

Annual Conference Showcases HEI's Scientific Program

More than 200 people from around the globe — from industry, government, nongovernmental organizations, the media, and many academic institutions — gathered in mid-April in San Francisco, California, for HEI's 27th Annual Conference. Leading international researchers discussed advances in methods to assess the health effects of air pollution and its components and provided initial results of the emissions characterization and animal exposures that were conducted as part of the Advanced Collaborative Emissions Study (ACES).

This year's opening Sunday session — "Beyond PM_{2.5} Mass: What Have We Learned?" — focused on metrics that are being considered for defining and regulating the levels of particulate matter (PM) in ambient air. HEI Vice President Robert O'Keefe opened the session with a brief overview of current trends in air quality regulations. The speakers noted that many components of the PM mix appear to be associated with some effects, but no specific component has been associated with all effects. With that in mind, Daniel Costa of the U.S. Environmental Protection Agency (EPA), one of the designated respondents, outlined the agency's new multipollutant approach to setting air quality regulations, which also has benefits on the climate-change side because it will indirectly affect levels of carbon dioxide, a greenhouse gas. Allen Robinson of Carnegie Mellon University and the HEI Research Committee, another respondent, stressed the need to consider secondary aerosols, which contribute substantially to PM mass but are not directly regulated.

Stephanie London of the National Institute of Environmental Health Sciences and the HEI Review Committee introduced the Monday morning session, "From Particle Exposure to Cardiovascular Effects: How Well Do We Understand the Mechanisms?" She pointed out that while epidemiologic studies have associated exposure to PM with

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An image from Dublin in 1980, a decade before coal burning was banned in the city. Coal was once commonly used in Ireland to heat homes.

PHOTO BY PHILIP RUTH

NEW HEI RESEARCH REPORT

Did the Irish Coal Bans Improve Air Quality and Health?

Health outcomes research — the investigation of whether actions to improve air quality have also been effective in improving public health — has been an important component of HEI's research program over the past decade. One regulatory change that has been the subject of considerable attention was the decision by the Irish government to ban the marketing, sale, and distribution of coal — first in Dublin in 1990 and later in other Irish cities. These steps were taken to address repeated episodes of severe air pollution in the 1980s that were caused largely by the

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Many investigators currently working on HEI's health outcomes studies attended the conference. From left: Fred Lurmann, Sonoma Technology; Frank Gilliland, University of Southern California; Ying-Ying Meng, University of California—Los Angeles; Ted Russell, Georgia Institute of Technology and HEI Review Committee; Edmund Seto, University of California—Berkeley; Corwin Zigler, Harvard School of Public Health; Melissa Pickett, University of California—Los Angeles; and Ed Avol, University of Southern California.



David Foster, University of Wisconsin—Madison and HEI Research Committee, and Katherine Walker, HEI senior scientist.



Eun Sug Park, Texas A&M Transportation Institute.



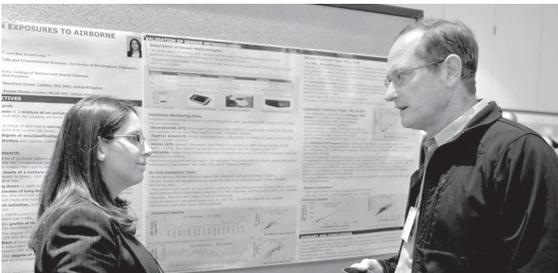
Chad Bailey, U.S. Environmental Protection Agency.



Allison Fryer, Oregon Health Sciences University (right), with Grace LeMasters, University of Cincinnati College of Medicine and HEI Research Committee.



Hilary Selby Polk, HEI senior science editor (left), and Kate Adams, HEI senior scientist.



Juana Maria Delgado-Saborit, University of Birmingham, United Kingdom, and David Bush, quality assurance auditor for HEI.



Junichi Hosoya, Japan Automobile Research Institute (left), and Jun Kagawa, Environmental Health Institute.



Philip Bromberg, University of North Carolina—Chapel Hill, one of the principal investigators for the Multicenter Ozone Study in Elderly Subjects (MOSES).

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cardiovascular effects, it is critical to explain the mechanisms by which this may occur. The four speakers, all expert cardiologists, then presented evidence that exposure to PM may elicit preclinical changes in different pathways related to oxidative stress, pulmonary and systemic inflammation, endothelial function, and control of the autonomic nervous system. Summing up the discussion, David Christiani of the Harvard School of Public Health and the HEI Research Committee said that although the speakers provided evidence of an effect of PM on all these pathways, key questions remain about how the pathways are linked and which biomarkers along these pathways are most predictive of clinical effects.

In the annual “HEI Update” session, HEI Director of Science Rashid Shaikh presented highlights of the institute’s major

research programs (the National Particle Component Toxicity [NPACT] initiative, ACES, and the Multicenter Ozone Study in Elderly Subjects [MOSES]) and described HEI’s progress in meeting the objectives of the HEI Strategic Plan for 2010–2015. HEI Senior Scientist Katherine Walker then summarized the recently published HEI Perspectives 3: *Understanding the Health Effects of Ambient Ultrafine Particles*. The review concluded that currently there is no strong evidence that the effects of short-term exposure to ultrafine particles are dramatically different from those of exposure to PM_{2.5} (PM with an aerodynamic diameter of 2.5 μm or smaller). The session ended with the presentation of the 2012 Walter A. Rosenblith New Investigator Award to Jason Surratt of the University of North Carolina—Chapel Hill. The award, named for the first chair of the

HEI Research Committee, supports the work of a promising scientist early in his or her career.

The Monday afternoon session, “Beijing to Long Beach: Measuring the Effectiveness of Air Quality Actions,” featured results of outcomes studies conducted in different areas of the world. The speakers took stock of recent efforts to evaluate air quality actions taken during the Beijing Olympic Games, low emission zones and other measures to reduce traffic congestion, and programs to reduce emissions in seaports. In addition, the session included a summary of a recent workshop on health outcomes research sponsored by the EPA, the Centers for Disease Control and Prevention, and HEI. The speakers reported improvements — albeit sometimes small ones — in air quality and health outcomes as a result of the specific

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Patrick Ryan, Cincinnati Children's Hospital Medical Center.



Grace LeMasters, University of Cincinnati College of Medicine and HEI Research Committee, and Ted Russell, Georgia Institute of Technology and HEI Review Committee.



Daniel Costa, U.S. Environmental Protection Agency.



Sanjay Rajagopalan, Ohio State University Wexner Medical Center.



Jiang Zhou, University of Pittsburgh Graduate School of Public Health, and Jing Wang, St. Louis University.



Stephanie London, National Institute of Environmental Health Sciences and HEI Review Committee.



Carol Henry, George Washington University and consultant to Cummins.



Robert Shavers, HEI operations manager, and Anny Luu, HEI administrative assistant.



Fred Lurmann, Sonoma Technology (left), and Morton Lippmann, New York University School of Medicine.

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actions taken. They cited the local scale of many actions, among other factors, as a key challenge in health outcomes research. Longer-term and national-scale regulations, such as those affecting emissions at U.S. power plants and ports, were identified as opportunities for future research.

On Tuesday, "The Future of Studies of Long-Term Exposure to Air Pollution" explored innovations in study designs, exposure assessment, and methods to evaluate the incidence of chronic disease. Speakers discussed approaches to building dynamic cohort studies; expanding spatiotemporal exposure measurement and models by taking advantage of remote sensing, new sensors, and cybertechnology; and studying the effect of pollution exposure on neurobehavioral outcomes in susceptible populations.

The final session, "The Evolution of Diesel Engines: Progress and Remaining Questions,"

focused on achievements in reducing emissions from diesel engines through regulatory actions and technological innovations. HEI President Dan Greenbaum introduced the session, noting the substantial progress in replacing older diesels with new technology in North America and Europe, as well as the continuing challenges in achieving new-technology diesel in the rest of the world. Alberto Ayala of the California Air Resources Board described how measures taken in California to retrofit old diesel vehicles with particulate traps have resulted in lower emissions. Imad Khalek of the Southwest Research Institute in San Antonio, Texas, presented the initial results of Phase 2 of ACES, the characterization of emissions from three 2010-compliant engines, which showed that the 2010 technologies for reducing oxides of nitrogen are extremely effective. Jacob McDonald of the Lovelace Respiratory Research Institute in

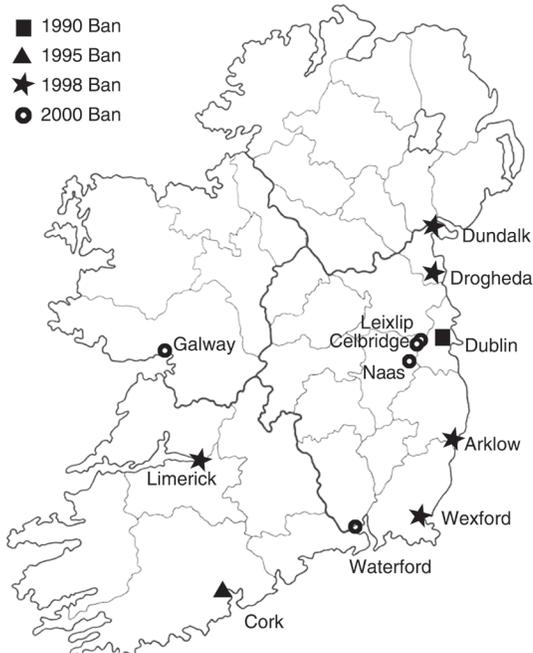
Albuquerque, New Mexico, presented the initial findings of Phase 3B, a chronic bioassay in rats exposed to the exhaust from a representative 2007-compliant diesel engine. The session concluded with a presentation by Daniel Krewski of the University of Ottawa, chair of the recently formed HEI Diesel Epidemiology Panel, describing HEI's plan to evaluate the suitability of the latest diesel epidemiology studies for use in estimating quantitatively the cancer risks associated with exposure to diesel exhaust. [HEI](#)

The final conference program and all presentation slides are available at www.healtheffects.org/annual.htm. Mark your calendar for next year's Annual Conference, scheduled for May 4–6, 2014, at the Westin Alexandria in Virginia. Registration information will be available at the same Web page early in 2014.

Conference photos by Jay Mallin

burning of coal for heating. A 2002 study of the 1990 ban by Irish and American investigators, published in *The Lancet*, indicated that the ban led to immediate improvements in air quality and reductions in mortality in Dublin. Results of a follow-up study, which extends the analysis to include the bans in other cities, appear in HEI Research Report 176, *Effect of Air Pollution Control on Mortality and Hospital Admissions in Ireland*.

Douglas Dockery of the Harvard School of Public Health in Boston, Massachusetts, led a team of investigators on the HEI study. The Irish government had extended the coal ban to 11 other, smaller Irish cities and towns — namely to Cork, Ireland’s second largest city, in 1995; to Arklow, Drogheda, Dundalk, Limerick, and Wexford in 1998; and to five other towns in 2000. As in the earlier study, the team examined changes in black smoke, a measure of combustion-related air pollution, and in total gaseous acidity, an indicator of sulfur dioxide and other acid gases, as well as changes in mortality from cardiovascular, respiratory, and other diseases after the implementation of each ban. However, the investigators included a number of substantial innovations and improvements in their study design. They gathered and analyzed changes in hospital admissions data to compare with their findings on mortality; they also compared changes in health outcomes in the areas where bans were implemented



Cities and towns affected by the coal bans of 1990 (Dublin), 1995 (Cork), 1998 (Dundalk, Drogheda, Arklow, Wexford, and Limerick), and 2000 (Leixlip, Celbridge, Naas, Waterford, and Galway). (From HEI Research Report 176)

HEI Seeks Nominations for Review Committee Chair

The HEI Board of Directors has initiated a search for a new chair of the Review Committee. This committee critically evaluates reports from completed HEI studies and writes a commentary for each report that discusses the study’s strengths, weaknesses, and contribution to the understanding of the health effects of air pollution. Homer Boushey, professor of medicine at the University of California–San Francisco, has chaired the Review Committee since 2006, and his term will end in May 2014. The board is seeking candidates with a broad perspective on HEI’s mission and the Review Committee’s work, along with an understanding of the importance of a balanced interpretation and thoughtful communication of research results. The chair could be an outstanding health scientist or clinical researcher — whether or not involved with environmental issues — or an environmental scientist from a range of disciplines. Nominations should be sent before August 30 to Rashid Shaikh, HEI director of science, at rshaikh@healtheffects.org.

with changes in comparable areas of Ireland where bans had not been put in place. Results in both ban and non-ban areas were controlled for long-term “background” improvements in health that may have been related to socioeconomic changes in Ireland during that period but were unrelated to the bans.

The investigators reported large, almost immediate declines in black smoke, ranging from 4 to 35 $\mu\text{g}/\text{m}^3$ (decreases of 45–70%), following the bans. The largest reduction in black smoke (70%) was seen after the earliest ban (1990) in Dublin. A more mixed pattern was seen for sulfur dioxide measured as total gaseous acidity, with some cities reporting a decrease (e.g., Dublin) while other cities reported an increase following the ban (e.g., Cork).

Mortality from respiratory disease was reduced, after adjustment for long-term background trends. The largest reduction was observed in Dublin (17%) and was similar to that reported in the earlier Dublin study. In contrast to the earlier study, there appeared to be no reductions in total mortality or in mortality from other causes, including cardiovascular disease, that could be attributed to any of the bans. That is, after correcting for background trends, similar reductions were seen in ban and non-ban areas.

In its independent review, the HEI Review Committee concluded that this study holds important lessons for future studies of air quality interventions, in particular regarding the methods used to account for long-term background trends in health and the use of comparison areas unaffected by the policy or regulation. The study by Dockery

and colleagues shows that accounting for background trends in mortality can be crucial, since the earlier Dublin study appears likely to have overestimated the effects of the 1990 coal ban on mortality rates from diseases that were already declining for other reasons. However, the new study also demonstrates that such long-term adjustments are not straightforward, particularly when changes are investigated over long periods.

Research Report 176 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 Katherine Walker (kwalker@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 all published HEI reports are available for downloading, free of charge, from the Web site.

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Study Takes Novel Approaches to Analyzing Health Effects Data

To improve scientific understanding of the relationships between air pollution exposure and health outcomes, HEI has frequently sponsored research and review activities focused on the methods used for statistical analysis. One result of such efforts is the soon-to-be-published HEI Research Report 175, *New Statistical Approaches to Semiparametric Regression with Application to Air Pollution Research*, by James M. Robins of the Harvard School of Public Health in Boston, Massachusetts, and colleagues.

Robins and his team focused on the use of time-series methods, which are commonly used to evaluate relationships between short-term exposure and mortality or hospitalizations. Time-series methods analyze the numbers of disease events or deaths in relation to air pollution levels on the same day or during the same short period of time. Investigators therefore need to control systematically for time-dependent phenomena other than air pollution levels, including factors such as weather patterns or seasonal temperatures. Such factors, known as confounders, may be related to pollution exposure levels but may also independently affect the health outcomes being examined.

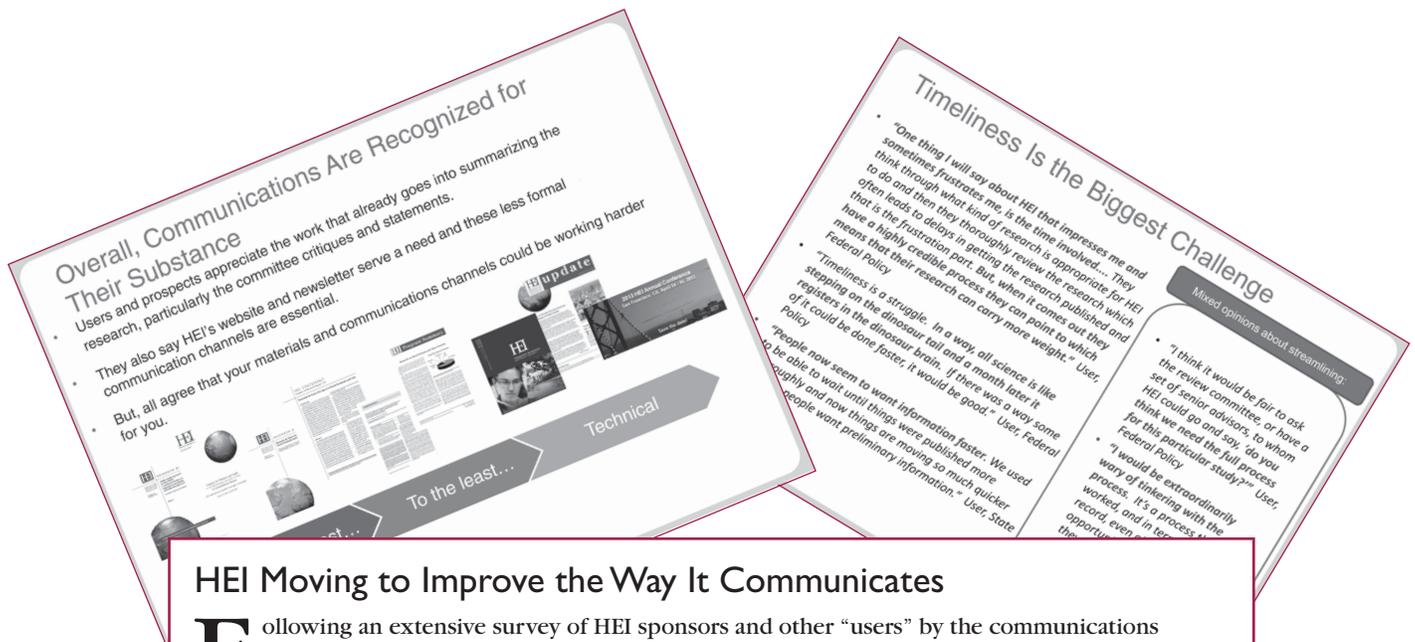
In their study, Robins and colleagues developed and applied statistical methods to address some of the fundamental analysis issues related to time-series studies that were raised in a 2003 HEI Special Report, *Revised Analyses of Time-Series Studies of Air Pollution*

and Health. That report focused on reanalyzing data from selected studies and the HEI-funded National Morbidity, Mortality, and Air Pollution Study (NMMAPS). In the current study, Robins and colleagues successfully reanalyzed the NMMAPS data set using semiparametric regression models, which control for the effects of time-varying confounding in time-series data. These methods make fewer assumptions about the form of the time trends in the data than the methods used in the 2003 report.

In its independent review of the study, the HEI Review Committee noted that the concurrence between the current investigators' results and the NMMAPS results was reassuring. The committee thought that Robins had performed high-quality work in the development of these semiparametric methods, which are rather complex.

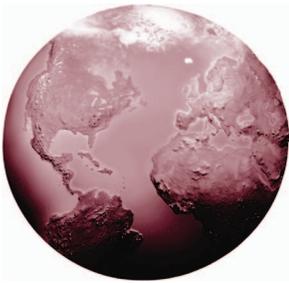
Given the novelty and complexity of the work by Robins and his coinvestigators, HEI asked noted statistician and author Sander Greenland to provide a short editorial-style discussion to be published with the report. Greenland's comments provide interpretation and clarification of the study and its contributions to epidemiologic methods in air pollution research. 

Research Report 175 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 Kate Adams (kadams@healtheffects.org).



HEI Moving to Improve the Way It Communicates

Following an extensive survey of HEI sponsors and other "users" by the communications consulting firm Edge Research of Arlington, Virginia, HEI is taking action to improve the timeliness of its reports, make its "bottom-line messages" clearer, and revamp its electronic communications. HEI Managing Scientist Annemoon van Erp and Senior Science Editor Hilary Selby Polk are taking the lead, with input from staff and the HEI Research and Review Committees, in identifying ways to rethink how reports are produced, reviewed, and published. "Our goal," says HEI President Dan Greenbaum, "is to maintain quality while shortening the time spent by all involved." HEI will begin to roll out changes over the coming months. If you have ideas that might help, please write to avanerp@healtheffects.org and hpolk@healtheffects.org. (Shown are highlights from Edge Research presentations to HEI sponsors and staff.) 



Health Effects Institute

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PHOTO BY ANNEMOON VAN ERP



PHOTO BY THERESA SHARP, COVANCE

Expert Group Conducts Peer Review of ACES Pathology Results

In May, HEI invited a group of expert pathologists to provide peer review of the final research phase of the Advanced Collaborative Emissions Study (ACES), the most comprehensive study ever undertaken to characterize the emissions and health effects of new-technology diesel engines. The Pathology Working Group met at Covance Laboratories in Chantilly, Virginia, to examine the final pathology results from the ACES inhalation bioassay, in which rats were exposed for up to 30 months to exhaust from a new-technology heavy-duty diesel engine (2007 model). The exposures were conducted at the Lovelace Respiratory Research Institute (LRRI) and completed last December. The working group was chaired by Gary Boorman (Covance) and included Heinrich Ernst

(Fraunhofer Institute), Jack Harkema (Michigan State University), Ann Hubbs (National Institute for Occupational Safety and Health) and Roger Renne (ToxPath Consulting). Pictured in the lab are Boorman (standing), and (from left) Harkema, Ernst, Ron Herbert (National Toxicology Program at the National Institute of Environmental Health Sciences; observer), Renne, and Hubbs. Above, the group is joined by all the designated observers; from left are Renne, Annemoon van Erp (HEI), Charlie Plopper (University of California-Davis), Ernst, Rodney Miller (Experimental Pathology Laboratories), Hubbs, Herbert, Gene McConnell (ToxPath), Boorman, Harkema, and Andrew Gigliotti (LRRI). [HEI](#)