

**State of California  
AIR RESOURCES BOARD**

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

**May 11, 2012  
10:00 a.m.**

**ADVANCE AGENDA**

I. Approval of Minutes of Previous Meeting:  
March 9, 2012

II. Discussion of a New Research Project:

- 1) "New Car Buyers' Intentions Toward Zero-Emission Vehicles," University of California, Davis, \$250,000, Proposal No. 2744-274

New advanced light-duty vehicle technologies and designs, including those that reduce criteria pollutant and greenhouse gas emissions, continually evolve in response to consumer preferences and other market conditions. Total on-road fleet emissions and compliance with vehicle standards will therefore depend on consumers' willingness to purchase and use these advanced light-duty vehicles. This project's objective is to conduct a statewide survey and household interviews of California buyers of new vehicles to understand consumer attitudes, barriers, and motivators toward purchasing zero, near-zero, and low-emission vehicles. The project will produce a statistically robust representation of California's new car buying population to identify the factors that influence new-vehicle purchase decisions and the areas where additional policies, incentives, or outreach could be implemented to facilitate greater adoption rates of cleaner cars.

III. Discussion of Draft Final Reports:

- 1) "Toxicity of Source-Oriented Ambient Aerosol," University of California, Davis, \$838,934, Contract No. 06-331

Ambient particulate matter (PM) has been associated with premature death and hospitalization, but it is unknown which components are the most responsible for the adverse health effects. Ambient PM derives from a wide range of sources

and experiences a range of atmospheric processes that may alter its toxicity. Direct exposures of animals to PM emissions neglects the atmospheric photochemistry that may enhance toxicity, while exposure to total ambient PM combines the effect of many sources so that it does not elucidate which source contributes to the toxicity. This study used a single-particle mass spectrometer to selectively collect and separate ambient particles with a series of biosamplers attached to a particle concentrator. Mice were exposed to biosampler contents and studied for possible toxicity. The results demonstrated that there were clear differences in the physiological responses in mice exposed to particles from different biosamplers for a number of toxicological endpoints. The driving force of this project was to develop relative toxicity indices for particles or particle components derived from different source categories.

- 2) "Effects of GSTM1 Genotype on Ozone-Induced Allergic Airway Inflammation," University of California, San Francisco, \$747,990, Contract No. 03-315

Epidemiological data suggest that asthmatics may be more sensitive to Ozone ( $O_3$ ) exposure than nonasthmatics, although the basis for this difference is largely unknown. Animal and human exposure studies have shown that  $O_3$  exposure can enhance allergic inflammatory and bronchoconstrictor responses in the lungs, both of which are features of asthma. Several studies suggest that variant forms of the antioxidant gene that produces glutathione S-transferase 1 (GSTM1) may influence responses to inhaled  $O_3$ . A variant form of the GSTM1 gene (GSTM1 null), which occurs in 30 to 50 percent of the population, produces an inactive form of GSTM1 that has no antioxidant properties. It has been hypothesized that individuals with the inactive form of the GSTM1 gene would be more responsive to  $O_3$  than individuals with the active form of the gene. This study compared the lung function and airway inflammatory responses of ten adult allergic asthmatics to allergen challenge. The subjects underwent four-hour intermittent exercise exposures to filtered air (FA) or 0.16 ppm  $O_3$ , which were followed twenty hours later by an allergen challenge (dust mite). Lung function, airway inflammation and allergic responses were measured four hours after the allergen challenge.  $O_3$  exposure induced the expected decrease in lung function, as well as larger decrements following the allergen challenge compared to FA exposure. There was a small, non-significant increase in lung inflammatory cells in response to the allergen challenge after  $O_3$  compared to FA exposure, but unexpectedly, the levels of most inflammatory biomarkers were lower after the  $O_3$  than the FA exposure. There were no significant differences in lung function response to  $O_3$  between subjects with the two forms of the GSTM1 gene, but the inflammatory mediator response to allergen was consistently lower in the subjects with the inactive form of the gene, contrary to expectations.

- 3) "Environmental Exposures in Early Childhood Education Environments," University of California, Berkeley, \$417,496, Contract No. 08-305

This study sought to characterize the exposures of children to contaminants in child care centers and the potential risks posed by those exposures. The environmental characteristics of 40 California early childhood education (ECE)

facilities and the contaminant levels in their air and dust were examined. The results showed that the highest concentrations of volatile organic compounds were d-limonene (from cleaning products) and decamethylcyclopentasiloxane (found in personal care products). For most chemicals, health-based dose or exposure benchmarks were not available, but when they were available, estimated exposures were usually below levels of concern. However, formaldehyde levels exceeded the California eight-hour reference exposure level and chronic reference exposure level in 87.5 percent of facilities, and acetaldehyde concentrations exceeded the United States Environmental Protection Agency reference concentration in 30 percent of facilities. Levels of formaldehyde, acetaldehyde, chloroform, benzene, and ethylbenzene exceeded child-specific Safe Harbor Levels for cancer, based on Proposition 65 guidelines, in several facilities. Child dose estimates for two brominated flame retardants (BDE-47 and BDE-99) exceeded the non-cancer U.S. EPA reference doses for children <1 year old in 10.3 percent of facilities. Concentrations for indoor PM10 collected over eight hours exceeded the level of the 24-hour California PM10 Ambient Air Quality Standard in 46 percent of the facilities. PM2.5 collected over eight hours exceeded the level of the U.S. EPA 24-hour PM2.5 standard in 11 percent of the facilities. Overall, the findings suggest that contaminant levels in ECE environments are similar to those measured in homes and schools in previous studies, but that mitigation strategies may be warranted to reduce exposures to some chemicals, especially formaldehyde, that exceed health benchmarks. This information will help ARB and other agencies better protect children's health by identifying key exposures that can be reduced through regulations, guidelines, or other approaches.

- 4) "Assessment of Baseline Nitrous Oxide Emissions in California Cropping Systems," University of California, Davis, \$300,000, Contract No. 08-324

Nitrous oxide (N<sub>2</sub>O) is a potent greenhouse gas that contributes to global warming. Agriculture is the major source of N<sub>2</sub>O on both the global scale and in California, accounting for about 60 percent of anthropogenic N<sub>2</sub>O emissions, most of which is derived from agricultural soils. Because N<sub>2</sub>O is produced in soil through microbiological processes involving nitrogen (N) compounds, its emission is closely related to soil N content and influenced by numerous variables that govern microbial activities such as soil properties, meteorological conditions, and crop management practices. As a result, N<sub>2</sub>O fluxes from agricultural fields are highly variable and subject to large uncertainties in N<sub>2</sub>O emissions estimates. Thus, characterization of N<sub>2</sub>O fluxes from agricultural fields is important in determining both baseline N<sub>2</sub>O emissions and mitigation potentials of N<sub>2</sub>O. This project measured N<sub>2</sub>O fluxes from five major California crops (tomatoes, wheat, alfalfa, lettuce, and rice) representative of a large acreage of the state's crop land, evaluated impacts of soil conditions and N fertilizer rate on N<sub>2</sub>O emissions, and established crop-specific emission factors. The project provided the most comprehensive and robust dataset of N<sub>2</sub>O monitoring so far from California crop systems, which will serve as critical inputs to an ongoing modeling study for the development of statewide baseline N<sub>2</sub>O emissions from agricultural soils in California.

- 5) "SOA Formation: Chamber Study and Model Development," University of California, Riverside, \$474,229, Contract No. 08-326

Secondary organic aerosol (SOA) is an important component of airborne particulate matter (PM) which has a significant impact on public health, visibility, and climate change. SOA is formed through atmospheric reactions from reactive precursors, including volatile organic compounds and nitrogen oxides. However, the photochemical processes involved in SOA formation are poorly understood, and current air quality models often seriously under-predict ambient SOA levels. To develop reliable and effective PM control strategies, an improved SOA mechanism is needed for use in air quality models, which in turn requires a better understanding of SOA formation processes. In this project, environmental chamber experiments were conducted in order to develop a chemical mechanism to predict SOA formation from aromatic compounds, which are an important class of SOA precursors for which existing models perform poorly. Current and alternative aromatic mechanisms were evaluated, and SOA yields and partitioning parameters were optimized to simulate the available data. The results indicate that the model simulated most of the data without large biases, but with more run-to-run variability in model performance than is seen in ozone mechanism evaluations. It is concluded that this reflects the current state-of-the-science and represents significant progress toward the eventual development of a chemical model to predict SOA from anthropogenic emissions. Such a model is essential to developing cost-effective control strategies for fine PM.

- 6) "Nocturnal Chemistry in the Urban Boundary Layer of Los Angeles," University of California, Los Angeles, \$409,090, Contract No. 08-318

This project addressed one of the least well-understood areas in the atmospheric chemistry of urban areas – nocturnal atmospheric chemical processes and their impact on daytime ozone and aerosol concentrations. Field measurements were made in the greater Los Angeles area using a remote sensing technique, Long Path Differential Optical Absorption Spectroscopy, which recorded trace gas concentrations in 4 height intervals over distances ranging from 5 to 7 kilometers. This work was carried out as part of the CalNex 2010 field study that was organized by ARB and the National Oceanic and Atmospheric Administration to study processes at the intersection of climate change and air quality in California. Professor Jochen Stutz, the Principal Investigator for the nocturnal chemistry project, took the lead in organization and set up of a comprehensive field site on the CalTech campus for CalNex 2010; this site attracted over 40 research groups and gave the most detailed insight into gas- and particle-phase chemistry in a large urban area to date. Two important results, among many, from the project are: 1) nocturnal  $\text{NO}_x$  loss is comparable to its daytime loss due to OH chemistry and is primarily due to  $\text{N}_2\text{O}_5$  aerosol uptake; 2) a currently unknown source of daytime nitrous acid (HONO) contributes significantly to hydroxyl radical OH formation and hence ozone ( $\text{O}_3$ ) formation. The likely source of this HONO is photo-enhanced conversion of  $\text{NO}_2$  on the ground. Concentration profiles and results from this project will help constrain and improve models for nocturnal

atmospheric chemistry, and lead to more accurate predictions of O<sub>3</sub> and particle formation in urban areas.

- 7) "Source Apportionment of Carbonaceous Aerosols Using Integrated Multi-Variant and Source Tracer Techniques and a Unique Molecular Marker Data Set," University of Wisconsin-Madison, \$409,963, Contract No. 07-333

Organic carbon (OC) and elemental carbon (EC) are important contributors to fine particle concentrations throughout the State of California. As such, this carbonaceous material is important to human health, visibility, and regional climate forcing. A comprehensive year-long data set was collected to provide information to assess, inform, and compare modeling tools designed to apportion emission sources to individual OC and EC sources. Improved characterization of individual sources, such as gasoline powered vehicles, diesel engine exhaust, and primary and secondary organic aerosols (biogenic and anthropogenic) in California will help the state develop effective particulate matter control strategies and support health and climate forcing studies.

A year-long time series of hourly particulate matter 2.5 (PM<sub>2.5</sub>), daily OC and EC measurements, daily PM<sub>2.5</sub> molecular marker measurements, and daily PM<sub>2.5</sub> measurements of bulk fine-particle parameters (including water soluble organic carbon, water soluble nitrogen, and ultrafine particle number) were generated. Data generated during the first portion of the project were used as inputs for source apportionment models. Results from these models were compared to determine if the commonly used source apportionment models differ significantly. Lastly, statistical analyses were performed on the data to characterize trends in day-of-the-week, time-of-day, and wind trajectory analysis was employed to identify the strengths and weaknesses of the models.

Results from the Chemical Mass Balance (CMB) and Positive Matrix Factorization (PMF) receptor models were compared, and found to show good agreement for the contributions of mobile sources and biomass smoke to PM<sub>2.5</sub> OC of 30 percent and 10 percent, respectively. The Iterative Confirmatory Factor Analysis (ICFA) modeling results are also in reasonable agreement with mobile sources contributing 23 percent to the total PM<sub>2.5</sub> OC. However, the CMB model estimates indicate that secondary organic carbon (SOC) dominated the remaining OC with a contribution of 60 percent while the PMF modeling results indicate that 40 percent of the remaining OC was from SOC and 20 percent was from primary biogenic material (e.g. forest fires and possibly cooking).

Overall, this study shows: 1) the importance of year-long data sets in accurately quantifying OC emissions and source apportionment, particularly seasonal trends; 2) that source apportionment techniques are sufficiently accurate for certain source contributions, but may generate substantially different results for other emission sectors; and 3) the diesel/gasoline exhaust PM split remains difficult to accurately quantify using all tested receptor models and molecular markers.

#### IV. Other Business:

- 1) Update on Annual Research Plan