

**State of California
AIR RESOURCES BOARD**

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

**October 26, 2012
9:00 a.m.**

ADVANCE AGENDA

I. Approval of Minutes of Previous Meeting:

July 11, 2012 meeting

II. Discussion of New Research Projects:

- 1) "Measuring Real-World Emissions from the On-Road Heavy-Duty Truck Fleet,"
University of California, Berkeley, \$450,000, Proposal No. 2745-275

The Air Resources Board (ARB or Board) Truck and Bus Regulation is leading to the introduction of exhaust aftertreatment devices to reduce emission of particulate matter (PM) to 0.01 grams per brake horsepower-hour (g/bhp-hr) and oxides of nitrogen (NO_x) to 0.2 g/bhp-hr. This would lead to the introduction of diesel particulate filters (DPF's) to control PM on a majority of California fleet by 2014 followed by gradual phase-in of model year (MY) 2010 engines, such that by 2023, all the heavy-duty diesel engines operating on California roadways will meet the MY 2010 heavy-duty engine standard. The PM and NO_x emission reductions realized by the introduction of aftertreatment devices are far greater than those associated with normal fleet turnover. However, along with the emission reduction benefits, there may be some unintended consequences of using such devices such as concomitant increase in ultrafine particle numbers, ammonia (NH₃) emissions and the nitrogen dioxide (NO₂) to NO_x emission ratio. It is therefore important to measure actual on-road emissions in order to quantify the overall effect of the regulation.

ARB-funded studies being conducted near the Port of Oakland are already demonstrating significant emission reductions occurring in the port truck fleet due to implementation of ARB's Drayage Truck Rule. The proposed research will build upon these and other sampling programs performed at the Caldecott tunnel by measuring emissions from the broader on-road truck fleet at three stages of

implementation of ARB's statewide Truck and Bus Regulation: 1) 2014, when a significant fraction of the truck fleet will be equipped with DPF's; 2) 2015, when pre-1994 engines will be replaced with MY 2010 engines; and 3) 2017, when pre-1996 engines will be replaced with MY 2010 engines, and by which time a significant portion of the fleet will have MY 2010 engines or newer engines. The measurements will be performed at the Caldecott tunnel in the San Francisco bay area, where an uphill grade will ensure that the trucks operating under load have elevated exhaust temperatures to make aftertreatment systems functional (i.e., urea injection is active).

The results of this study will be used to quantify emission factor distributions, identify unintended consequences, investigate the durability and failure rates associated with the introduction of aftertreatment, and establish emissions benefits resulting from the Truck and Bus Regulation. ARB staff may perform further analysis to assess compliance of on-road fleet with the provisions of the Truck and Bus rule.

- 2) "Evaluating the Benefits of Light Rail Transit," University of California, Irvine, \$200,000, Proposal No. 2746-275

Senate Bill (SB) 375 requires Metropolitan Planning Organizations (MPOs) in California to develop a Sustainable Communities Strategy (SCS) that demonstrates how they will meet regional greenhouse gas reduction targets set by ARB. The introduction and expansion of light rail transit (LRT) systems and the densification of communities living around LRT stations are among the strategies being considered and pursued by regions as they work toward SB 375 goals. However, the regional travel demand forecasting models used by MPOs in their planning process are limited in their ability to accurately evaluate the impact of transit investment and transit-oriented development projects on travel demand. This research project will implement the first ever longitudinal, experimental-control, before/after evaluation of the impact of a light rail transit investment in California on travel behavior and the active transportation co-benefits for nearby residents. This project will build on an existing study that collected baseline data on travel behavior for 248 households in and near the Expo Line corridor in south Los Angeles. Due to substantial co-funding to support the second phase of data collection, this project will support a third phase of data collection, which will not only provide a rare longitudinal look at travel behavior, but will also include a significant expansion of data collection and analysis. The results of this research can provide insight into whether and to what extent light rail transit investments can support the goals of SB 375.

- 3) "Economic and Operational Considerations in Transitioning to a Zero or Near-Zero Emission Rail System in California," University of Illinois, \$399,889, Proposal No. 2747-275

Meeting California's long-term air quality, toxics, and climate change goals will require transitioning to a zero or near-zero emissions freight transport system, including rail operations. The objective of this research is to identify and examine the operational changes and the economic challenges and opportunities required to transition to zero or near-zero emission freight rail operations in California.

Results from this project will provide technology deployment scenarios and the associated operational, economic and logistic impacts of these scenarios. The project will also identify the benefits from reduced energy costs of each deployment scenario and possible renewable energy development on railroad right-of-way. An independent project review of the draft final report and stakeholder input will provide an objective assessment of the feasibility of rail electrification to assist the State in meeting our long-term air quality, toxics, and greenhouse gas reduction goals.

- 4) "Life Cycle Assessment and Co-Benefits of Cool Pavements,"
Lawrence Berkeley National Laboratory, \$450,000, Proposal No. 2748-275

The construction, use, and maintenance of California roadways and parking lots are responsible for substantial energy and resource consumption, emissions of greenhouse gases (GHG) and other air pollutants. They therefore have a strong influence on local temperatures and air quality. As California re-engineers its cities to reduce GHG emissions, air pollution, and to adapt to the temperature and air quality impacts of climate change, decision-making requires a strong understanding of the life-cycle environmental impacts of conventional and cool pavements.

To address this need, this project will conduct a life cycle assessment (LCA) of traditional cool pavements that will evaluate their lifecycle GHG emissions, and impacts on local climate and air quality. A pavement strategy guidance tool will be created to help local decision-makers as they consider adopting cool pavements in their Climate Action Planning. Finally, outreach and partnership strategies will be pursued to ensure the results are used in policy planning.

- 5) "Improving Detection of Particulate Matter Emissions for Certification of Advanced Clean Cars (CRC Project E-99, 'Very Low PM Measurement'),"
University of California, Riverside, \$100,000, Proposal No. 2749-275

In 2012, the ARB adopted more stringent tailpipe particulate matter (PM) emissions standards for light-duty vehicles (LDVs) as part of the Advanced Clean Cars regulations. Auto companies have expressed concerns about the repeatability of PM measurements made at the very low emissions levels called for by these new standards. The objective of this project is to study improvements to the LDV certification test procedures that would result in reduced variability for PM measurements. Possible modifications include changes to emissions sample dilution, changes to filter face velocity, and/or other modifications to the Code of Federal Regulations (CFR), Part 1066 test procedures. Results from this project are expected to include specific recommended changes to the CFR Part 1066 to reduce test-to-test variability. The successful completion of this project will aid in the timely implementation of the ARB's lower PM emissions standards.

- 6) "Investigating Controls and Measurement Methods for Semi-Volatile Organic Compound Emissions from Light-Duty Vehicles," Colorado State University, Fort Collins, \$500,000, Proposal No. 2750-275

Recent research indicates that light-duty gasoline vehicles (LDGVs) may be significant contributors to the organic aerosol portion of ambient Particulate Matter (PM) because of the contribution from secondary organic aerosol (SOA) formation. It has been suggested that LDGVs certified to ARB's super ultra-low emission vehicle (SULEV) standards may be equipped with emissions control systems that effectively control semi-volatile organic compounds (SVOCs) which lead to SOA formation. The objectives of this project are to: 1) investigate the control effectiveness of SULEV control technology in reducing SVOC emissions and SOA formation by testing a small fleet of in-use SULEVs, both new vehicles, as well as older, high mileage vehicles; 2) project these emissions results to a fleet-wide basis; and 3) evaluate methods for making SVOC emissions measurements. In addition, the SVOCs control effectiveness of other fuels (E85, diesel and CNG) will also be studied. Results will inform policy makers about the effectiveness of the SULEV regulations and implementation schedule for reducing SVOC SOA-precursor emissions.

- 7) "Improving Chemical Mechanisms for Ozone and Secondary Organic Carbon," University of California, Davis, \$450,024, Proposal No. 2751-275

Despite improvements in urban air quality in recent years, unacceptable levels of ground-level ozone (O_3) and atmospheric particulate matter (PM) continue to be a persistent problem in both urban and rural areas of California. To meet National Ambient Air Quality Standards, State and local agencies must develop State Implementation Plans and adopt additional regulations to control emissions of these pollutants and their precursors. It is therefore necessary to understand the physical and chemical processes that form these pollutants under various atmospheric conditions. Photochemical air quality models are the primary tool for determining the limiting precursors for various secondary pollutants in California air sheds. Chemical mechanisms are an integral part of these photochemical air quality models and must represent the state-of-the-science understanding of how O_3 and other secondary pollutants are formed and their relationships to the primary pollutants emitted from different sources. This project will comprehensively update chemical mechanisms for predicting the formation of secondary organic carbon, assess the reactivity of volatile organic compounds (VOC) in California's airsheds related to O_3 formation, and evaluate impacts of nitrogen pentoxide (N_2O_5) on secondary aerosol formation. The results will provide ARB with improved and more up-to-date mechanisms for gas-phase and secondary particulate matter PM prediction that underlie ARB's air quality planning effort.

- 8) "Characterizing the Climate Impacts of Brown Carbon," University of California, San Diego, \$530,000, Proposal No. 2752-275

Black carbon (BC) (the dark soot produced from combustion) absorbs light and gives off heat, and is now recognized as a significant contributor to global warming. Light-absorbing organic carbon that is not black, called brown carbon (BrC), was recently discovered to also be a potentially large contributor to global warming. The combustion sources that contribute to BrC in the atmosphere are not well characterized, and recent studies suggest that there may be multiple pathways for its formation. To help characterize and differentiate sources of BrC from BC, the proposed research will apply advanced instrumentation that will provide unprecedented chemical and optical characterization of BrC sources and investigate its formation pathways. These results will be used to separate and characterize BrC, and quantify its importance in regional and global modeling climate forcing. This project will improve our understanding of the fundamental processes that govern BrC formation and its evolution in the atmosphere, and help us determine the potential climate benefit of mitigating sources of BrC emissions in California.

- 9) "Advanced Plug-in Electric Vehicle Travel and Charging Behavior," University of California, Davis, \$650,000, Proposal No. 2753-275

Plug-in electric vehicles (PEV) are anticipated to become an increasing share of new light-duty vehicle sales; however their environmental benefits will vary depending on consumer usage and charging behavior. This project's objective is to collect and analyze in-use vehicle data from a variety of vehicle types in a household context to improve estimates of emission profiles and consumer benefits. This will result in a comprehensive and highly resolved dataset of vehicle and recharging/refueling parameters that allows for characterization of the current state of PEV household travel. This information can help regulators and policymakers to adjust treatment of PEVs in regulatory or incentive programs, appropriately plan for possible grid impacts from PEV charging, and evaluate the benefits of public infrastructure investments. Lastly, this research can also continue to improve our understanding of how general vehicle operations and travel behavior may affect emissions.

- 10) "New Car Buyers' Valuation of Zero-Emission Vehicles," University of California, Davis, \$250,000, Proposal No. 2744-275

New advanced light-duty vehicle technologies and designs, including those that reduce criteria pollutant and greenhouse gas emissions (GHG), 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 about 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.

- 11) "Identifying Urban Designs and Traffic Management Strategies that Reduce Air Pollution Exposure," University of California, Los Angeles, \$388,001, Proposal No. 2754-275

While California has made tremendous progress in reducing vehicular emissions, evidence of the dangers of near-roadway pollutant exposure is growing; highlighting the need to ensure that implementation of Senate Bill (SB) 375 is consistent with ARB's criteria and toxic pollution exposure reduction policy goals. The objective of this study is to characterize pollution levels at various transit stop environments in southern California, with a focus on features in the built environment, such as building setback and height. This will be accomplished through pollution measurements, meteorological measurements, and modeling. The results of this project will be a rich data set characterizing transit stop environments and a predictive model for a complex urban landscape. This information may provide transportation and urban planning decision makers with the tools they can use to guide everyday decisions that impact exposures in these environments.

III. Discussion of Draft Final Reports:

- 1) "Mobile Platform III: Characterizing Spatially Inhomogeneous Non-Criteria Pollutants in the Los Angeles Air Basin," University of California, Los Angeles, \$290,000, Contract No. 09-357

Highly localized vehicle emission impacts due to sharp concentration gradients near roadways are a concern for people who live or spend time in these environments. These impacts are magnified by atmospheric conditions present during the early morning hours (pre-sunrise (PSR)). Previous results suggest broad areas of elevated pollutant levels around major roadways may be common during pre-sunrise hours, however, this hypothesis needed to be tested. The objective of this project was to expand these important pre-sunrise results by measuring early morning pollution gradients in a wider variety of geographic locations and to characterize air pollution and exposure in low-income and/or minority neighborhoods that are adversely impacted by sources (e.g. freeways, busy arterial roads). The results showed pre-sunrise impacts occurred throughout various locations in the South Coast Air Basin (SoCAB), with pollution gradients extending greater than 2 km downwind of major freeways. In addition, significant differences in pollution levels were seen between different communities in SoCAB that could be attributed to sources such as freeways and airports. These results have important exposure implications as 50 percent of SoCAB population lives within 1.5 km of freeways.

- 2) "Measuring the Climate Impact of Residential Buildings: Greenpoint Rated Climate Calculator Version 2," University of California, Berkeley, \$101,575, Contract No. 09-344

Residential buildings generate a significant source of greenhouse gas (GHG) emissions. Green buildings are recognized as a strategy to reduce GHG emissions, but further research was needed to better quantify GHG reductions. The objectives of this study were to review, validate, and enhance existing methods used to estimate GHG reductions of green homes, expand the capacity of the GreenPoint Rated (GPR) Climate Calculator, and conduct field testing and stakeholder input to develop Version 2 of the GPR Climate Calculator. Version 2 of the Calculator is more accurate in estimating the GHG emission reduction potential of green homes. Results of the study can help to inform the body of knowledge to better estimate the GHG reduction potential of green homes compared to conventional homes regardless of occupant behavior.

This information may give greater confidence in estimating the GHG reduction potential of green homes to meet the 2020 climate goals of Assembly Bill 32 and longer term 2050 climate goals.

- 3) "Measurement of Diesel Solid Nanoparticle Emissions Using a Catalytic Stripper for Comparison to Europe's Particle Measurement Programme Protocol," University of California, Riverside, \$170,000, Contract No. 08-302

Europe's Particle Measurement Programme (PMP) protocol prescribes regulatory specifications for sampling particle emissions from both gasoline (direct-injection) and diesel vehicles having very low PM mass emissions. A number of studies have demonstrated that the PMP protocol yields robust and repeatable measurements of solid particles larger than 23 nanometers (nm) in diameter. Volatiles and particles smaller than 23 nm are excluded from the PMP measurement. However, when using the PMP approach to measure solid particles, ARB and other investigators have observed high number concentrations of apparently solid sub-23 nm particles downstream of the PMP sampling system. ARB recently evaluated instruments implementing the PMP protocol and found a significant number of solid sub-23 nm particles in several ARB in-house investigations and in a University of California, Riverside (UC Riverside) study entitled, "Evaluation of the Proposed New European Methodology for Determination of Particle Number Emissions and Its Potential in California for In-use Screening," (contract 05-320).

The current study further investigated sub-23 nm diesel particle penetration and formation in laboratory and vehicle exhaust experiments using a PMP compliant particle measurement system and an alternative catalytic stripper (CS) system. The results provide evidence that the majority of sub-23 nm particles found downstream of the PMP systems are artifact particles formed by chemical reaction and/or re-nucleation of volatile compounds. The artifact particles are mainly present below 10 nm.

- 4) "Are There Any Counteracting Effects that Reduce the Global Warming Benefits Attributed to Black Carbon Controls: Assessment of Cloud Drop Number Concentration Changes and its Importance in Modeling Cloud Albedo Effects on Climate," University of California, San Diego, \$114,751, Contract No. 09-337

Black carbon (BC) is a major component of atmospheric particles that is generally emitted by combustion sources such as automobile exhaust and biomass burning. BC is the main light-absorbing component of atmospheric particles and has been tied to regional climate change by its contribution to global warming and the suppression of precipitation. BC particles could also indirectly cause changes in the absorption or reflection of solar radiation through changes in the properties and behavior of clouds. These so-called BC indirect effects are thought to have a net cooling effect on the atmosphere. In contrast to the direct BC effect, the net climate forcing due to these indirect cloud feedbacks is highly uncertain. This report provides an assessment of the relative importance of the indirect effect of BC forcing on California's climate, based on observations, data analyses, and modeling studies. The results suggest that for regions like the California sites studied in this report, where BC mitigation targets primarily fossil fuel sources, the cloud albedo effect of BC particles may partially offset the climate benefits of direct forcing reduction. The result of this study has immediate value for understanding the pathways by which BC could be of importance in California's climate change, and will help inform ARB's policy making on developing BC emission control strategies.

- 5) "Inverse Modeling to Verify California's Greenhouse Gas Emission Inventory," California State University, East Bay, \$150,000, Contract No. 09-348

The California Global Warming Solutions Act of 2006 (AB 32) requires ARB to develop a statewide greenhouse gas (GHG) emissions inventory. This study uses ambient methane (CH₄) measurements and inverse modeling to estimate emissions and provide a comparison to the ARB-developed inventory. The inverse model relies on maps of CH₄ source locations and emission estimates to accurately estimate emissions. This study uses two different maps, one based on California-specific data and the other that uses a generalized approach (EDGAR 4.2). Utilizing these different maps, along with ambient measurements, the analyses yields annually averaged CH₄ emissions that are 1.5±0.1 and 2.5±0.3 times larger than the ARB estimated CH₄ emissions based on the California-specific CH₄ and the generalized CH₄ emission maps, respectively. These results suggest that CH₄ emissions could account for approximately 8 percent to 16 percent of the State's total GHG emissions (whereas ARB currently estimates about 6 percent). However, as can be seen from the large range of emission estimates, the modeling approach has large uncertainties derived from the different emission maps. The other part of the uncertainties lie in the inability of the model to accurately resolve the Southern California area and additional tower measurements in the South Coast Air Basin (SoCAB) are recommended. Additional work is also needed to identify and reduce the remaining model uncertainties.

IV. Discussion of a Response to a Request for Proposals:

1) "Measuring Real-World Emissions from the On-Road Passenger Fleet,"
RFP No. 12-303

- University of Denver, Colorado,
Proposal No. 2755-275, \$75,000

V. Discussion of Requests for Proposals:

1) "Technical Analysis of Vehicle Load-Reduction Potential for Advanced Clean Cars," \$250,000, RFP No. 12-311

2) "Evaluating Technologies and Methods to Lower Nitrogen Oxide Emissions from Heavy-Duty Vehicles," \$1,000,000, RFP No. 12-310

VI. Other Business:

1) Update on the 2012-2013 Research Solicitation