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

October 28, 2011
9:00 a.m.

ADVANCE AGENDA

I. Approval of Minutes of Previous Meeting:
June 9, 2011

II. Discussion of Final Draft Reports

1) "Spatiotemporal Analysis of Air Pollution and Mortality in California Based on the American Cancer Society Cohort," University of California, Berkeley, $749,974, Contract No. 06-332

The portion of the nationwide American Cancer Society (ACS) cohort living in California (76,000 individuals with over 20,000 deaths for an 18-year follow-up ending in 2000) was used to investigate the statewide health risk associated with exposure to particulate matter (PM) and gaseous air pollution on all-cause and cause-specific deaths. The investigators used twenty individual-level variables to control for confounding of the air pollution-death association from lifestyle, dietary, demographic, occupational, and educational influences, and variables to control for neighborhood-level confounding (e.g., poverty, unemployment). Using multiple statewide models for PM less than or equal to 2.5 µm (PM2.5), the investigators found significantly elevated risks for death due to cardiovascular disease (CVD), with the largest risk for death due to ischemic heart disease (IHD). PM2.5 was also associated with all-cause deaths statewide, but only when using the land use regression (LUR) model for exposure and controlling for residence in the largest urban areas. The other pollutants investigated – nitrogen dioxide (NO_2), PM less than or equal to 10 µm (PM10), PM10 sulfates, and ozone – all showed consistent associations with CVD and IHD that are similar in size to those observed for PM2.5, although the exposure estimates for these pollutants are correlated with each other and with PM2.5.

2) “Assessing Near-Field Exposures from Distributed Residential Wood Smoke Combustion Sources,” California Polytechnic State University, San Luis Obispo, $320,286, Contract No. 07-308

In many California communities, wood is burned for heat and is a significant contributor to winter PM2.5, which often exceeds State and federal standards and exposes individuals to significant health risk. This study examined the effect of near-field wood burning sources on personal exposure. The investigators collected wood smoke samples at pre-determined sites within a 1 km^2 area as well as meteorological data for 15 nights in Cambria, California, a city with substantial residential wood burning. They also performed modeling studies of wood smoke. Black carbon served as an indicator compound for wood smoke because it is a significant component of soot and wood combustion and was the only major source of black carbon in this area. Large concentration variations were observed for each night both at individual locations and between locations. Sites with the highest overall concentrations (averaged over all nights) had levels 2 to 10 times higher than the lowest concentration sites. Neither multiple linear regression nor dispersion models produced a strong representation of measured concentrations. Thirteen indoor/outdoor measurement pairs from four different residences showed an average indoor/outdoor concentration ratio of 0.88 ± 0.41.

Based on the measured concentrations, the intake fraction calculated using near-field concentrations was 25 percent higher versus that calculated using the average regional concentration. This study showed that residential wood burning is associated with variable wood smoke concentrations that may lead to higher exposures for some individuals than what would be predicted using data from regional monitors. This finding demonstrates the need to better understand localized wood smoke patterns when developing control plans to protect the public health and welfare by reducing wood smoke levels.

3) “Physicochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy-Duty Vehicles Operating with and without Emissions Control Technologies,” University of Southern California, $677,950, Contract No. 05-308

Diesel Particulate Filter (DPF) and Selective Catalytic Reduction (SCR) aftertreatment technologies are being adopted by most manufacturers to comply with the 2007 and 2010 heavy-duty diesel vehicle (HDDV) particulate matter (PM) and nitrous oxides (NO_X) standards. These aftertreatment devices have proven effective in reducing their target pollutants, PM and NO_X, by >95 percent and 80 percent respectively under most conditions. However, their effect on the chemical composition and toxicity of PM is not yet fully understood. PM emissions from vehicles include both semi-volatile and non-volatile compounds. It has been demonstrated that some of the emission control technologies could increase the number emissions of semi-volatile particles. It is therefore important to know whether the semi-volatile material is

more or less toxic than the non-volatile particles. This project characterized the physicochemical and toxicology-related properties of the semi-volatile and non-volatile fractions of PM from HDDVs operating with and without aftertreatment control technologies. Four vehicles in seven configurations were tested on ARB's heavy-duty chassis dynamometer over highway cruise, transient, and idle operation. The aftertreatment devices tested in this study include various DPFs (catalyzed and uncatalyzed) and two prototype SCRs (vanadium and zeolite based). The semi-volatile and non-volatile fractions of PM were separated using thermal treatment methods. A comprehensive dataset was generated, including real-time measurements of particle information (number and size distribution, particle-bound polycyclic aromatic hydrocarbons (PAHs)), and integrated measurements of regulated pollutants (CO, NO_X, THC, PM, and CO_2), unregulated pollutants (PAHs, nitro-PAHs, total and speciated gas-phase NMHC, carbonyls, metals, EC/OC, water-soluble organic carbon, and water-soluble ions), and toxicity related assays (oxidative potential using dithiothreitol (DTT) and macrophage reactive oxygen species (ROS) assays). Unlike the PM from the uncontrolled baseline diesel vehicle, the majority of PM emitted by vehicles with aftertreatment is semi-volatile in nature. The aftertreatment devices reduced the oxidative potential by 60 percent to 98 percent when expressed per vehicle distance traveled; when expressed per unit mass, there were substantial differences among the various devices. Even though the levels of pollutants are substantially reduced, the issue of the toxicological potential of the remaining compounds is still an area of interest.

4) "Reducing Emissions of Volatile Organic Compounds (VOCs) from Agricultural Soil Fumigation: Comparing Emission Estimates Using Simplified Methodology," United States Department of Agriculture, $150,000, Contract No. 07-332

Volatile organic compounds (VOCs) are active ingredients of soil fumigants used in agricultural fields to control pests. As ozone precursors, fumigant VOCs contribute to exceedances of ozone air quality standards in the San Joaquin Valley of California. However, large uncertainties exist in both the estimates of their baseline VOC emissions and reductions achievable from emissions control strategies. This project studied emissions of three fumigant VOCs: 1,3-dichloropropene (1,3-D), chloropicrin (CP), and methyl iodide (MeI), in both laboratory experiments and modeling simulations under five soil fumigation practices:

1. intermittent sprinkler irrigation following fumigation;
2. soil organic amendment;
3. deep injection;
4. application of fertilizer ammonium thiosulfate (ATS) and
5. soil surface seal with various plastic films. All of the tested strategies reduced 1,3-D and CP emissions.

Soil surface seal with virtually impermeable film (VIF) was the most effective method, which reduced VOC emissions by over 95 percent, followed by soil organic amendment (80-85 percent), intermittent sprinkler irrigation

(50 percent), and ATS with irrigation (43-88 percent), ATS with low water-volume spray (26-42 percent), and deep injection (23-36 percent). Covering the soil surface with a VIF was also the most effective in reducing MeI emissions. In addition, both laboratory and modeling approaches generated total emission estimates for 1,3-D comparable to the field conditions but less satisfactory for CP. All flux models predicted the emissions of MeI well. Although the accuracy of these approaches varied, their variability was within the experimental uncertainty expected in field studies.

5) "Using Pb and Sr Isotopes to Assess Asian Aerosol Impacts in Urban and Interior California," University of California, Berkeley, $80,806, Contract No. 07-318

   The global-scale transport of airborne pollutants increases the local "background" pollutant burden in California. Asian dust and fuel-related combustion products are known to be regularly transported to California. Growth of Asian emissions will increase this background burden and may complicate attainment of air quality standards. Asian aerosols dominate the mean composition of the lower free troposphere over California, but chemical and elemental analyses cannot unequivocally measure the mass fraction of Asian aerosols in urban or agricultural areas where local sources mask their chemical signatures. Ratios of stable isotopes of Pb are diagnostic "fingerprints" for source rock bodies for metal ores, soils, and native impurities in fossil fuels. Similarly, stable isotope ratios of Sr and Nd are known to be diagnostic of their parent terranes, and these have been used to identify Asian dust in polar ice. This project used source-linked Pb and Sr isotopic fingerprints measured in aerosol samples from Asia and California to assess Asian contributions of both fugitive dust and combustion products in rural and urban aerosol samples from California. For samples analyzed in this project, 72 percent of Pb at Mt. Tamalpais was of Asian origin, as expected for a clean elevated site. By using the fraction of Asian Pb to estimate total Asian PM2.5 at Mt. Tamalpais, and applying that to the Asian Pb observed in Berkeley, it was estimated that, for the week of July 21, 2008, approximately 45 percent of the PM2.5 at Chabot Observatory in the Oakland Hills was sourced in Asia.

6) "Developing a California Inventory for Industrial Applications of Perfluorocarbons, Sulfur Hexafluoride, Hydrofluorocarbons, Nitrogen Trifluoride, Hydrofluoroethers and Ozone Depleting Substances," Institute for Research and Technical Assistance, $199,840, Contract No. 07-313

   The objective of this project was to develop a bottom up inventory of California greenhouse gas (GHG) emissions and banks from certain applications and to analyze methods of reducing or eliminating the emissions. The applications included solvent applications, fixed total flooding and portable fire extinguishers, dry cleaning, use in implantable medical devices, and cleaning of energized electrical equipment. The approach relied on information from air districts, equipment installers, and suppliers to generate estimates of emissions and banks. The results demonstrated that emissions will decline from 2010 to

2020 because of trends already underway. Cumulative emissions from solvent and fire protection applications are estimated at 0.185 and 0.363 million metric tons of carbon dioxide equivalent respectively over the ten year period. Cumulative emissions from other applications that were analyzed are estimated at 0.017 million metric tons of carbon dioxide equivalent. The project also involved investigating non-GHG alternatives and alternatives that are reasonably cost effective. These alternatives were identified for most applications. ARB policies could reduce emissions further, particularly in solvent applications.

7) "Lifecycle Analysis of High-Global Warming Potential Greenhouse Gas Destruction," ICF International, $297,766, Contract No. 07-330

High global warming potential (GWP) greenhouse gases (GHGs) found in refrigerants, insulating foam, fire extinguishing agents, and stockpiled high-GWP solvents represent a significant source of potential GHG emissions. While a number of existing regulations already target the reduction of high-GWP gas "in-use" emissions, their recovery and reuse/destruction at product/equipment end-of-life (EOL) is a possible option to achieve further reductions. The objective of the research was to generate a lifecycle analysis (LCA) for the recovery and destruction options for high-GWP GHGs in order to develop and recommend the most cost-effective and practical approaches to reduce high-GWP GHG emissions from these sources. Six separate high-GWP emission sectors were investigated, with potential emission reductions and cost of those reductions developed for each sector. The sectors researched for recovery and destruction of high-GWP GHGs were: 1) residential refrigerator-freezers at time of disposal; 2) other stationary refrigeration and air-conditioning equipment at time of disposal (includes commercial refrigeration and air-conditioning, and residential air-conditioning); 3) non-refillable refrigerant cylinders; 4) construction and demolition building insulating foam at time of disposal; 5) high-GWP fire extinguishing agents, and 6) high-GWP solvents. Emission reductions of up to 10.1 million metric tons CO2 equivalent (MMTCO2E) annually by 2020 could be achieved by increasing recovery of refrigerant from the sector of other stationary and air-conditioning equipment at time of disposal (sector includes all refrigerant-containing equipment except residential refrigerator-freezers), at a cost of $2.36 - $6.23/MTCO2E reduction. Recovery and reclamation or destruction of high-GWP fire extinguishing agents results in 0.09 MMTCO2E annual reductions by 2020, at a cost savings of $2.01 to a cost of $6.62/MTCO2E. The remaining four sectors would result in net reductions of 0.3 MMTCO2E annually by 2020, at higher reduction costs of $77 - $444/MTCO2E reduction. Findings of the research will better inform ARB's greenhouse gas reduction strategy policies.

III. Discussion of New Research Projects

1) “Black Carbon and the Regional Climate of California,” University of California, San Diego, $24,080, Contract No. 08-323

Black carbon (BC) is a major component of aerosol particles that is generally emitted by combustion sources such as automobile exhaust and biomass burning. BC is the main light-absorbing component of atmospheric aerosols and has been tied to regional climate change by its contribution to global warming and the suppression of precipitation. Unlike other greenhouse gases (GHG), BC has a short atmospheric lifetime resulting in a strong correlation to regional emission sources. Hence, the mitigation of BC warming effects by emission controls can be a viable policy. The objective of original research proposal, which was approved by the RSC on January 23, 2009, is to assess the impact of BC on California’s climate by developing a balanced approach between observations, data analyses, and modeling studies. The first set of results from the existing ARB funded study have led to a major finding by showing that the particulate matter control policies as implemented by California have resulted in a reduction of atmospheric BC by 50 percent. In this supplemental study, the investigators propose to analyze surface solar radiation flux measurement data to explore the link between policies on diesel emissions and climate mitigation. This request for supplementary funds ($24,080), if approved, can provide additional unique data set for understanding the BC radiative forcing from an observational perspective and thus provide a first of its kind data set to validate model predictions of BC radiative forcing and provide direct observational data for BC mitigation actions. Hence, the investigation is expected to enhance informed policy-making on mitigating BC emissions.