California Air Resources Board

Research Screening Committee Meeting

November 5, 2021

9:00 a.m.

ADVANCE AGENDA

I. Approval of Minutes of Previous Meeting

August 20, 2021

II. Discussion of Research Proposals

1. "Understanding Travel Demand and Built Environment Factors to Optimize Increased ZEV Access in Underserved Communities," University of California, Davis, $599,978, Proposal No. 2860-300

   To date, new light-duty zero emission vehicles (ZEV) have largely been bought by higher-income, single-family home-owning households. Growing the ZEV market to meet the Governor's Executive Order N-79-20 goal of 100 percent ZEV sales by 2035 and achieving the long-term air quality and climate goals will require expanding ZEV access and usage to all California drivers. Accelerating this access to historically underserved communities is especially important to ensure that those communities can enjoy the air quality benefits of these vehicles and have access to economic opportunities that may become available with improved transportation options. To investigate travel demand and built environment factors to optimize increased ZEV access in underserved communities in California this project will: 1) hold community listening sessions to inform research questions and topics; 2) collect primary data from residents of underserved communities in California using a survey administered via mail and online; and 3) analyze data using descriptive statistics and statistical models, including investigating variation between and within regions to test various hypotheses. CARB will use these results and policy recommendations to inform how ZEVs may best be integrated into underserved communities through related regulations and incentives programs.

2. "Equitable Electrification of Existing Buildings," University of California, Los Angeles, $599,159 Proposal No. 2859-300

   Building electrification is one of the most viable strategies for reducing GHG and criteria pollutant emissions from the building sector. While several studies have demonstrated the theoretical cost-effectiveness of building electrification in new and existing buildings, the equity implications and actual costs of electrification for priority populations living in existing buildings are not well-understood. This

study will collect and synthesize existing data to model the extent to which current policy supports leave critical gaps in Californians' ability to electrify end uses in accordance with the State's climate and air quality goals. The project will also collect and analyze primary data related to electric service panel upgrade requirements and costs, and household-level electrification drivers and barriers. Results from this project will inform ongoing CARB and other public agency efforts to develop an aligned set of standards, incentives, and regulations across policy scales and domains to support rapid and equitable building decarbonization.

III. Discussion of Proposed Contract Augmentation

1. "Understanding and Mitigating Wildfire Risk in California," University of California, Berkeley, $200,000, Contract No. 19RD008

   A contract augmentation is requested to cover unanticipated expenses associated with the delay in controlled burns in Fall 2020. Due to the COVID-19 pandemic and associated restrictions, severe wildfire season, and abrupt changes in weather conditions, the burn permit could not be obtained for the originally intended burn period. As part of this augmentation, the Contractor will enhance the current research project by adding near fire measurements of black carbon (BC) using ground based and airborne drone-based platforms during controlled burns. Data from these small sensors complement measurements obtained from more complex monitors that are stationary. In addition, the contractor will provide new data analysis to examine wildfire particulate matter (PM) that caused air pollution exceedances in California during 2018 and 2020 and quantify the chemical composition and properties of biomass burning emissions in an effort to improve the First Order Fire Effects Model (FOFEM). The contractor will also quantify indoor PM2.5 intrusions from outdoors using PurpleAir Network sensors during wildfire smoke episodes reaching populated regions of California in 2018 and 2020. The extent to which smoke intrusions penetrate buildings under normal operations, will help safeguard both forest and human health, addressing important environmental justice concerns for vulnerable communities.

IV. Discussion of Draft Final Reports

1. "Screening Method and Map for Evaluating Transportation Access Disparities and other Built Environment-related Social Determinants of Health," University of California, Los Angeles, $349,812, Contract No. 18RD021

   CARB and other state agencies are working to improve access to clean transportation options for all Californians. Existing tools identify "disadvantaged" California communities according to a variety of environmental and socioeconomic factors and, importantly, highlight potential health impacts associated with these

factors. However, these tools do not currently characterize disparities in access to clean transportation options (including active modes such as walking and cycling), access to jobs and other key destinations, transportation cost and time burdens, etc. This project helped fill this gap by creating: 1) a statewide database of forty (40) indicators that highlight the causes, characteristics, and consequences of transportation disparities; and 2) a Transportation Disparities Mapping Tool that allows users to both visualize and analyze the data (for the latter, via filtering and layering capabilities programmed into the tool). Using the database and tool, UCLA conducted a distributional analysis to determine patterns of transportation disparities across census tracts. They found that low-income neighborhoods experience several challenges: more barriers to vehicle ownership, disproportionately fewer clean vehicles and more "clunkers," more limited ability to travel (less access to private vehicles and lower VMT), and less access to infrastructure supporting active transportation. The database and mapping tool provide insights into the types of policies and investments that can mitigate disparities in access to clean transportation options, and will inform CARB's implementation of SB 375, SB 350, and SB 150. Furthermore, it contributes to California's commitment to ensure that all segments of society benefit from the state's climate change agenda, including disadvantaged populations and neighborhoods (cited legislation plus SB 535, AB 1550, and AB 617).

2. "Long-term Characterization of Fine Particulate Matter Chemical Composition in the San Joaquin Valley," University of California, Davis, $320,000, Contract No. 17RD008

PM pollution in the San Joaquin Valley (SJV) in wintertime remains the worst in California, frequently exceeding the 24-hour National Ambient Air Quality Standard (NAAQS). In addition, summertime PM2.5 concentrations are also sufficiently large enough to frequently exceed the annual PM2.5 NAAQS. A process-level understanding of PM2.5 formation in the SJV has been limited, however, by a lack of chemically resolved measurements of PM2.5 concentrations needed to assess the long-term trends, seasonal variabilities, and diurnal differences in the sources and atmospheric processes that lead to seasonal specific pollution events. This project addressed this need by collecting 30 months of near-continuous PM2.5 chemical speciation data at the Fresno-Garland Monitoring site using a Time-Of-Flight Aerosol Chemical Speciation Monitor (TOF-ACSM). Mass loadings of major non-refractory PM2.5 components (NR-PM2.5) – ammonium, sulfate, chloride, nitrate, and organic species – were measured with ten minute time resolution. Overall, the mass and components of NR-PM2.5 agreed very well with equivalent daily PM2.5 mass measurements from the CARB network and the EPA Chemical Speciation Network (CSN) measurements. The highly time-resolved data allowed detailed analyses of seasonal changes in sources and diurnal profiles. Analysis of the organic aerosol (OA) component via positive matrix factorization (PMF) yielded further insights into the sources and processes that control the OA, with three factors identified

across a winter period. These factors were associated with particles derived from biomass burning, vehicles, and secondary production. The results from this project demonstrated that routine monitoring of NR-PM2.5 composition with sub-hourly time resolution is possible and greatly expands on the 1-in-3 day available from EPA CSN sampling. The results provided insights into the sources and key atmospheric processes that drive PM2.5 concentrations and pollution events in the valley during different seasons and supply a scientific basis for the development of optimal PM2.5 ammonium nitrate (AN) and OA mitigation policies.

3. "Benchmarking of Post-Alternative Manure Management Program (AMMP) Dairy Emissions and Prediction of Related Long-Term Airshed Effect", University of California, Davis, $384,974, Contract No. 17RD017

   Methane (CH4) emissions from dairies represent nearly half of all CH4 emissions in California, with dairy manure accounting for 26 percent (30 MMTCO2e), and enteric fermentation accounting for 29 percent (33 MMTCO2e). Most dairy farms in California utilize manure lagoons, in which organic matter in manure undergoes a biochemical degradation process that creates CH4. Alternative Manure Management Program (AMMP) practices are considered as a cost-effective set of solutions to reduce CH4 emissions; however, data on real-world effectiveness of such technologies is limited. This project aimed at evaluating the effectiveness of AMMP practices on the emissions of GHG and other criteria pollutants by conducting real-world emissions measurements on four dairies after installation of AMMP practices (post-AMMP) and comparing the results to those of the pre-AMMP. It also applied regional chemical transport models to determine the effect of extreme dairy emissions reductions on the SJV airshed-wide ozone (O3) and PM2.5 concentrations in the coming years. Although it was expected that the post-AMMP CH4 emissions would be lower than the pre-AMMP emissions as AMMP practices divert volatile solids away from anaerobic conditions, measurement results indicated higher or similar emissions for post-AMMP. Multiple factors may have contributed to this observation: 1) Changes in manure characteristics from pre- to post AMMP conditions that are not related to AMMP installation; 2) Changes in other confounding factors that were not captured during the measurement period; and 3) Improper execution of the AMMP technologies on dairies. The regional chemical transport modeling revealed the changes in airshed-wide O3 and PM2.5 concentrations in the SJV under an extreme dairy emissions reduction scenario against Business As Usual (BAU) and future clean energy scenarios. Since future scenarios for AMMP did not show measurable impact on the SJV air quality, dairy digester scenario model run was added as well. Additional manure management options were explored to gain a comprehensive understanding of potential future air quality challenges. The results suggested the need for an AMMP execution follow-up plan, highlighted the importance of long-term measurements in evaluating real-world emissions, and provided insight into the effects of extreme emissions reductions from the

dairy sector on the SJV air quality that can help facilitate the development of the future State Implementation Plans (SIP).

4. "Hybridization of Full Electrification Potential in Off-Road Applications," University of California, Riverside, $350,000, Contract No. 18RD016

   The off-road sector accounts for an increasingly larger share of GHG and criteria pollutant emissions in California. To lower the emissions from the sector, a combination of regulatory strategies and incentive programs have been implemented in California and should be continued by partially or fully electrifying feasible off-road equipment. In the effort to transition towards cleaner emission and lower carbon technologies, it is important to have sufficient knowledge of their applications, operations, energy demands, and duty cycles. This research has assessed the technological and economic feasibilities of hybridizing or electrifying off-road equipment in the context of their vocational activities and energy demands. This research has shown that agricultural tractors, excavators, graders, rubber-tired loaders, and backhoes, which are among the most populous and high emitting equipment types, can be electrified with currently available electric motor and battery components. For these equipment types, replacing fossil fuel powered equipment smaller than 100 horsepower (HP) with electric equipment are generally the most cost-effective in terms of dollars per ton of emission reduction. The research recommends prioritizing design of incentive programs to accelerate the development, demonstration, and adoption of electric off-road equipment of these types and sizes.

5. "Combined Exposures to Ultrafine Particulate Matter and Ozone: Characterization of Particular Deposition, Pulmonary Oxidant Stress and Myocardial Injury," University of California, Davis, $196,806, Contract No. 17RD011

   Epidemiological research has suggested a statistical correlation between adverse health effects and exposure to PM and O3; however, there are few experimental data that support the biological plausibility of these relationships. The current animal study examined lung and heart tissues to determine whether ultrafine particulate matter (UFPM) +O3: 1) Induced myocardial ischemia and nonapoptotic cell death; 2) Increased microthrombi in lung and heart; and 3) altered UFPM deposition and its relation to cellular antioxidant expression within the airways. The current study showed that cardiac fibrosis was significantly greater in mature adult rats with (spontaneous hypertensive, SH) compared to rats without cardiovascular diseases (CVD) (normotensive Wistar Kyoto, WKY). The results of the current study indicate that simultaneous exposure to UFPM and O3 elicits stronger responses than that expected from exposure to O3 or UFPM alone. Further, CVD increases susceptibility to pollutant-induced thrombosis, which may contribute to UFPM+O3-induced myocardial injury. This study advances scientific understanding of the adverse health effects of simultaneous combined-pollutant

exposure. The study also provides novel insights into the association between ambient air pollution and increased cardiac morbidity and mortality in mature adult individuals with CVD. This knowledge will support CARB in establishing health-protective ambient air quality standards.

6. "Characterizing the Potential Health and Equity Impacts of Oil and Gas Extraction and Production Activities in California," University of California, Berkeley, $299,988, Contract No. 18RD018

   There is a need for studies in California to assess the impacts of exposure to oil and gas development (OGD) on health outcomes as well as potential threats to drinking water sources, particularly among communities reliant upon domestic wells. Also, high methane emitting facilities, which include OGD activities as well as landfills, dairies, and refineries, can emit non-methane co-pollutants that are harmful to human health but have been understudied both in terms of their implications for environmental justice and for their potential to produce acute or chronic health effects. Previous research has found a link between OGD and adverse birth outcomes in other areas of the US. To provide information in these areas the investigators in this contract examined the relationship between perinatal health outcomes and OGD and found associations between adverse birth outcomes and exposure to active and inactive wells and hydraulic fracturing (HF) during pregnancy in California. They also conducted a spatial analysis of OGD infrastructure sites and domestic wells areas (DWA-- populated areas served by at least one domestic well) and community water systems (CWS-- public drinking water systems with at least connections) to identify potential groundwater threats in the San Joaquin Valley and found that these systems particularly serve Latino populations. Finally, the investigators examined the relationship between the proximity to high methane emitting facilities and migraine prevalence and exacerbation and conducted an equity assessment of community proximity and exposure concentration for California's high methane emitting facilities. The results of these studies showed that high methane emitting facilities are located more in comminutes of color and that migraine cases are associated with their emissions. These analyses indicate the importance of characterizing the potential human health and equity implications of oil and gas development as well as high methane emitting facilities to ensure that regulatory decision-making for these facilities integrates public and environmental health, and environmental justice goals.

V. Other Business

1. Update on Research Planning