State of 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

January 30, 2015

9:00 a.m.

ADVANCE AGENDA

I. Approval of Minutes of Previous Meeting:

October 3, 2014 meeting

II. Discussion of a Proposed Contract Augmentation:

1) "Modeling Household Vehicle & Transportation Choice & Usage," University of California, Davis, $45,000, Contract No. 11-322

A contract augmentation is requested to cover unanticipated expenses and delays associated with changes in the Air Resources Board's (ARB) policy for handling confidential Department of Motor Vehicles (DMV) data for research purposes. This dataset is fundamental to the development of the vehicle choice and usage model which this contract will deliver. The two tasks in this contract will support ARB efforts to reduce greenhouse gas and criteria pollutant emissions from the transportation sector. The first major component of the project focuses on understanding the factors that lead some Californians to a small transportation emissions footprint. It will identify the geographic and demographic characteristics of these low transportation emissions households. This first component of the project is on track and is not affected by this proposed augmentation. The second major component of the proposed project focuses on jointly modeling the consumer decision process about when to buy a vehicle, what type of vehicle to buy, and how much to drive the vehicle. This will allow for a more rigorous evaluation of the effects of policies that influence either the choice of vehicle or the usage of vehicles and will shed light on consumer valuation of different vehicle attributes. The results will provide valuable insights in support of ARB's Sustainable Communities and Advanced Clean Cars programs, and will provide a more sophisticated understanding of the evolution and emissions of the light-duty fleet.

III. Discussion of Draft Final Reports:

1) "Health Effects of Central Valley Particulate Matter," University of California, Davis, $496,429, Contract No. 09-330

Epidemiological studies have demonstrated that health effects associated with particulate matter (PM) are often not apparent until one to three days after exposure. However, the temporal patterns for development of pulmonary and cardiovascular responses appear to differ. Little is understood as to whether adverse changes in respiratory and cardiovascular endpoints represent independent effects that have different time courses for development, or whether they represent a continuum of effects that share common biological pathways and are inter-related. In addition, past studies have evaluated all endpoints at the same time post-exposure. Because of this, little is known about the time course for development of respiratory and cardiovascular effects. This project investigated how time lags in exposure increase or diminish pulmonary and cardiovascular responses in a mouse model that has similar pulmonary and systemic responses to PM as humans. The study also investigated the effect of two different methods of removing particles from collection filters on particle composition and elicitation of biological effects. The hypothesis of this project was that local pulmonary inflammatory responses in the airways of the lung precede, and then initiate vascular inflammation and subsequent platelet activation. The results demonstrate that responses of different endpoints do not have the same temporal patterns, explaining some of the lack of concordance between published studies. In addition, the method used to remove particles from the monitoring filter influences particle composition and toxicity. These findings provide new information on the biological mechanisms through which PM adversely impacts health. Moreover, the temporal patterns observed in different endpoints, as well as the findings from the particle extraction analysis, will influence experimental designs for future studies so that they are optimal to capture time varying effects.

2) "Risk of Pediatric Asthma Morbidity from Multi-Pollutant Exposures," University of California, Irvine, $285,000, Contract No. 10-319

One of ARB's goals is the protection of sensitive populations, such as children, from air pollution impacts. Numerous studies have shown a link between particulate matter (PM) exposure and asthma morbidity outcomes in children; however, several issues regarding the biologically active components of PM remain to be addressed. There is limited information on the impact of primary organic aerosols (POA) directly emitted from combustion sources, and secondary organic aerosols (SOA) which are largely photochemically-produced, on the risk of acute asthma morbidity among children. This study analyzed the possible relationship between asthma morbidity (using hospital data for 7,954 children with asthma) and both regional and local exposures to PM including POA and SOA in Orange County. The UC Davis/California Institute of Technology (UCD/CIT) Source Oriented Chemical Transport Model was used to output daily POA and SOA concentrations. Traffic-related air pollution (TRAP) was assessed using CALINE4 dispersion models at subject residential locations for ultrafine particle

number concentrations as well as PM2.5, and NO_X concentrations averaged seasonally and weekly. Acute asthma morbidity was found to be increased in relation to short-term elevations in various indicators of air pollution (CO, NO_2, NO_X, TRAP, and POA from on-road and off-road diesel plus gasoline emission sources). There were no associations with SOA in either season. Associations of asthma with ambient CO, NO_2, NO_X, and PM2.5, were stronger among subjects living in homes near high TRAP suggesting that this is a vulnerable population. Assessing the important sources and components of PM2.5 that are related to health outcomes could aid ARB by targeting specific PM2.5 sources for future control measures.

3) "Reducing Air Pollution Exposure in Passenger Vehicles and School Buses," University of California, Los Angeles, $150,000, Contract No. 11-310

For most Californians, the highest personal exposure to particulate matter (PM) occurs while commuting on roadways. The investigators assessed the effectiveness of utilizing high efficiency cabin air (HECA) filters in cars and high efficiency filtration systems in school buses to mitigate commuter roadway PM exposures. Ultrafine particles (UFP), black carbon (BC) and PM2.5 were concurrently monitored inside and outside of each vehicle under three driving conditions: stationary, on local roadways, and on freeways. The effectiveness of two types of HECA filters relative to the original equipment manufacturer-supplied (OEM) filter was evaluated in 12 cars, which were operated with the vents open to prevent CO_2 build-up from occupants' exhaled breath. The effectiveness of the bus HECA system was evaluated by measuring in-cabin particle levels in 6 school buses with and without the HECA filtration system operating. When cars were outfitted with HECA filters, average in-cabin reductions of 89 percent (UFP), 82 percent (BC), and 64 percent (PM2.5) were achieved, relative to the measured on-road ambient concentrations. These reductions were about twice the reductions achieved with the low efficiency manufacturer-supplied filters, which showed reductions of 29 percent to 46 percent. When the bus HECA filtration system was operating, average reductions of 89 percent (UFP), 85 percent (BC), and 73 percent (PM2.5) were achieved inside the bus, relative to the measured on-road ambient concentrations. High efficiency filtration appears to be a potential mitigation strategy available in the near-term to reduce vehicle occupants' exposure to roadway PM and provide additional health protection while ARB's emission control measures are implemented and fleet turnover occurs over time.

4) "Development of a Portable In-Use Reference Particulate Matter Measurement System," University of California, Riverside, $300,000, Contract No. 10-311

Heavy-duty diesel trucks are an important source of particulate matter (PM) emissions in California. The Statewide Truck and Bus Regulation implemented in 2007 have accelerated the use new technology engines. For PM emissions, this rule has already resulted in retrofit or replacement of nearly the entire on-road fleet with engines equipped with diesel particulate filters (DPF) to reduce PM emissions. There is a need for accurate measurement of in-use PM emissions using Portable Emissions Measurement Systems (PEMS) to evaluate in-use compliance, to improve the emission inventory, and to evaluate commonly used

real-time PM instruments against gravimetric reference methods. Unlike PEMS systems for measurement of nitrogen oxides (NO_X), the reliability of commercially available PEMS using real-time PM instrumentation is questionable at the low PM emission levels of DPF equipped vehicles. The results of light scattering and absorption methods used by commercially available real-time PM instrumentation are highly dependent on particle size, composition, and concentration, and can result in large deviations from reference gravimetric methods. The goal of this project was to develop a new filter-based PM PEMS to measure in-use PM emissions using a gravimetric method with focus on equivalence to the federal reference methods. The gravimetric PM PEMS should be adaptable to characterize PM emissions from diverse activities including on-highway, non-road, and marine applications. The instrument was designed based on the measurement principles specified in 40 Code of Federal Regulations (CFR) 1065 for gravimetric mass measurements using proportional sampling. The design included an automatic filter switching system that can collect multiple filter samples during a single test drive, in order to cover various driving modes, not-to-exceed (NTE) events, and sampling windows fixed time, total mass, and other approaches of interest to ARB.

The design was implemented and tested in an iterative process. The final design was arrived at by looking at best practices for each component. The components chosen include a remote diluter manufactured by AVL, a proportionality methodology by Sensors, a filter flow variable pump controller by Control Systems, and multi-filter auto indexing system by AEI. The investigators utilized the component from each vendor and created a cohesive sampler that is simple to operate, has low power requirements, and is light weight. The final version of the system demonstrated good equivalence with gravimetric PM emission measurements made using a full scale, 40 CFR 1065 compliant, Constant Volume Sampler (CVS) system.

5) "Determination of the Spatial Distribution of Ozone Precursor and Greenhouse Gas Concentrations and Emissions in the Los Angeles Basin," University of California Los Angeles, $299,968, Contract No. 09-318

This project developed and deployed for three years two novel remote sensing methods from a mountaintop overlooking the South Coast Air Basin (SoCAB) to measure concentrations of several ozone precursors and greenhouse gases. The instruments, one operating in the ultraviolet-visible (UV-vis) range and the other in the near-infrared (IR), were located at the Jet Propulsion Laboratory's (JPL) Mt. Wilson California Laboratory for Atmospheric Remote Sensing (CLARS), which is located 1674 m above sea level. The UV-vis instrument is based on Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) and measured solar absorption spectra of nitrogen dioxide (NO_2), formaldehyde (HCHO) and tetra oxygen (O_4) (as a proxy for aerosol extinction) over eight elevation angles. These measurements provided height resolved concentrations and three-year time series of NO_2 and NO_X/VOC sensitivity studies in the SoCAB. The near-IR instrument is based on a novel remote sensing approach - Fourier transform spectroscopy - for monitoring the spatial and temporal distributions of greenhouse gases in the Los Angeles. The instrument recorded reflected near-IR solar

radiation from a number of ground target locations in the Los Angeles basin; column-averaged dry-air mole fractions of greenhouse gases (XGHG) including XCO_2, XCH_4, and XCO were retrieved several times per day for each target. Data for each trace gas observed span three years and can be used to improve emission inventories and air quality models, and help ARB to strategically target mitigation efforts for air quality and climate change.

6) "Assessment of the Emissions and Energy Impacts of Biomass and Biogas Use in California," University of California, Irvine, $167,497, Contract No. 11-307

California has been adopting regulations to promote renewable electric power and transportation fuels through the PUC's Renewable Portfolio Standard (RPS) and the ARB's Low Carbon Fuel Standard (LCFS). Increased use of biomass and biogas for fuel and electric power can lead to reduced emissions of criteria pollutants and greenhouse gases (GHG), and thereby help achieve these standards. This study was designed to evaluate the potential air quality co-benefits of biomass and biogas use. Various feedstocks and technologies were reviewed to determine existing and projected bioenergy capacity and emissions, and air quality modeling was used to determine overall air quality impacts. With current technology and maximum power production potential, NO_X emissions could triple from current levels by 2020, leading to a 6 ppb increase in ozone concentrations downwind of major facilities. However, technology upgrades would significantly reduce these emissions. CNG production for vehicles may be the best option, in terms of air quality and GHG emissions. By providing a scientific basis to evaluate the potential air quality co-benefits of biomass and biogas use, the results will help State agencies develop strategies to meet the RPS & LCFS.