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

May 25, 2007
9:00 a.m.

ADVANCE AGENDA

Request for Proposals

1. "Economic Value of Reducing Cardiovascular Disease Morbidity," $400,000

The objective of this study is to estimate the economic value of reducing development (or exacerbation) of cardiovascular disease using willingness-to-pay (WTP) estimation methods.

Recent health effects research points toward air pollutants as risk factors for several chronic respiratory and cardiovascular illnesses. These include cardiovascular disease, asthma, and permanent lung function decrements. WTP estimates are available in the economics literature only for reducing risk of developing chronic bronchitis (Viscusi et al., 1991).

This project will make an important contribution to better quantifying the health benefits of air pollution control in California, because there are no WTP estimates, or even very good cost-of-Illness (COI) estimates, for cardiovascular disease (CVD) morbidity. The study team will design, implement, and analyze a WTP survey that develops a monetary estimate of individual WTP to reduce the risk of developing or exacerbating cardiovascular disease.

A WTP estimate for CVD morbidity, along with established mortality estimates, can be combined with exposure data and relevant dose-response functions to better assess the health benefits of regulations that reduce air pollutants associated with cardiovascular disease

Sole Source Proposals

2. “A Spatial Synoptic Classification Approach to Projected Heath Vulnerability in California Under Future Climate Change Scenarios," Kent State University, $191,533, Proposal No. 2631-256

Executive Order S-3-05, signed by Governor Schwarzenegger on June 1, 2005, called for the California Environmental Protection Agency to prepare biennial science reports on the potential impact of global warming on certain sectors of the California economy. The Air Resources Board was assigned to lead the analyses of public health impacts of climate change. The first report under this executive order was released in 2006, it included an analysis of the risk of heat-related mortality on five of the most populous areas of California that was performed by Sheridan, Hayhoe, and Kalkstein, the same group of contractors proposed for the project described below. The project will extend the previous methodologies and extend the analysis to two additional cities in an updated analysis that will be included in the next scheduled report to the Governor. The objectives are to estimate potential changes in oppressive air mass events over the coming century under higher and lower scenarios of climate change; to translate these changes into potential impacts on mortality rates in California, by urban center and age group; and to assess the expected adaptation potential of the population in each city to these changing conditions.

The final products of this study will include estimates of heat-related mortality across California’s seven largest metropolitan areas through 2100, both with and without acclimatization, and estimates of the numbers of actual heat warnings that would be called under the same circumstances by an operational HWWS. Products will also include an assessment of the adaptation potential that might be achieved through implementing HWWS in additional cities beyond San Francisco and San Jose.
The results of the study will be included in the next report to the Governor on the impacts of climate change in California and will inform possible future regulatory actions to protect the public from heat mortality consequences related to climate change.

Contract Augmentations

3. “Effect of GSTM1 Phenotype on Ozone-Induced Allergic Airway Inflammation,” University of California, San Francisco, $250,000, Proposal No. 2630-256, Augmentation to Contract No. 03-315

Epidemiological data suggest that asthmatics may be more sensitive to ozone (O_3) than nonasthmatics. Animal studies provide evidence that O_3 can enhance allergic inflammatory responses in the lungs. Controlled studies of the airway inflammatory responses of allergic asthmatics to O_3 suggest that O_3 can enhance both early and late bronchoconstrictor responses to inhaled antigen in some, but not all, allergic asthmatics. Data also indicate that variants of several genes that regulate aspects of defense against and repair from oxidative stress in airway cells may affect responses to O_3 exposure. Fifteen mild-moderate allergic asthmatics will participate in the study.

Subjects will participate in two exposures. The day before each exposure subjects will undergo allergen challenge, followed the next day by 4-hour exposure to filtered air or 0.16 ppm O_3 with moderate intermittent exercise, with the two experiments separated by at least 3 weeks. Six hours later subjects will undergo bronchoscopy with bronchoalveolar lavage to collect samples of airway lining fluid and cells. Dependent variables will include cell distribution in bronchoalveolar lavage fluid, analysis for biochemicals indicative of airway inflammation (total protein, GM-CSF, RANTES, MPO, ECP, tryptase, IL-4, IL-5, IL-8, IL-13), and spirometric pulmonary function. Subjects will be genotyped for GSTM1, GSTP1, GSTT1, NQO1 ser187 variants, SOD2, GPX1 and catalase. This information will be used in exploratory analyses of the role(s) of these genetic factors in allergic airway inflammation with O_3 exposure. The results of this study will help to better characterize the susceptibility of asthmatics to O_3 exposure, clarify whether O_3 enhances allergen-induced airway inflammation, and help to explain the wide variability in responses of asthmatics to O_3.

4. "Cardiovascular Health Effects of Fine and Ultrafine Particles During Freeway Travel," University of California, Los Angeles, $60,469, Proposal No. 2628-256, Augmentation to Contract No. 04-324

The purpose of this study is to investigate possible links between exposures to freeway-related fine and ultrafine (< 0.1 µm) particles and changes in measures of cardiovascular function. Ultrafine particles are suspected to play an important role in the link between particulate matter (PM) and cardiovascular mortality and morbidity effects because of their high deposition efficiency, high surface area, and ability to penetrate cell membranes. They have been shown in human subjects to translocate from the lung to the circulatory system and effect hemostasis.

Although the mechanisms by which PM affects the cardiovascular system are not clear, recent epidemiology studies have found an association between traffic and adverse cardiovascular outcomes. A recent study by Peters et al., N.E.J.M.: 352, 1721-1730 (2004) found an association between myocardial infarction and exposure to traffic before the onset of the myocardial infarction. They found the strongest effect was for one hour prior to onset. This suggests that short term exposure may be important in producing cardiac effects. Another recent paper by Adar et al, Epidemiology, 18:95-103 (2007) evaluated changes in heart rate variability of 44 nonsmokers, 60 or older, associated with four group bus trips in downtown St. Louis. Each trip involved two one-hour segments on the same day. They found heat rate variability (HRV) was negatively associated with traffic-related fine particles and black carbon concentrations. Several studies have examined PM exposure and associated cardiovascular health effect in human subjects, however, the present study is the only human exposure study focused on fine and ultrafine particle exposure and response during freeway travel.

In this study, human subjects are exposed to fine and ultrafine particles in a van instrumented with particle and gaseous air pollutant measurement instruments, along with a filtration system capable of removing most particles when activated. In this augmentation, three healthy, elderly subjects, in addition to the 16 subjects originally

proposed, will be subjected to vehicle emissions on either gasoline-dominated or diesel-dominated freeways, with and without particles. Noninvasive measures of cardiovascular function such as HRV will be monitored to see if exposures have immediate and/or short-term effects, and blood cytokines will be measured. Other studies have found effects for vehicle-related PM2.5 exposures, but vehicle-related ultrafine particles exposures have not been studied.

The results will aid the Air Resources Board (ARB) in evaluating the importance of ultrafine particles and motor-vehicle-related ultrafine particles. It will also contribute to the evidence needed to evaluate whether mass-based PM standards alone are adequate to protect public health, or if particle numbers also need to be regulated. Furthermore, this work will add to ARB's ability to evaluate the contribution of freeway driving to overall air pollution exposures.

5. "Improving the Carbon Dioxide Emission Estimates from the Combustion of Fossil Fuels in California," University of California, Berkeley, $30,000, Proposal No. 2629-256, Augmentation to Contract No. 05-310

California has been a leader in both the science of climate change and in identifying solutions. The State has also been at the forefront of efforts to reduce heat-trapping emissions, passing precedent-setting policies such as aggressive standards for tailpipe emissions, renewable energy, and energy efficiency. In September 2006, the California legislature passed AB 32, which caps California's greenhouse gas (GHG) emissions to 1990 levels by 2020. In order to effectively implement the cap, AB 32 directs ARB to develop appropriate regulations and establish a mandatory reporting system to track and monitor GHG emissions levels. There are numerous milestones identified in the bill beginning now and continuing for the next several years. Two areas which are extremely active right now are work on the GHG inventory and development of a list of early action items.

Central to any study of climate change and identification of GHG mitigation strategies is the development of an emission inventory that identifies and quantifies the primary anthropogenic sources and sinks of GHG emissions. Fossil fuel combustion accounted for 98 percent of gross California carbon dioxide (CO_2) emissions. CO_2 emissions are relatively well characterized at the state level; however no estimates exist at a more disaggregated spatial level. In this study, the investigators propose to enhance a current ARB research contract for improving the CO_2 emission estimates by developing a disaggregated estimate of energy-related CO_2 emissions. Understanding the CO_2 emission profile, finding ways of validating these on a sector-by-sector basis, and providing a validation approach to the statewide greenhouse gas emission inventory through disaggregation is an important service for building AB 32 GHG emission inventory baselines and projections. This project will provide disaggregated information on these emissions, based on the available data, which can then be evaluated using information from local sources.

Draft Final Reports

6. "Source Apportionment of Fine and Ultrafine Particles in California," University of California, Davis, $314,998, Contract No. 01-306

Atmospheric Particulate Matter (PM) is associated with increased human mortality and morbidity in many epidemiological studies. It has been postulated that ultrafine particles (Dp < 0.1 µm) (PM0.1) are more pathogenic and are thus a likely candidate for some observed correlation between fine PM and adverse health. The composition and source origin of ultrafine particles must be determined to fully understand their relationship with human health. The research described in the University of Calfiornia, Davis final report quantifies source contributions to fine and ultrafine particle mass in California using molecular marker source profiles.

Source profiles for particles smaller than 0.1 µm in diameter (PM0.1) were measured from light-duty gasoline-powered vehicles, heavy-duty diesel vehicles, pine wood combustion, oak wood combustion, eucalyptus wood combustion, rice straw combustion, and meat cooking. PM0.1 concentrations in the roadside environment adjacent to a busy freeway were dominated by contributions from gasoline and diesel with smaller contributions from lubricating oil. Ambient air measurements in Sacramento, Modesto, and Bakersfield showed that the majority of the PM0.1 mass was composed of organic carbon with smaller amounts of elemental carbon. Wood combustion and meat cooking account for the majority of the PM0.1 organic carbon and therefore the majority of the PM0.1 mass. Gasoline fuel, diesel fuel, and lubricating oil accounted for the majority of the PM0.1 elemental carbon. These findings reflect the proximity of the sampling locations to each source type and indicate that future inhalation exposure studies should also consider including wood combustion and meat cooking sources as potential causes of adverse health effects in central California cities during cold winter stagnation events. This information provides scientists and regulators with a starting point from which they can determine how to best protect the public from particulate air pollution.