

**State of California
AIR RESOURCES BOARD**

**Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Conference Room 550
Sacramento, California 95814
(916) 445-0753**

**December 2, 2011
9:00 a.m.**

ADVANCE AGENDA

- I. Approval of Minutes of Previous Meeting:
October 28, 2011

- II. Discussion of New Research Projects:
 - 1) "Reducing In-Home Exposure to Air Pollution," Lawrence Berkeley National Laboratory, \$1,300,994, Proposal No. 2733-272

New California homes are now required to have mechanical ventilation systems, many of which do not filter the incoming polluted air. The increase in the number of new homes built near major roadways may elevate the public's indoor exposure to high levels of ambient particulates, especially ultrafine particles (UFPs); and ozone continues to be a major pollutant in urban areas. Employing high efficiency filtration in homes can be a very effective mitigation tool in reducing such exposure. The objective of this study is to measure the effectiveness and energy use of combinations of mechanical ventilation and filtration systems in order to identify compatible low-energy systems that are most effective at reducing indoor exposures to indoor, and incoming outdoor, pollutants. Specifically, the investigators plan to: 1) identify and evaluate up to 15 current and new systems, and select seven of the most promising systems to be compared to one reference or baseline system; 2) identify and prepare a test home near a major roadway with high ambient ozone and PM2.5 levels in which the experimental measurements will be conducted; and 3) evaluate the in-situ performance of system combinations operating over a period, including several weekdays and one weekend day, during a warm, spring/summer season and a cool, fall/winter season. The results of this study will identify combinations of mechanical ventilation and filtration systems that are both health-protective and energy-efficient that can be specified for new homes and homes of people with severe asthma or other respiratory conditions.

- 2) "Reducing Air Pollution Exposure in Passenger Vehicles and School Buses," University of California, Los Angeles, \$150,000, Proposal No. 2730-272

Exposure to roadway-related particulate matter (PM) has been linked to respiratory and cardiovascular diseases. A significant percentage of the daily exposure to this pollution has been demonstrated to occur while commuting between home and work or school. While substantial progress has been made in reducing on-road emissions by tightening vehicle emission standards and retrofitting trucks and buses, exposure to commuters is still of concern due to their proximity to the sources of this pollution. The investigators will assess the effectiveness of high efficiency (HEPA) filters in cars and school buses to mitigate roadway exposures of commuters. In-cabin particulate levels will be tested in 12 cars driven under three in-cabin filter schemes, including: 1) no passenger-cabin filters, 2) passenger-cabin filters provided by the manufacturer, and 3) HEPA passenger-cabin filters. In-cabin particulate levels in buses will be tested with and without in-cabin HEPA filters. Results from these studies will provide the Air Resources Board (ARB) with a detailed understanding of the extent to which passenger cabin filters can mitigate exposures to roadway pollution at a relatively low cost.

- 3) "Modeling the Formation and Evolution of Secondary Organic Aerosol during CalNex 2010," University of Colorado, \$350,000, Proposal No. 2731-272

Organic aerosols (OA), and specifically secondary organic aerosols (SOA) formed from oxidation of gaseous precursors, constitute a large fraction of the submicron particulate mass and are responsible for significant health and climate effects. Despite their importance, a substantial gap remains between model predictions and field measurements of SOA concentrations, with predictions typically too small by a factor of two to three. The objective of the proposed research is to improve modeling of the concentration, composition and evolution of SOA in California by using measurements from the CalNex 2010 field study to optimize and constrain state-of-the-art SOA models. The improvements to SOA models will be based on a wide variety of measurements that were taken during the largest field study of atmospheric processes over California – CalNex 2010. These include high-resolution time-of-flight Aerosol Mass Spectrometer (HR-ToF-AMS) measurements of aerosol composition taken by the Jimenez Group and supporting measurements of aerosol precursors and other species taken by other research groups at the Pasadena supersite. By employing multi-group data sets, the research team effectively leverages several million dollars' worth of data collection and analysis work from the CalNex 2010 campaign. State-of-the-art SOA models will be run using SOA precursor and oxidant data as inputs to provide predictions for the concentration, composition and volatility of SOA at the field site; the resulting predictions will be compared against experimentally determined SOA characteristics. Parameters within the models will then be adjusted to provide the best description of the data. Given the scope and the sophistication of the gas-phase and particle-phase measurements carried out

during CalNex 2010, the proposed research will test and constrain SOA models at a level of detail that has not been possible before. Results from this work will be used to help identify sources of SOA and improve models that quantitatively predict the evolution of SOA; these improvements will aid in the development of effective strategies to reduce SOA pollution in California and in predictions of future climate change.

- 4) "Long Range Transport of Air Pollutants into California," University of California, Davis, \$506,084, Proposal No. 2729-272

Wind patterns in the Northern Hemisphere typically carry pollutants across the Pacific Ocean from Asia to North America. The natural and anthropogenic emissions in Asia contribute to the background concentrations of air pollutants in the air masses crossing California. This baseline in pollutant concentrations has been increasing and, with limited prospects for reductions in Asian emissions in the short-term, more stringent control efforts on emission sources in California will be needed if all health-based ambient air quality standards are to be attained. Most of what we know about Asian transport is from short-term intermittent measurements and modeling studies. To more fully characterize air quality, particularly when ozone ambient air quality standards are exceeded, this project will make continuous measurements of ozone as well as size and composition measurements of particulate matter (PM) for two years during the extended summer season (March-October) at two remote monitoring sites. The measurements will include chemical markers previously shown to be indicative of emission sources over which the air mass has passed. The measurements and data analysis associated with this project will refine the contributions of Asian transport to air quality in northern California. This information is critical for ensuring that emission control efforts are sufficient to achieve ambient air quality standards and to avoid federal sanctions. In addition, the data will help define policy-relevant background (PRB) ozone concentrations in California. These results will help identify the need for international emission reductions, which would avoid the imposition of additional control programs on California's businesses and residents.

- 5) "Atmospheric Measurement and Inverse Modeling to Improve Greenhouse Gas Emission Estimates," Lawrence Berkeley National Laboratory, \$680,000, Proposal No. 2724-272

Assembly Bill 32 (Global Warming Solutions Act of 2006, AB 32) requirements make it necessary for the Air Resources Board (ARB) to develop and evaluate a greenhouse gas (GHG) emissions inventory for California. Some of the current inventory estimates of GHGs are uncertain, especially methane (CH₄) and nitrous oxide (N₂O). Atmospheric GHG measurements from tall towers, when combined with inverse modeling estimation techniques, have the potential to independently quantify GHG emissions. The research proposed here constitutes a focused effort to evaluate California's GHG emissions inventory.

The proposed project is divided into three tasks: 1) continue to collect a long-term dataset of GHG and carbon monoxide (CO) measurements from the tall tower near Walnut Grove, California, adding continuous N₂O measurements to the existing measurement suite, and compiling a one-year measurement record for inverse modeling; 2) expand the ARB GHG research measurement network to a new tower site in the Riverside/San Bernardino area, capturing GHG and CO emissions from the entire South Coast Air Basin (SoCAB), and compile a one-year measurement record for inverse modeling; 3) apply inverse modeling to include the new Riverside/San Bernardino measurement site and the full suite of measured GHG and CO in order to evaluate the inverse modeling methodology using ARB's independently confirmed CO emissions inventory and to evaluate ARB's GHG emissions inventory.

- 6) "Source Speciation of Central Valley GHG Emissions using In-Situ Measurements of Volatile Organic Compounds," University of California, Berkeley, \$360,000, Proposal No. 2732-272

Accurate and precise greenhouse gas (GHG) emission inventories for all source categories are essential to determine their mitigation potential and to apportion the required GHG emission reductions. The Air Resources Board's (ARB) GHG emission inventories have gone through a number of evaluation and validation exercises. Nevertheless, peer-reviewed literature and ARB-supported research recommends further improvements, particularly to the methane (CH₄) and nitrous oxide (N₂O) inventories. Many GHG emission sources also emit volatile organic compound (VOC) species which can help to identify the source. Using a proton transfer reaction mass spectrometer (PTR-MS), this study would add speciated VOC measurements to the measurement program at a tall tower in Walnut Grove. Using speciated VOCs, this study would develop detailed GHG source profiles and test their use in more robust inverse estimation and modeling for GHG emission inventory evaluation and validation.

- 7) "Development of a New Methodology to Characterize Truck Body Types along California Freeways," University of California, Irvine, \$350,000, Proposal No. 2727-272

Inductive loop detector (ILD) systems are widely deployed in major freeway corridors in the United States to collect traffic data. However, the current systems only provide the number of vehicles and occupancy data. These systems are unable to characterize the traffic composition such as the percentage of trucks and buses, which is a critical input for emissions estimation. Recently, University of California, Irvine (UCI) under contract with ARB developed a California Vehicle Activity Database (CalVAD) to estimate highway vehicle miles traveled (VMT), average speed, heavy-duty truck VMT and heavy-duty truck weight. However, these enhancements do not provide information on truck body classification and the relationship between body size and weight characteristics that influence emissions from the truck fleet.

Therefore, this study proposes to develop and implement an improved data collection methodology that will provide body type classification for trucks traveling on the California freeway system. This project includes development of a truck body classification model that will use classifications similar to the classifications in the Vehicle Inventory Use Survey (VIUS) . The results from the proposed study are expected to differentiate between freight and non-freight trucks both spatially and temporally. The results of this study can be used to estimate the proportion of long haul and short haul trips in major corridors. This will lead to improvements in emission inventory models to predict the effectiveness of various emissions control program. Further, the information from this study will also be used to calibrate and validate the statewide freight-forecasting model and will help inform freight models under development by metropolitan planning organizations (MPOs). Ultimately, the results from this study will help to develop strategies to reduce emissions from California's goods movement.

- 8) "Evaluating Mitigation Options of Nitrous Oxide Emissions in California Cropping Systems," University of California, Davis, \$400,000, Proposal No. 2728-272

The agricultural sector is the largest contributor of nitrous oxide (N₂O), a potent greenhouse gas (GHG), both globally and in California, accounting for about 60 percent of anthropogenic N₂O emissions. Since N₂O is produced in soil through microbial processes involving nitrogen (N) compounds, its emissions from agricultural soils are closely related to soil nitrogen content, but highly variable due to numerous environmental factors that govern microbial activities. Therefore, crop management practices that affect microbial activities in soil would also affect N₂O emissions. This project will identify and quantify the N₂O emission reduction potential from alternative management practices for five important crops in California: grapes, almonds, lettuce, tomatoes, and corn. The proposed alternative management practices will include: use of alternative nitrogen fertilizers, use of nitrification and urease inhibitors, fertigation via subsurface drip irrigation (SDI), changing cover crops, organic farming, and conservative tillage. This project is expected to provide data needed for the development of potential agricultural offset protocols pursuant to AB 32.

- 9) "Assessment of the Emissions and Energy Impacts of Biomass and Biogas Use in California," University of California, Irvine, \$169,997, Proposal No. 2726-272

ARB has adopted regulations to promote renewable electric power and renewable transportation fuels through the Renewable Electricity and the Low Carbon Fuel Standards. Increased use of biomass and biogas can lead to reduced emissions of criteria pollutants and greenhouse gases (GHG). Sewage digester gas, landfill gas, and biomass resources can be used to generate electricity and heat, and to provide renewable gaseous or liquid fuels for stationary and vehicular applications. This study will quantify the

emissions from various fuel paths that utilize biomass and biogas, and determine the potential to exploit emerging resources, focusing on the South Coast Air Basin (SoCAB) and the San Joaquin Valley (SJV). This study will use the resulting data as input into air quality modeling to determine the overall air quality impacts and GHG emissions of the projected biomass and biogas infrastructure. The results will provide a scientific basis to evaluate the potential air quality co-benefits of biomass and biogas use.

III. Review of Draft Final Reports:

- 1) "Is Disparity in Asthma among Californians due to Higher Pollution Exposures, Greater Vulnerability, or Both?" University of California, Los Angeles, \$299,794, Contract No. 07-309

The California Health Interview Survey (CHIS) is a population-based random-digit dial telephone survey conducted in California every two years since 2001 and directed by the University of California, Los Angeles (UCLA) Center for Health Policy Research. According to analysis of the CHIS 2003 data, 4.5 million Californians suffer from asthma and an additional 3.4 million Californians suffer from asthma-like symptoms. Previous studies have indicated that children, the elderly, racial/ethnic minorities, and low-income Californians suffer disproportionately from asthma and asthma-like symptoms. Studies have also indicated that some sub-populations are more affected by pollutants due to increased vulnerability or increased exposures. Data from the CHIS project was used to examine air pollution susceptibility in vulnerable populations and to provide information on whether the disproportionate burden of asthma or asthma-like symptoms among low socioeconomic status (SES) individuals is related to greater pollutant exposures, greater vulnerabilities, or both. Using Geographic Information System (GIS) software, CHIS 2003 respondents' residential addresses were linked to air pollution data for O₃, PM₁₀, PM_{2.5}, and NO₂ from the nearest air monitoring stations. Annual pollutant averages and days exceeding air quality standards were calculated. Traffic density and residential distance to roadways were also determined. Higher exposures were found for lower income groups and racial/ethnic minorities (Latino, African Americans and Asian/Pacific Islander/Other) for NO₂, PM₁₀, and PM_{2.5}. The study found associations between pollutant exposures and increased asthma outcomes among adults and children. The results suggested that some racial/ethnic populations (Latino, African Americans and Asian/Pacific Islander/other) and low-income groups had greater levels of adverse asthma outcomes with similar increases in air pollution exposures compared to higher income reference groups (white). Overall, the results of this study found that some lower income and minority groups are more impacted by air pollution due to higher exposures and in addition, certain lower income and minority groups are more vulnerable to the effects of air pollution exposures than other groups.

- 2) “Retail Climate Change Mitigation: Life-Cycle Emission and Energy Efficiency Labels and Standards,” University of California, Berkeley, \$265,144, Contract No. 07-322

Air Resources Board (ARB) is at the forefront of reducing greenhouse gas (GHG) emissions from a wide range of sources. Estimates are that up to 67 percent of the annual GHG “footprint” of the average United States consumer is attributable to the purchase, use, and disposal of retail products. The emissions associated with their manufacture, use, and disposal may represent an untapped source of potential GHG emissions reductions. The contractor developed a model to estimate total lifecycle GHG emission for 22 retail products sold in California.

The completed research provides ARB with:

- A comprehensive emission multi-regional input-output (MRIO) lifecycle analysis (LCA) model that characterizes the embedded GHG emissions of retail products sold in California.
 - An estimate of lifecycle GHG emissions reductions technically attainable for 22 retail products.
 - An assessment and analysis of the emissions reduction from a labeling and a standards program if applied to these 22 products.
- 3) “SF₆ Replacement Evaluation in Magnesium Sand and Investment Casting,” California State Polytechnic University, Pomona, \$49,995, Contract No. 09-366

Molten magnesium rapidly oxidizes upon exposure to the atmosphere, hindering the magnesium casting process and resulting in high product scrap rates. In current casting practice, sulfur hexafluoride (SF₆) is used as a cover gas to prevent exposure of the molten metal to air. Unfortunately, SF₆ has an extremely high global warming potential (GWP) and, per the state’s efforts under the Global Warming Solutions Act of 2006 (AB 32), a low GWP replacement is desired. This project’s objective was to select and utilize a viable alternative in normal casting operations to determine viability as a replacement for SF₆. The most viable candidate is a fluorinated ketone called Novec 612, manufactured by 3M Corporation. Several California magnesium foundries used Novec 612 in their sand and investment casting production work and evaluated the products produced. The product quality and scrap rates were comparable to those achieved using conventional SF₆ cover gas, indicating that Novec 612 is technically capable of meeting industry needs while greatly reducing the industry’s climate change impact and helping Air Resources Board (ARB) and California to meet their climate change emission reduction goals. Cost analysis was not a major goal of this project, but data indicate that operational costs for using Novec 612 relative to SF₆ range from a benefit to a significant cost penalty depending on the type of process and gas prices.