2024, CARB is proposing eleven research projects that each address multiple research initiatives identified in the Triennial Strategic Research Plan. By investing in these projects, CARB can address long-term goals and challenges holistically.

The research program continues to focus on issues that are unique to California and its priority populations and communities, and to leverage resources and complement research supported by other funding organizations. The projects proposed for Fiscal Year 2023-2024 will identify and prioritize strategies that have health, environmental, and economic co-benefits, create additional health endpoints to assess our programs, leverage new tools and methods to identify and refine mitigation strategies to support air quality goals.

The proposed research projects will support the Board's decision-making and effective program implementation. A research budget of approximately $6 million is anticipated to fund eleven new projects in fiscal year 2023-2024. Staff will also outline proposed changes to future Board updates on the Research Program, and request that the Board delegate approval of research contracts to the Executive Officer.

Board approval of the Proposed 2023-2024 Research Projects will authorize staff to proceed with developing these research projects.

TABLE 1: SUMMARY TABLE OF PROPOSED PROJECTS FOR FY23-24

Project Titles	Cost
Improving Health Analysis and Understanding Nexus of Health and Climate Change Impacts	
Development of Health Analysis Methodology for Natural and Working Lands Management Scenarios	$550k
Combined Impacts of Multiple Climate Change Stressors on Health in California	$500k
Air Toxics Cancer Impact Monetization	$500k

Air Quality – Understanding Emissions Sources	
Long-term chemical characterization and source apportionment of PM2.5 in the San Joaquin Valley	$950k
Characterization of train brake- and wheel-wear PM emissions	$900k
Understanding air quality and health impacts from wildfire and prescribed burns in California at the wildland-urban interface	$600k
Improvement of the Toxic-metal Aerosol Real-Time Analysis (TARTA) instrument	$150k
Advancing the Initial Research Priorities Identified in the Imperial Valley Region Community Roadmap	$200k
Climate – Improving Quantification of GHG Sources	
Emissions Monitoring of Landfill Methane in California	$500k
What are the industrial sectors contributing to methane emissions in the southern San Joaquin Valley?	$900k
Nitrous Oxide Emissions from Fumigants Used on Agricultural Soils in California	$400k
TOTAL	$6.15M

Project Descriptions

Development of Health Analysis Methodology for Natural and Working Lands Management Scenarios

Implementing effective strategies to promote the health of California's natural and working lands is paramount to ensuring that these lands sequester carbon and enhance public health benefits. Building on previous CARB-funded research on health benefits of natural and working lands, this project will develop and expand CARB's ability to quantify the health benefits from future climate actions that promote healthy forests and other natural lands and reduce the frequency and negative impacts of wildfire events. This work will build on existing ecosystem, health, and air quality models and data that assess future wildfire emissions under various climate and management scenarios. The priority for the analysis will be to develop streamlined methods to quantify the annual health benefits of future statewide management strategies (e.g., prescribed fire, thinning, and other fuel reduction treatments) in forests, shrublands, and grasslands under climate change scenarios from 2025 to 2045. The analysis will quantify annual statewide and regional estimates of future health benefits given pre-developed estimates of wildfire emissions that incorporate multiple climate and management scenarios. Multiple health endpoints beyond life expectancy and mortality, including cardiac and respiratory impacts, and expanded birth outcomes as well as mental health will be investigated for inclusion. A second priority will be to develop expanded health analysis methods for quantifying the benefits of increasing urban tree canopy scenarios, both for statewide and regional areas. The project will include an equity analysis of the health outcomes. The final product will be

capable of providing decision support for natural and working land management and possibly urban greening strategies to reduce the risk of wildfire and other climate change impacts by quantifying the health benefits from these strategies.

Cost estimate: $550,000.

Combined Impacts of Multiple Climate Change Stressors on Health in California

Climate change is a major public health concern due to more frequent and severe wildfires, heat waves, and drought that elevate health risks. While there is an array of literature on specific climate impacts, the cumulative health impact of combined climate stressors (i.e., heat, air pollution, wildfires) alongside environmental justice, racial equity, and social vulnerability factors are under-examined. The goal for this project is to understand these combined impacts based on scenarios of increasing temperatures. The results are expected to illustrate the impacts of climate change and the benefits of climate actions that reduce GHG emissions and support the state's long-term climate goals. The study will estimate, for various temperature increase scenarios, the combined health impacts from increased temperature, air pollution, and wildfire smoke for different regions and race/ethnic groups. Other related impacts (e.g. impacts associated with drought) may also be considered. The focus would be on developing combined health impact estimations on a statewide level and, as feasible, on a regional or local level. This project will not only investigate the interaction of climate stressors on health but will also study how social determinants of health (e.g., race/ethnicity, income, proximity to air pollution sources, ownership and use of air conditioning devices) affect the level and risk of combined health impacts. The study will also consider ways to mitigate and reduce the combined health effects. Lastly, this project will attempt to quantify and value the combined health effects in relation to increased temperatures. The health impacts would include but are not limited to respiratory and cardiovascular illnesses, hospitalizations, heat-related illnesses, and mortality. The combined health impacts found in this study could be used in a future study or tool to examine and valuate the impacts for a range of possible future scenarios of increased temperature in California.

Cost estimate: $500,000.

Air Toxics Cancer Impact Monetization

California regulates toxic air contaminants (TACs) such as diesel PM and other air pollutants because they have the potential to pose serious human health risks such as cancer. As part of the regulatory evaluation process, CARB is required to consider the costs and risk before developing regulations. However, many of these toxic contaminants do not have cost values associated with their cancer risks. The main objectives of this research project are to define a methodology to translate cancer risk

numbers to estimated cancer cases and develop a method to quantify and valuate effects associated with cancer cases from exposure to specific TACs. A secondary objective is to quantify and valuate the effects associated with non-cancer effects from exposure to TACs. The research will include the review of existing methods and the development of new methods for quantifying and monetizing cancer mortality and morbidity health effects (e.g., methods based on willingness to pay and cost of illness (COI)) at different stages of life due to varying cancer onset latency periods, types and severity of illness, and outcomes. The researchers will incorporate factors such as medical and hospitalization costs, reduced quality of life and life expectance, caregiving, lost workdays, and other costs as appropriate to valuate cancer costs, including pain and suffering related to cancer health effects. This project will identify options for incorporating the results in regulatory benefits assessments. The results of this study will help CARB and others assess quantitative benefits associated with cancer risk reduction from various TAC control measures and policies.

Cost estimate: $500,000

Long-term chemical characterization and source apportionment of PM2.5 in the San Joaquin Valley

Ambient PM2.5 levels in the San Joaquin Valley (SJV) are expected to change because of various emission reduction efforts that are currently underway (e.g., FARMER program and agricultural burning phase-out). This research project will build on the long-term chemical characterization of PM2.5 in the SJV (Contract #17RD008) to track and evaluate the efficacy of such PM2.5 control programs over the next three years. This research project will conduct source apportionment analysis on the long-term, high-frequency PM2.5 composition data and other supporting ambient measurements to gain an in-depth understanding of the sources and the atmospheric processes that drive ambient PM2.5 levels in the SJV. The results of this research project will support the development of the State Implementation Plans for future PM2.5 mitigation.

Cost estimate: $950,000

Characterization of train brake- and wheel-wear PM emissions

Non-exhaust PM emissions, including brake-, tire-, and wheel-wear PM, have become a concern. As exhaust emissions decrease, the contribution of non-exhaust PM has increased and became a major source of PM emissions from vehicles. Current non-exhaust research is mainly focused on on-road vehicles in characterizing emission factors and potential health effects. However, no studies have been done on brake- and wheel-wear (BWWW) PM emissions from trains and their potential health risks in near-railway communities. Moreover, the CARB off-road emission inventory model does not currently include train non-exhaust PM emission factors. Therefore, the objective of this research is to characterize train brake- and wheel-wear PM emissions,

to identify the factors that affect those emissions the most for different types of trains in California, and to help promote environmental equity for near-railway communities. This research will include the following tasks: 1) extensive review of train brake- and wheel-wear emission research and studies, relevant programs and policies, near-railway community forums and discussion boards, and environmental justice expert consultation on communities' concerns, 2) identify California relevant train types, major routes, corresponding brake and wheel materials, and their market share, 3) determine which train types and corresponding brake and wheel types should be tested, and how these trains are operated, 4) develop representative duty cycles by train types based on collected activity data, 5) develop brake- and wheel-wear PM measurement methods and conduct pilot tests, 6) measure brake- and wheel-wear PM emissions separately, preferred, and develop speed/fuel-consumption/engine load-dependent emission factors by train types, 7) conduct a suite of chemical, metals, oxidative stress analyses for collected PM samples, 8) evaluate the potential health risks and exposure of BWWW PM to near-railway communities based on acquired BW and WW emissions factors and compositions, 9) assess potential of existing programs and policies to address environmental equity for near-railway communities based on results from previous tasks, consult with environmental justice expert(s) to suggest methods for further addressing community concerns, and suggest future steps, and 10) assess opportunities to reduce PM emissions by regenerative braking technology. The results can be used to update off-road emission inventory, understand potential health impact on the near railway communities, help to promote environmental equity for underrepresented neighborhoods and inform relevant programs.

Cost estimate: $900,000

Understanding air quality and health impacts from wildfire and prescribed burns in California at the wildland-urban interface

Extreme wildfire events, both in terms of acres burned and associated infrastructure losses, have been increasing in recent years with the seven largest wildfires in recorded California history occurring since 2015. Many of these large wildfires happened at the wildland-urban interface (WUI) areas where severe air quality health impacts and tragic loss of life occurred. To assess the impacts of fires on air quality and human health in the WUI, this research will deploy monitoring campaigns to investigate the levels of smoke emissions and the gas and chemical smoke constituents (including criteria air pollutants and air toxics) from different fire sources that populated areas in the WUI are exposed to, and how these smoke levels and gas and chemical constituents compare to other smoke-exposed areas of the state. The measurement campaigns conducted during wildfires and prescribed burns require specialized mobile monitoring capabilities as traditional stationary monitors do not adequately capture the air quality impacts of the fires. Assessment, analysis, and validation of the collected data captured by these mobile measurements is a critical

component to provide the necessary information to be used in the health analysis. This research will also investigate the health impacts of smoke exposures in the WUI by linking the smoke exposure data collected to health datasets for the same areas. This project also has an equity component in that it will develop a better understanding of the wildfire smoke impacts to vulnerable communities at the WUI. Environmental Justice communities will be invited to participate in selecting priority WUI sites for measurement campaigns and recommending or developing health datasets for investigation of health effects, possibly including health surveys. Furthermore, this project would build on the importance of community engagement in the exchange of information and knowledge and would seek to increase community resilience to wildfire effects. CARB is seeking a multidisciplinary research team that has expertise in air quality monitoring, air quality and health impact assessments, and community engagement. This study is planned to provide information on the greater vulnerability and impacts to communities in the wildland-urban interface and will assist CARB in understanding the needs for mitigation resources.

Cost estimate: $600,000

Improvement of the Toxic-metal Aerosol Real-Time Analysis (TARTA) instrument

Toxic metals in ambient aerosols continue to raise concerns for communities near industrial activities and transportation corridors. This research aims to facilitate the improvement of the Toxic-metal Aerosol Real-Time Analysis (TARTA) instrument developed by University of California, Davis. This project will leverage the previous work to develop an improved user-friendly version of the instrument (TARTA-2) for research, air monitoring, and citizen science applications. This project will create non-proprietary software that runs on a small single-board computer (SBC) integrated into the instrument. The project will also produce an EZ-swap nozzle/optics cartridge that removes the need for complex maintenance procedures. Such improvements must only improve the accuracy and precision of the data product while maintaining a low detection limit of individual toxic metals. The project will produce five newly designed TARTA-2 for CARB to own and deploy for its current and upcoming studies. These instruments will be loaned to community groups as they are available. It is expected that feedback from the end-users will be leveraged to improve the user interface and its usability.

Cost estimate: $150,000

Advancing the Initial Research Priorities Identified in the Imperial Valley Region Community Roadmap

Community residents in the Imperial Valley are disproportionately exposed to harmful air pollutants from unique combinations of emission sources (e.g., Salton Sea,

agricultural activities, vehicles, unpaved roads, industrial operations, biomass, and waste burning). The heterogeneity of the air pollutant sources contributes to the challenges in developing a comprehensive and equitable air pollution reduction strategy for the Imperial Valley that reduces air pollution exposure and its adverse health outcomes. A project currently funded by the California Air Resources Board (CARB), which began in February 2022, is creating a comprehensive Strategic Community Research Roadmap for the Imperial Valley Region (Community Roadmap) that reflects community concerns and priorities for research to increase health equity in the region. This new research project aims to implement the initial tasks of a research project identified by the Community Roadmap. The project will include continued engagement with community groups, agencies, and stakeholders that need to be involved to effectively implement the research tasks. This project could inform potential CARB efforts to implement and develop emission control strategies and regulations for the Imperial Valley region that will benefit public health and help meet the state's long-term air quality and climate change targets.

Cost estimate: $200,000

Emissions Monitoring of Landfill Methane in California

Methane is an important greenhouse gas, which is 84 times more potent than CO2 over a 20-year time horizon and 25 times more potent over a 100-year time horizon. In 2015, the Governor approved AB 1496, which requires the CARB to monitor and measure high methane emission hotspots within the State using the best available scientific and technical methods. And in 2016 Senate Bill 1383 was passed which requires a 40% reduction in methane emissions from 2013 levels by 2030.

Landfill methane emissions are an important fraction of total methane emissions in California representing approximately 20% of the current inventory. Previous studies to better understand total landfill methane emissions have shed new light on where and how emissions occur on landfills but have all been either snapshots in time or only measured emissions from a fraction of the area of landfills. To get a better understanding of total annual emissions whole landfill emissions measurements are needed. The objective of this research is to apply methane emissions monitoring at major landfills across California to track methane emissions and estimate reliable annual emissions totals for these facilities. This work will be informed by a pilot study and aims to combine atmospheric measurement with landfill specific information, such as gas collection, waste amounts, cover properties and surface operations, to gain a better understanding of methane generation and fate at landfills. The study aims to collect such data at several landfills in California selected to allow some generalization of the results for the waste sector in California.

Cost estimate: $500,000

What are the industrial sectors contributing to methane emissions in the southern San Joaquin Valley?

Mitigation of methane emissions is a keystone for the State of California to meet its methane target of a 40% reduction below 2013 levels by 2030. In 2014 a satellite identified a regional methane emission hotspot in the southern San Joaquin Valley of California. This area contains anthropogenic methane emission sources from all the major methane-emitting industrial sectors: Oil and Gas Production, Waste, and Agriculture. There are gaps that exist in our understanding of methane emissions in this region and a spatially extensive, temporally representative study that generates statistically robust estimates of emissions will help resolve those gaps. Utilizing state-of-the-art techniques will provide not only an estimate of total methane emissions in the area but also the contribution from each industrial sector. This work will leverage existing research efforts such as California's statewide greenhouse gas monitoring network and bolster them by designing and implementing new measurements to fill the existing observational gaps within the area. This combination of measurement techniques will result in spatially representative estimates of emissions over the broader study region, providing near-continuous data for at least one year, and enabling top-down estimation of sectoral contributions. Sectorally resolved methane emissions provide information that can help guide programs, regulations, and policy for CARB and its sister agencies to meet the state's greenhouse gas emissions reduction targets.

Cost estimate: $900,000

Nitrous Oxide Emissions from Fumigants Used on Agricultural Soils in California

Fertilizers and other agricultural amendments are known to influence biogeochemical processes in soils that can increase or inhibit the production of greenhouse gasses (GHG) by soil microorganisms. In coordination with other California state agencies and agricultural stakeholders, CARB previously conducted multiple research projects to measure and model the emissions of nitrous oxide (N_2O), a potent GHG, from fertilizer applications to major California crops. In contrast, the impact of fumigants on N_2O emissions from agricultural soils in California is not well studied. Limited experiments, using short-term monitoring, have been inconclusive about whether fumigants increase or inhibit soil N_2O emissions. This project will assess the extent to which fumigants lead to N_2O formation, including the impact of different management practices, including application methods. The project will do this by conducting long term N_2O flux measurements in California agricultural fields to investigate the N_2O forming potential associated with the application of selected fumigants. The field experiments will be conducted in major cropping systems, such as strawberry, carrots, almonds, that receive fumigants as well as fertilizers. A public workshop will be held at

the beginning of this study to inform the prioritization of the fumigants, application practices, and crops to be used in this study. This work will also be conducted in coordination with other state agencies and stakeholders. The study will provide much needed information on the N_2O emissions from fumigants used on agricultural soils in California. While focused on N_2O, the study may also examine other GHGs or volatile organic chemicals as part of the research.

Cost estimate: $400,000