CALIFORNIA AIR RESOURCES BOARD

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Conference Room 510, 5th Floor
Sacramento, California 95814
(916) 445-0753

September 14, 2018
9:00 a.m.

ADVANCE AGENDA

I. Approval of Minutes of Previous Meeting:

July 13, 2018 meeting

II. Discussion of New Research Proposals:

1. "Real-world Tire and Brake-wear Emissions," University of California, Riverside, $400,000, Proposal No. 2817-289

   Vehicles emit inhalable particulates from two major sources: the exhaust system, which has been extensively characterized and regulated; and non-exhaust sources including brake-wear, tire-wear, and road dust resuspension. Increasingly stringent standards for exhaust emissions have led to the non-exhaust fraction becoming increasingly important. Model predictions (both MOVES and EMFAC) suggest that traffic-related emissions of both PM2.5 and PM10 from non-exhaust sources are currently on par with exhaust sources and will continue to increase in importance. Additionally, there is a growing concern over their potential toxicity due to their high metal content. Given the increased relevance of non-exhaust emissions and associated health concerns, new studies are needed to better estimate their magnitude and their impact on communities situated near major roadways. A greater understanding of the physical and compositional characteristics as well as overall emissions is needed for non-exhaust sources. Currently, a laboratory project is being funded to measure brake-wear particulate matter (PM) under controlled laboratory conditions, but an additional study is needed to determine how those emissions behave in the real-world. The objective of this project is to deploy a comprehensive measurement campaign near major roadway sites to capture a variety of driving behavior and fleet compositions. Real-time instrumentation will capture transient effects and discern the influence of driving conditions (smooth freeway driving verses stop and-go) and fleet mix (light-duty vs. heavy-duty). Filter measurements will help quantify total PM mass and identify tracers of individual non-exhaust sources. The information gathered will be analyzed to derive emission factors of non-exhaust emissions and in particular individual sources such as brake and tire-wear. It will also be input into a dispersion model to validate the derived emission factors and to

estimate the potential exposure of downwind communities to these PM sources. The University of California, Riverside (UCR) proposes to deploy a comprehensive suite of instruments designed to detect PM in a wide size range as well as tracers unique to the individual non-exhaust sources. The results of this project will be compared to current and future laboratory tests measuring brake and tire-wear PM under controlled conditions to determine how representative they are of the real-world. This project will develop a standardized experimental protocol to measure non-exhaust PM near roadways and will be used as a benchmark measurement for comparison with future campaigns when it is expected that non-exhaust influence may increase relative to exhaust. The results will also be compared to the updated EMFAC emission factors generated from the laboratory measurements. Thus, this work will have important implications for our ability to predict the impact of these emissions on communities living near roadways.

2. “Hybridization and Full Electrification Potential in Off-Road Applications,” University of California, Riverside, $350,000, Proposal No. 2818-289

   California has set ambitious goals to reduce statewide greenhouse gas (GHG) emissions to eighty-percent below 1990 levels by 2050 and to achieve air quality goals by meeting National Ambient Air Quality Standards. Attaining these emissions targets will require reductions in fossil fuel use in various sectors of the state’s economy. Mobile sources constitute a major portion of the GHG inventory and off-road equipment is one important sector. Off-road equipment is also a major source of criteria pollutants such as particulate matter (PM) and oxides of nitrogen (NO_X). For this reason, incentivizing the adoption of zero-emission technology in this sector would have multiple benefits of reducing both GHG and criteria pollutants. Although some electrified off-road equipment currently operates in the state, more work is needed to determine the feasibility of electrifying wider vocational applications of this important emissions source. The objective of this study is to propose previously unexplored pathways for hybridization and electrification in off-road equipment that maximize climate and air quality benefits while remaining both technically and economically viable. This study will assess the current trends toward electrification in the off-road equipment sector and determine the factors that have driven these trends. Additionally, this study will examine the entire off-road sector with an engine horsepower greater than 50hp and classify the various vocations by energy demand and operational activity to determine which sectors have not been considered for hybridization or electrification but could be partially or fully electrified in the near future. The University of California, Riverside (UCR), proposes to examine the inventory of off-road equipment, particularly construction and agricultural equipment, in California and classify by power requirements, engine sizes, population, and emissions. They will perform a market share analysis to discern major trends in this sector and compare to current inventory predictions. They will summarize current information on existing electrification efforts and leverage the expertise of their subcontractor, CALSTART, INC., to better understand which vocational applications are already on their way toward electrification and determine the factors that encouraged these trends. The contractor has direct access to a diverse set of activity and emissions data collected in the field from off-road equipment. They will utilize this data to perform a duty cycle analysis and input it into a powertrain model to test the feasibility of electrifying equipment. They will specifically target equipment that has not yet been explored for

electrification and which is a major source of emissions in the state. The results of this study will provide CARB with a roadmap for future incentive programs that will help meet its air quality and climate goals.

3. “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, Proposal No. 2819-289

   In accordance with State law, 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 research will identify indicators for transportation access disparities along with a screening method and visualization tool that will be useful for analyzing data related to this and other important social determinants of health. The project is an integral part of CARB’s implementation of Assembly Bill (AB) 32, Senate Bill (SB) 375, SB 350, and SB 150. Additionally, 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 (all four of the cited legislation plus SB 535, AB 1550 and AB 617).

4. “Estimating Induced Travel from Capacity Expansions on Congested Corridors,” University of California, Berkeley, $249,371, Proposal No. 2820-289

   In California, roadway expansion has historically been used as a strategy to relieve traffic congestion, but a growing body of research now shows that adding freeway lane capacity can lead to increases in vehicle miles traveled (VMT) - a phenomenon called “induced travel.” Accepting this, more transportation planning agencies are pursuing other strategies to reduce congestion, including non-general purpose lanes or managed lanes, like high-occupancy and high-occupancy toll lanes. Little is known, however, about the potential induced travel impacts of these types of projects, and there is no standard method for capturing short- and long-term induced travel impacts in transportation demand and land use models. This study will attempt to fill these knowledge gaps using empirical data and statistical analyses and techniques to estimate the induced travel impacts of non-general purpose lane projects. It will also assess existing regional and state practices for estimating the VMT impacts of capacity expansion projects and provide recommendations for improving these practices. The results will help CARB refine its review of sustainable communities’ strategies, as required by Senate Bill (SB) 375, and it will also help improve state and regional transportation demand and land use planning models. As state funds are increasingly distributed to projects that address “congested corridors,” the findings will also be important for informing holistic consideration of project impacts before they are selected for funding.

5. “Environmental Chamber Experiments to Improve Secondary Organic Aerosol Model Prediction,” University of California, Riverside, $450,000, Proposal No. 2821-289

   A major fraction of fine particular matter (PM2.5) in the atmosphere is comprised of secondary organic aerosol (SOA), which is created in the atmosphere from the oxidation of a variety of volatile organic compounds (VOCs). Recent research concluded that non vehicular sources (e.g., volatile consumer products or food-derived cooking emissions) of reactive gas-phase organics in urban areas may now contribute a larger fraction of the total VOC emissions. These non-vehicular sources must be better characterized to fully understand their impact on ambient ozone (O_3) and SOA formation. The primary effort of this research project is to optimize SOA chamber experiments that can be used to evaluate and improve SOA formation mechanisms in regulatory or scientific modeling applications. The investigators will review the existing chamber database, perform experimental comparison of SOA yield determination for several key SOA systems by conducting identical VOC oxidation experiments in two chamber facilities: California Institute of Technology (Caltech) and University of California Riverside (UCR). The proposed research project will also characterize SOA precursors that are emitted from a variety of VOC sources, such as consumer products (CPs), and the chemicals to be tested will be selected based on their chemical composition and potential importance to both ozone and SOA formation. The resulting environmental chamber datasets will be used to evaluate the predictive capabilities of the SOA formation mechanisms using selected SOA models. The results from this project will aid in the improvement of regulatory air quality models used to develop the State Implementation Plan, and enhance our ability to develop regulatory strategies that reduce ambient O_3 and PM2.5.

6. “Characterizing the Potential Health and Equity Impacts of Oil and Gas Extraction and Production Activities in California,” University of California, Berkeley, $299,988, Proposal No. 2822-289

   Oil and gas development (OGD) has been ongoing in California (CA) since 1900. Concerns about health impacts began to emerge in the United States around 2002 with rapid increase of unconventional OGD methods, like hydraulic fracturing (HF) and horizontal drilling. However, no studies have investigated the environmental health implications of OGD on birth outcomes in CA. In the event of well failures or inappropriate storage, fossil fuels may leak into the environment. In the case of natural gas, large-scale methane emissions can occur. Exposure to a combination of hazards including air and water pollutants, noise, odors, excessive and inappropriate lighting, and undesired land use changes could lead to health consequences like adverse birth outcomes. Among the hazards, the emerging evidence of surface and groundwater contamination related to OGD suggests that OGD could potentially threaten drinking water systems, especially small and domestic well systems that primarily serve rural and unincorporated areas in the state. Environmental justice stakeholders have also raised concerns regarding the equity implications of the potential air pollution, drinking water and health impacts of OGD and production activities.

This study seeks to inform the potential health implications of OGD among a racially, ethnically, and socioeconomically diverse population in urban, suburban, and rural settings in California, through three separate analyses:

- Analysis 1: Oil and Gas Development and Production and Birth Outcomes
- Analysis 2: Drinking Water Vulnerability Associated with OGD Activities
- Analysis 3: Methane Super-Emitters—Preliminary Environmental Justice and Health Assessment

lll. Discussion of Draft Final Report:

1. "Certification and In-Use Testing for Heavy-Duty Diesel Engines to Understand High In-Use NO_X Emissions," University of California, Riverside, $500,000, Contract No. 15RD001

   In order to achieve ambient air quality standards for ozone and PM, CARB has taken significant steps to reduce the NO_X emissions from on-road heavy-duty diesel engines (HDDEs). The certification standard for NO_X has been tightened to 0.20 g/bhp-hr over engine dynamometer testing cycles, and the not-to-exceed (NTE) in-use compliance requirements have been implemented for heavy-duty diesel vehicles (HDDVs). However, in-use NO_X emissions from HDDVs observed in recent real-world measurements were higher than their certification standard. It is important to investigate the differences between the certification and in-use NO_X emission rates and to understand the factors contributing to these differences. A contract was awarded to the University of California, Riverside (UCR) to test two HDDVs equipped with 2010-compliant HDDEs from different manufacturers with diesel particulate filter (DPF) and selective catalytic reduction (SCR) technologies using an engine dynamometer, a chassis dynamometer for laboratory testing, and portable emissions measurement systems (PEMS). Emission testing was conducted over a number of different cycles and on-road driving conditions, representing both urban and freeway driving. The NO_X emissions from both engines exceeded 0.20 g/bhp-hr over the Urban Dynamometer Driving Schedule (UDDS) and Federal Test Procedure (FTP) on the engine dynamometer. Under the same UDDS driving conditions, NO_X emissions from the chassis dynamometer and on-road testing were up to 4 times higher than the emissions from the engine dynamometer testing. In the in-use compliance analysis, 4.0 to 50.2 percent of the on-road vehicle operations were subject to the NTE in-use compliance requirements, while all the vehicle operations were subject to the European work-based Moving Averaging Window (MAW) requirements. The results of this study indicate that in-use NO_X emissions are above the 0.2 g/bhp-hr level for a wide range of operation, and that there are higher emitting trucks that also can contribute disproportionately to the NO_X inventory. It is likely that a combination of expanded certification criteria, tightened certification limits, and expanded in-use compliance procedures will be needed to provide greater control of in-use NO_X emissions.

lV. Other Business:

1. Update on the 2019/2020 Research Planning Process