

**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**

**April 28, 2011
9:30 a.m.**

ADVANCE AGENDA

Draft Final Reports

1. "Air Pollution and Cardiovascular Disease in the California Teachers Study Cohort," California Department of Public Health, \$284,652, Contract No. 06-336

Several studies have reported associations between long-term exposure to air pollution and mortality; however, few of these studies specifically analyzed populations in California. This study is an extension of a previously funded investigation that examined the effects of chronic air pollution exposures in a cohort of over 100,000 women teachers in California. The investigators collected information on mortality and hospitalizations, and used questionnaires to collect information on individual risk factors important in assessing the health effects of air pollution. The California Teacher's Study examined potential relationships of mortality and disease incidence with long-term residential exposures to particulate matter (PM) 10 μm or less (PM₁₀), ozone (O₃), carbon monoxide (CO), nitrogen dioxide (NO₂), nitrogen oxides (NO_x), and sulfur dioxide (SO₂) from 1996 through 2005, and to particulate matter 2.5 μm or less (PM_{2.5}) beginning in 1999. The study also investigated the effects of pollutant exposures on susceptible subgroups and examined critical time windows of exposure, as well as associations with specific PM_{2.5} constituents. The investigators re-examined the relationships between several traffic metrics and cardiopulmonary outcomes. Regarding PM_{2.5} exposure, this study found elevated risks of mortality from ischemic heart disease and, among post-menopausal women, increased incidence of stroke. Long-term exposures to PM₁₀, O₃ and NO_x were associated with elevated risks of ischemic heart disease mortality. PM₁₀ exposure was also linked to first-time occurrences of nonfatal stroke. The O₃ exposures were highly correlated with PM₁₀ and PM_{2.5} exposures, and therefore, for this analysis it was not possible to determine if there was any separate effect of O₃. Among never-smokers, NO_x exposure was associated with elevated risks of all-cause, cardiovascular and ischemic heart disease mortality. Traffic density was associated with all-cause, cardiopulmonary and cardiovascular mortality, with clear gradients of increasing risk with elevated traffic exposure. This study provides clear evidence that long-term exposure to air pollution is associated

with mortality from heart disease, and demonstrates for the first time that exposure to PM is associated with the incidence of new cases of stroke in California women.

2. "Systemic Platelet Activation in Mice Exposed to Fine Particulate Matter," University of California, Davis, \$300,000, Contract No. 07-337

The majority of air pollution-related adverse health impacts are associated with particulate matter (PM), but biological mechanisms identified to date do not fully explain how PM could cause these effects, particularly effects in the cardiovascular system. Several recently published studies suggest that PM may alter the function of the vascular endothelium and blood platelets, both of which are involved in control of cardiovascular function. The objective of this project was to investigate the potential for fine particles (PM_{2.5}) to alter the physiology of the pulmonary vascular endothelium and platelets in ways that promote blood clotting, and contribute to other adverse cardiovascular outcomes. The results showed different patterns of response with exposures to summer and winter PM, as well as urban and rural PM, suggesting different health risks by season and location. In addition, the results help to fill some of the gaps in understanding how inhaled PM could induce adverse cardiovascular health effects. The results further suggest that monocytes and the pulmonary endothelium, along with their interactions with platelets are part of the mechanistic pathway from inhalation to adverse cardiovascular health effects. The ambient air quality standards for PM are based on statistical associations between PM and health endpoints, with little strongly supporting biological data. The results of the proposed study help to clarify some of the gaps in the available mechanistic data supporting the biological validity of the observed epidemiologic associations, and also suggest several lines of inquiry that should be investigated in future studies.

3. "Development of an Updated Base Case Ambient VOC Mixture for Assessing Atmospheric Reactivity," University of Texas at Austin, \$40,010, Contract No. 08-327

Volatile organic compounds (VOC) are important precursors of ambient ozone and particulate matter pollutants. Up-to-date information about VOC composition in the air is necessary for developing a reliable VOC degradation mechanism, such as the State Air Pollution Research Center (SAPRC) for the chemical mechanism in support of O₃ and PM control strategies. This project analyzed recent VOC data acquired at Photochemical Assessment Monitoring Stations (PAMS) and from emission inventories using Principal Component Analysis (PCA) and box modeling, and developed updated mixtures of reactive organic gases (ROG) for assessing atmospheric reactivity in California. Compared with 20 years ago, the updated ROG mixtures over Los Angeles are lower in absolute concentrations and have significantly different chemical compositions. Based on ambient observations, the updated ROG mixture generally has a higher proportion of alkanes, carbonyls, and biogenic hydrocarbons, and a lower proportion of anthropogenic alkenes. The new profile derived from this work leads to fairly large differences (about 50-60 ppb less ozone under low NO_x conditions) in predicted ozone concentrations. Its overall incremental reactivity was estimated to be 20 percent less than that of the existing ROG profile although the incremental reactivity increased for most of the species

classes. The results will help ARB and the United States Environmental Protection Agency (U.S. EPA) to update the mechanistic parameters in air quality models as well as atmospheric reactivity assessment.

4. "Development of Updated ARB Solvent Cleaning Emissions Inventories," University of California, Riverside, \$249,343, Contract No. 06-322

Solvent cleaning is one of the five largest non-mobile sources of volatile organic compounds (VOC) emissions in California. Many local air districts need to update their solvent cleaning rules to obtain additional VOC emission reductions and meet SIP (State Implementation Plan) commitments, and up-to-date inventory information is necessary to accurately calculate those reductions. In addition, solvent cleaning is often conducted by small businesses that do not have air permits and are located near residential areas, particularly in environmental justice communities. However, ARB's inventory of VOC emissions from solvent cleaning is based on 1990's data and is therefore out-of-date. This project was intended to provide information to update ARB's VOC emission inventory for solvent cleaning operations, reflecting current solvent cleaning materials and technologies. The University of California, Riverside (UCR) collected information from businesses surveyed for solvent cleaning operations, identified types of solvent and equipment used, determined quantities of solvents, developed emissions factors, gathered employment information by industry code, and developed a statewide emissions inventory and species profile. This revised emission inventory will enable staff at ARB and at local air pollution control districts to accurately assess the benefits and feasibility of new regulations to reduce VOC emissions from solvent cleaning operations. It will also help staff to assess the impact of solvent cleaning on local communities.

5. "Environmental Chamber Studies of Ozone Impacts of Coatings VOCs," University of California, Riverside, \$200,041, Contract No. 07-339

When coatings are applied, solvents are emitted that contain volatile organic compounds (VOC) that contribute to ozone formation. ARB staff is considering the feasibility of reactivity-based VOC regulations for architectural coatings to allow industrial users in that category to determine the extent of allowable emissions based on the reactivity of the VOCs in their solvents. To estimate the reactivity values, data from experiments conducted in environmental chambers are necessary. These experiments can determine, under controlled, simulated atmospheric conditions, the extent to which the VOCs produce oxidized break-down products that are important for ozone formation. However, past chamber work was not able to satisfactorily characterize the ozone impacts from some compounds and mixtures of concern. Therefore, in order to adequately evaluate their ozone impacts, improvements to an environmental chamber were made that involved the addition of black-lights and the use of hydrogen peroxide as a radical initiator for photo-oxidation. Subsequently, tests on some VOCs used in architectural coatings and consumer products provided more reliable estimates of their ozone impacts. The results will help the ARB to develop regulations that should lead to less ozone exposure, with the lowest possible expense by the affected industry.

6. "The Climate Change Industry in California: An Economic Analysis Assessing the Current Market and Prospects for Growth in the Global Economy," Environmental Business International Inc., \$196,211, Contract No. 07-315

This study defined, quantified, and analyzed the economic profile of the emerging climate change industry (CCI) in California, and forecasted its growth. The California Global Warming Solutions Act of 2006 (Assembly Bill 32) has put California in a leadership position in CCI. Based on extensive interviews with experts in government, academia, non-profit organizations and the private sector, the contractor developed a comprehensive definition of the industry and its various segments and sub-segments. A database of the various segments was developed using several sources of market data, business information, research reports, surveys, and interviews. The results show that the CCI was a \$27-billion industry in California in 2009, representing 12 percent of the U.S. CCI valued at \$223 billion, and 2.5 percent of the global CCI valued at \$1.1 trillion. The California CCI was 1.4 percent of the 2009 California economy, employing approximately 123,000 Californians in about 4,000 companies. This CCI was growing at a double-digit rate in California in 2008 but slowed significantly in 2009 due to the recession. The industry is expected to resume growth in 2010 and is projected to continue growing at double digit rates until 2020.