HEI HEALTH EFFECTS INSTITUTE

update

FALL 2012

Japanese Auto Officials Visit HEI

A high-level delegation from the Japan Automobile Manufacturers Association (JAMA) visited HEI in October to share the latest research results from studies they had supported at the Japan Automotive Research Institute (JARI), to gain input on new studies they are planning, and to hear updates about HEI work on diesel, particulate matter, and other topics. Seated: HEI President Dan Greenbaum (left) and Yoshiaki Shibata of Toyota. Center: Keiko Shibata of Isuzu. Back row, from left: Tsuyoshi Ito of JARI, Ryuji Ohkubo of JAMA, Yoshihisa Katsumata of Nissan, Susan Collet of Toyota, and HEI Director of Science Rashid Shaikh.

PHOTO BY CHITOSE SUZUKI

HEI to Launch New Diesel Epidemiology Project

Epidemiologic studies conducted over the past 40 years provided information on the hazards associated with exposure to diesel exhaust, including the risk of lung cancer. However, there has been uncertainty about the use of such data to estimate the magnitude of lung cancer risk in humans, largely because of concerns about the reliability of exposure estimates. This was the conclusion reached in a Special Report published by HEI in 1999, *Diesel Emissions and Lung Cancer: Epidemiology and Quantitative Risk Assessment*, which examined the strengths and limitations of the epidemiologic studies then available and considered whether such data could be used for quantitative risk assessment (QRA).

Recently, results of several new studies examining the association between exposure to diesel emissions and lung cancer have been published. These include cohort studies of miners who worked in non-metal mines in the United States and studies of U.S. trucking industry employees. These studies have made strong efforts to estimate exposures more precisely than was possible in the past. After reviewing these studies, along with other epidemiologic and toxicologic evidence, the World Health Organization's International Agency for Research on Cancer (IARC) recently concluded a new hazard assessment and designated diesel exhaust as a known human carcinogen (Class 1).

As is often the case when epidemiologists attempt to estimate past exposures, the question remains how useful these new studies would be in estimating risk to populations in everyday, nonwork environments, a question that is key to future risk-assessment decisions. In view of the recent studies and the continuing questions — and in response to requests from its government and industry sponsors — HEI is launching an effort to revisit and update

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Also in This Issue

Potential Air Toxics Hot Spots in Truck Terminals and Cabs

HEI will soon release Research Report 172, *Potential Air Toxics Hot Spots in Truck Terminals and Cabs*, by Thomas Smith of the Harvard School of Public Health and colleagues. This is the last of five HEI-funded studies that aimed at identifying and characterizing so-called hot spots for air toxics: areas where concentrations of toxic air pollutants are expected to be elevated.

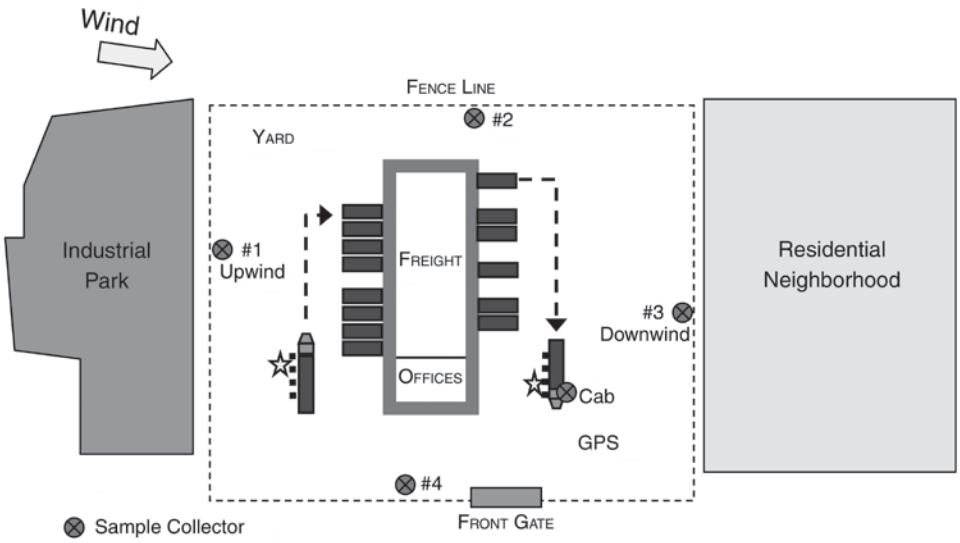

Diagram of hypothetical truck terminal and surrounding area, showing real-time monitors in four quadrants to resolve upwind and downwind pollutant concentrations and contributions. (From HEI Research Report 172)

Smith and colleagues focused on locations around the perimeter of 15 terminals for pickup and delivery trucks across the United States and also took air samples inside truck cabs during daily runs. For each terminal, they selected for sampling one location upwind of the terminal and one downwind. The investigators hypothesized that, at the upwind locations, concentrations of air toxics would be influenced by industrial parks and other commercial zones, while concentrations at the downwind locations would reflect the added contribution from truck traffic inside the terminal and could be representative of exposures in nearby downwind residential neighborhoods.

The investigators measured concentrations of selected volatile organic compounds (VOCs) and particulate matter (PM) during consecutive 12-hour, time-integrated sampling periods for five consecutive days at each terminal. During the second year they repeated the sampling at six terminals and added continuous sampling for total VOCs and $PM_{2.5}$ (PM with an aerodynamic diameter of 2.5 µm or smaller) at each of the four primary wind directions to allow more flexibility in classifying upwind or downwind locations during sampling. To determine whether the terminals were hot spots, they compared the downwind with the upwind measurements and also compared their results with those of other studies and with screening values set by the U.S. Environmental Protection Agency for noncancer and cancer risk.

Research Report 172 includes a Critique by the HEI Health Review Committee and will soon be available for downloading, free of charge, at *http://pubs.healtheffects.org*. Printed copies can be purchased from HEI. For more information, contact Maria Costantini (*mcostantini@healtheffects.org*).

New Investigator Award Announced

Jason Surratt, assistant professor in the Department of Environmental Sciences and Engineering at the University of North Carolina (UNC) at Chapel Hill, has been selected as the recipient of HEI's 2012 Walter A. Rosenblith New Investigator Award. Named for the first chair of the HEI Research Committee, the award supports the work of a promising scientist early in his or her career.

Jason Surratt.

Surratt received a Ph.D. in chemistry from the California Institute of Technology in Pasadena in 2010 and in the same year was appointed assistant professor at UNC. His prior work has focused on secondary organic aerosols, which are formed by the reactions of compounds in the atmosphere. For his New Investigator project, Surratt will conduct studies to evaluate the toxic and, in particular, inflammatory effects in human lung cells of particulate matter (PM) derived from the photochemical oxidation of isoprene. Isoprene is a small organic molecule that is a building block of much larger compounds that contribute to the formation of PM aerosols. Surratt will generate isoprene-derived PM in smog chambers and characterize the nature of the products in detail. To simulate an urban environment, isoprene-derived PM will be mixed with other compounds, including auto engine emissions. The mixtures will then be added to lung cells in culture, and experiments will be performed to determine which particle components are responsible for specific effects.

In selecting recipients for the New Investigator Award, the Research Committee considers each applicant's potential for a productive scientific career in air pollution research, the support provided by the applicant's institution, and the scientific merit of the research project and its relevance to HEI's mission. The committee thought that Surratt's proposed approach was innovative and multidisciplinary, bringing together state-of-the art atmospheric chemistry, exposure science, and toxicologic approaches.

Fourteen other scientists have received the New Investigator Award since the inception of the program in 1999 (see the list of awardees at *www.healtheffects.org/rosenblith.htm*).

PHOTO COURTESY OF UNC GILLINGS SCHOOL OF GLOBAL PUBLIC HEALTH/LINDA KASTLEMAN

NEW HEI RESEARCH REPORT

Impact of 1990 Hong Kong Limits on Sulfur Content in Fuel

In 1990, the Hong Kong government implemented a new restriction on sulfur in fuel, mandating a limit of 0.5% sulfur. After the full impact of this regulation was realized, airborne sulfur dioxide (SO_2) concentrations were reduced by 45% on average and by as much as 80% in some districts, although other components of the pollutant mixture, including PM_{10} (particulate matter with an aerodynamic diameter of 10 µm or smaller), did not decline. The reductions in the SO_2 concentrations were estimated in previous studies to have resulted in health improvements, including decreases in mortality rates and increases in life expectancy.

The study examined the role that gaseous pollutants and specific chemical constituents of particulate air pollution may have played in the legislation's observed effects on mortality.

As part of its Health Outcomes (Accountability) research program, HEI funded a team led by Chit-Ming Wong of the University of Hong Kong to explore the role that gaseous pollutants and specific chemical constituents of PM may have played in the observed effects on mortality of the 1990 legislation, develop methods for estimating the impact on life expectancy that rely on daily time-series data on air pollution and mortality, and apply these methods to the Hong Kong experience. Their findings appear in HEI Research Report 170, *Impact of the 1990 Hong Kong Legislation for Restriction on Sulfur Content in Fuel*.

The investigators reported decreases in nitrogen dioxide (NO_2) and SO_2 concentrations between pre- and post-intervention periods, which were particularly pronounced in the more heavily polluted industrial areas. No consistent changes in PM_{10} concentrations were observed after the intervention; however, there were decreases in PM-associated components, particularly nickel and vanadium — constituents derived mainly from the combustion of marine bunker fuels with high sulfur content.

Wong and colleagues analyzed the relationship between short-term exposure to air pollution and daily mortality over a 10-year period from 1985 to 1995 and reported that rates of daily mortality went up in association with increases in gaseous air pollutants (NO_2 and SO_2) and some PM_{10} components. Their analyses of PM-associated chemical species indicated associations between mortality and exposure to nickel and vanadium. However, the investigators were unable to reliably link changes in nickel and vanadium concentrations associated with the intervention to changes in the effects of short-term exposure in the pre- and post-intervention periods. They were also unable to disentangle the effects of individual gaseous and particulate pollutants on mortality over the 10-year period of the study.

Smog envelops a Hong Kong harbor. REUTERS/BOBBY YIP

In its independent evaluation, the HEI Review Committee discussed why definitive connections between changes in pollutant levels due to the intervention and changes in mortality rates were difficult to demonstrate. It noted that nickel and vanadium concentrations had been measured only on every sixth day and drew attention to the sensitivity of results to adjustment for time trends in mortality and for temperature, as well as their sensitivity to the spatial and temporal variation in concentrations of the various pollutants across Hong Kong. The inability of Wong and colleagues to disentangle the effects of SO_2, nickel, and vanadium was not surprising, given the common combustion sources of these pollutants (for example, sulfur-rich marine bunker fuel). It was impossible to attribute with confidence any beneficial effects on mortality that may have resulted from the intervention to any specific component of the air pollution mixture.

Estimating effects of the intervention on life expectancy also proved difficult. The investigators found that they were unable to control for the effects of potential confounding factors that were correlated over the long term with air pollution. The Review Committee noted the quality of the effort, but commented that the results suggest challenges in using daily time-series data to estimate effects on life expectancy.

Research Report 170 is available for downloading, free of charge, at *http://pubs.healtheffects.org*; printed copies can be purchased from HEI. For more information, contact Aaron Cohen (*acohen@healtheffects.org*).

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HEI is a nonprofit organization funded jointly by government and industry to research and evaluate the health effects of air pollution. An overview of HEI, information on its current research program, and a list of published HEI Research Reports are available on request or from the Web site.

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Advanced Collaborative Emissions Study Nearing Completion

The Advanced Collaborative Emissions Study (ACES) is the most comprehensive study ever undertaken to characterize the emissions and health effects of new-technology diesel engines. Much progress has been made during the past six months in Phase 2, which consists of the characterization of emissions from 2010-compliant heavy-duty engines under the oversight of the nonprofit Coordinating Research Council (CRC) and its panel of experts. These engines are designed to have substantially lower emissions of oxides of nitrogen (NO_x) than the 2007-compliant engines in order to meet strict federal emissions standards that went into effect in 2010, as well as to meet the very low particulate matter (PM) emissions standards mandated in 2007. The NO_x reduction is achieved using selective catalytic reduction technology, with urea as a reductant.

The participating manufacturers are Cummins, Detroit Diesel, and Volvo. So far investigators at the Southwest Research Institute in San Antonio, Texas, have tested two of the three engines using the Federal Testing Procedures (FTP) and a 16-hour cycle, which was specially designed for the animal inhalation exposures. The cycle includes a combination of the FTP and Air Resources Board 5-mode segments. The results of the characterization will be reviewed by the CRC and its panel and published next summer.

Phase 3, the lifetime inhalation exposure of rats to exhaust from a 2007 heavy-duty diesel engine being conducted at the Lovelace Respiratory Research Institute in Albuquerque, New Mexico, will be completed this December. At that point the rats will have been exposed for up to 30 months. The decision to continue exposure beyond the conventional 24-month duration (used in previous chronic diesel bioassays) was based on the relatively high survival rate after 24 months of exposure. At 24 months, a subset of animals were sacrificed to collect samples for the analyses of the same noncancer end points (such as overall organ toxicity, lung inflammation, and mutagenicity) that were measured after 3 and 12 months of exposure. These analyses will be conducted in the core study at Lovelace and in three ancillary studies.

Once the 30-month exposures are completed, the Lovelace investigators will conduct detailed histopathologic analyses of several organs and tissues, as was done in previous diesel bioassays, with a focus on determining whether tumors have developed. Results for noncancer effects after 1 and 3 months of exposure in rats and mice and after 12 months of exposure in rats were released online last spring and in print in September (Research Report 166). The report contains results of these subchronic exposures (and now includes findings of the study led by Daniel Conklin, which were not available at the time of the online publication) and a Commentary prepared by a specially convened ACES Review Panel, which conducted an independent review of the studies. A new appendix to the Commentary summarizes the results of the detailed characterization of chamber exposures.

The complete HEI Research Report 166 can be downloaded free of charge at *http://pubs.healtheffects.org*; printed copies can be purchased from HEI. For more information, contact Maria Costantini (*mcostantini@healtheffects.org*) or Annemoon van Erp (*avanerp@healtheffects.org*).

Panel Reviews Findings of Particle Studies

The NPACT Special Review panel of the HEI Review Committee met in October to examine key analyses and findings with HEI's National Particle Component Toxicity (NPACT) investigators and to begin to draw HEI's major conclusions from the NPACT studies. The comprehensive study reports, submitted by teams from New York University and the University of Washington/Lovelace Respiratory Research Institute, aim to determine whether some components or sources of airborne particulate matter are more or less harmful to health; such knowledge is expected to become increasingly important in informing the setting of national air quality standards.

PHOTOS BY CHITOSE SUZUKI

Jake McDonald, Lovelace Respiratory Research Institute, and NPACT panel member Jay Turner, Washington University, St. Louis, Missouri.

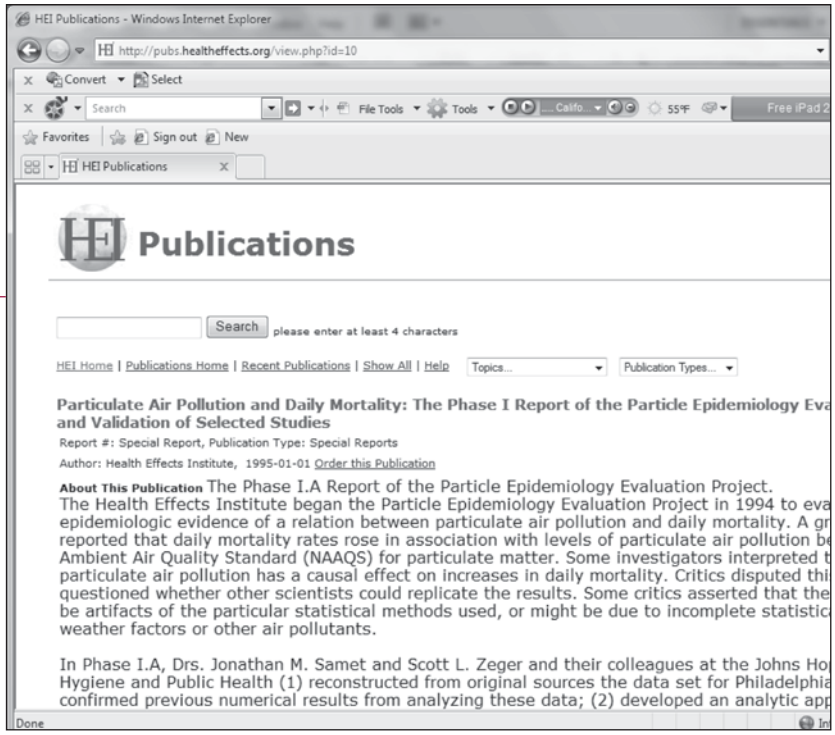
Ben Armstrong, London School of Hygiene & Tropical Medicine and HEI Review Committee.

Joel Kaufman and HEI Review Committee member Lianne Sheppard, both of the University of Washington, Seattle.

Complete Archive of HEI Reports Now Available on Web

More than 100 scientific reports published by HEI between 1985 and 1999 have recently been scanned and added to the HEI Web site as PDFs. This means that all HEI Research Reports published to date, along with Special Reports and Communications, can now be downloaded free of charge from *http://pubs.healtheffects.org*. Among the many older documents now available in electronic form for the first time are HEI "classics" such as the 1989 report of the HEI Multicenter Carbon Monoxide Study (Research Report 25) and three early studies by Joe Mauderly and colleagues on the health effects of diesel exhaust (Research Reports 8; 30; and 68, Part 1).

HEI was an early convert to the electronic medium, developing a Web site in the mid-1990s and then, starting in September 1999, posting all its new publications for anyone to download at no cost. The recent addition of earlier reports is only the first phase of HEI's plans to update its modes of communication. The institute is also considering other ways to improve future communications, and we welcome your ideas, such as features that you would like to see added to the Web site. Please send your suggestions to Annemoon van Erp at *avanerp@healtheffects.org*.



Call for Research Proposals: Traffic-Related Pollution

An upcoming HEI Request for Applications, "Improving Assessment of Exposure to Traffic-Related Pollution," will seek research to better quantify the relationships among motor vehicle (traffic) emissions, near-road concentrations, and human exposure for health studies. Letters of intent are due February 15, 2013; the deadline for full applications is March 29, 2013.

To obtain a copy of the RFA booklet, which will be available in December, visit the HEI Web site at *www.healtheffects.org*. For more information, contact Maria Costantini at *mcostantini@healtheffects.org*.

DIESEL EPIDEMIOLOGY *(Continued from page 1)*

its 1999 assessment. For this purpose, HEI plans to form a panel of scientists who have expertise in epidemiology and occupational health, biostatistics, emissions, and exposure assessment. The panel will be charged with the following:

- Review the findings of the 1999 HEI Special Report, *Diesel Emissions and Lung Cancer: Epidemiology and Quantitative Risk Assessment.*
- Review the epidemiologic studies, their data, and their exposure estimates that have recently become available and that may form the basis of QRA for diesel exhaust, and analyze such data as needed.
- Explore whether the data from these new studies enable analyses to extend exposure–response relationships to lower exposure levels, similar to those encountered in everyday, nonoccupational environments.
- Identify gaps in the available data and sources of uncertainty.
- Make recommendations about the usefulness of extending or conducting further analyses of existing data sets.
- If necessary, make recommendations for the design of new studies that would provide a stronger basis for risk assessment.

HEI expects the panel to be named this fall, with a workshop (including investigators from the original epidemiology studies and other experts) in the first half of 2013, panel deliberations throughout 2013, and final analyses and a report in 2014.

SAVE THE DATE

HEI Annual Conference 2013

April 14–16
Palace Hotel
San Francisco, California

Health Effects Institute
101 Federal Street, Suite 500
Boston, MA 02110-1817

HEI Welcomes Allen Robinson to the Research Committee

The HEI Board of Directors has appointed Allen Robinson, a professor in the Departments of Atmospheric Science and Mechanical Engineering at Colorado State University, Fort Collins, to the HEI Research Committee.

Allen Robinson.
PHOTO BY KEN ANDREYO

Previously, Robinson was a faculty member at the Center for Atmospheric Particle Studies at Carnegie Mellon University in Pittsburgh, Pennsylvania, where he continues to hold a research appointment. He is interested in the atmospheric transformation of particulate matter emissions from vehicular and other combustion systems and has done extensive research on field measurements and transport models to quantify the impact of emissions from gas development on local and regional air quality and climate. He received his bachelor's degree in civil engineering from Stanford University and his master's and doctoral degrees in mechanical engineering from the University of California–Berkeley.

Robinson has received many awards during his career, including, most recently, the Carnegie Institute of Technology Outstanding Research Award. He also serves on a number of important committees, including the Air Monitoring and Methods Subcommittee of the U.S. Environmental Protection Agency's Clean Air Scientific Advisory Committee, the editorial advisory board of *Aerosol Science and Technology*, and the editorial board of *Progress in Energy and Combustion Science*. He has authored or coauthored more than 90 peer-reviewed journal papers.

Robinson was appointed to fill the seat held for the past two years by David Allen of the University of Texas–Austin. Allen resigned from the committee — after helping to lead HEI's recent workshop on traffic-related air pollution and exposure — owing to the pressures of his extensive research activities in Texas, where he is leading several air-quality measurement campaigns.

"I have met Allen Robinson at several meetings and have always found him to be well informed and very knowledgeable, and also very approachable. I look forward to working with him," said Rashid Shaikh, HEI's director of science. "I regret that David Allen could not continue to serve on the committee, but we do understand the pressures that top academic scholars are under. We thank him for his service and wish him the very best."