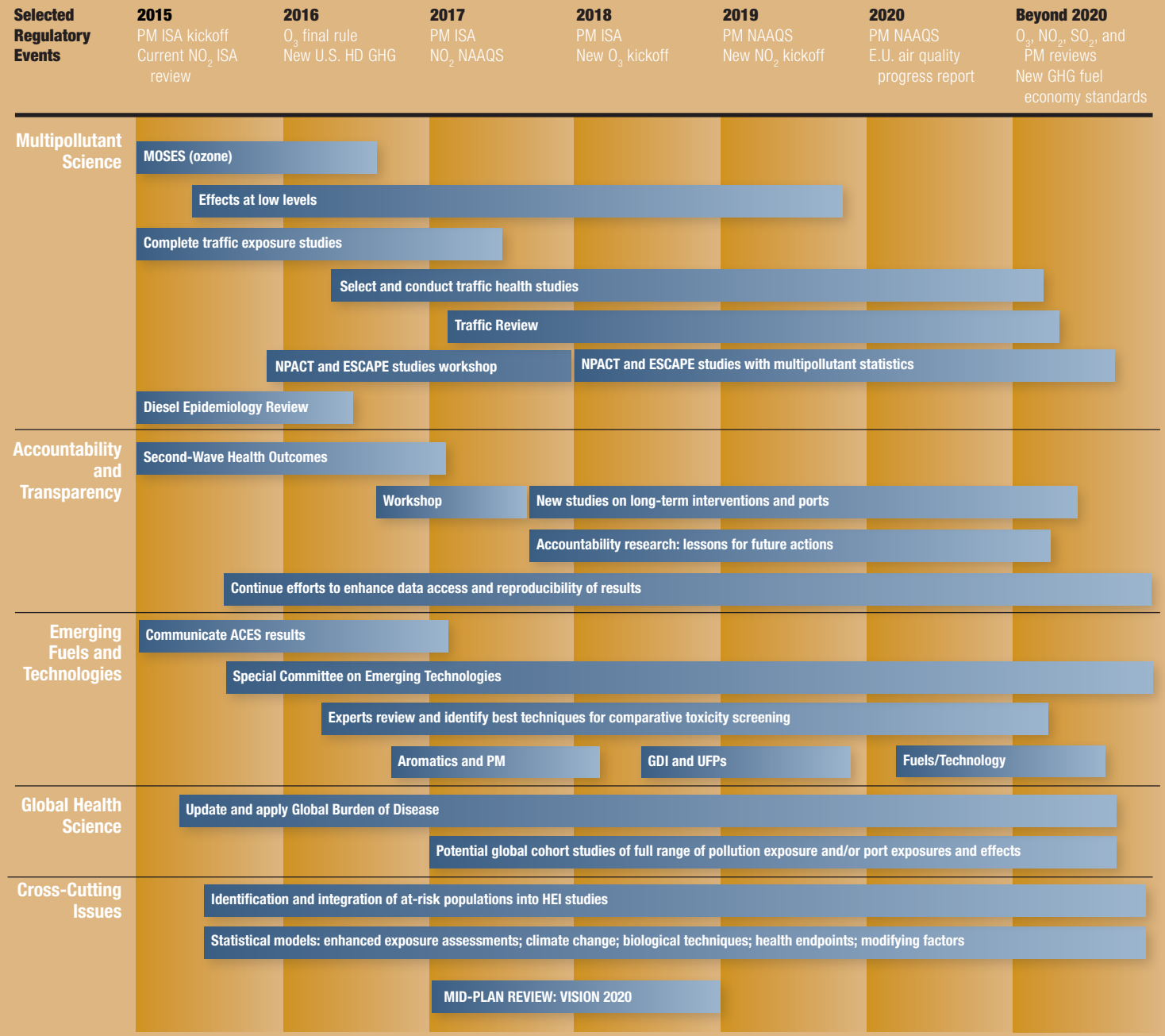

VISION 2020
HEI ANNUAL REPORT 2015 >

The HEI Strategic Plan 2015–2020



Implementing the *HEI Strategic Plan 2015–2020:* This time line highlights HEI's key research areas selected for the 2015–2020 *Strategic Plan* period, as well as related upcoming regulatory events.

A MESSAGE FROM THE CHAIR VISION 2020 >

When my predecessors set out to launch the Health Effects Institute some 35 years ago, they saw a straightforward vision for the Institute: to provide trusted facts about air pollution and health that could lead to the best possible decisions to reduce air pollution, and as a result improve public health. In the ensuing decades, HEI has done much to meet that vision, producing the highest quality studies, which have encouraged cleaner technologies and fuels and led to substantially cleaner air in many parts of the world.

One key to that success has been the disciplined development and implementation of the *HEI Strategic Plan for Understanding the Health Effects of Air Pollution*. Many strategic plans end up sitting on a shelf gathering dust rather than actively guiding the organizations that wrote them. The HEI Strategic Plan — the result of extensive input from HEI's sponsors, the scientific community, and other important environmental stakeholders, and built around a clear time line for producing targeted science to inform specific upcoming decisions — is instead a living, breathing document that guides every aspect of HEI's work.

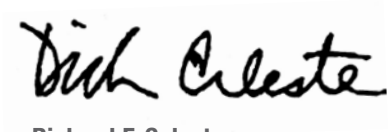
The input HEI received over the last year in producing its newest *Strategic Plan 2015–2020* did not disappoint. It laid out a series of important challenges for the years ahead: difficult scientific questions about the health effects of air pollution at very low and very high levels; the potential health burdens of different energy choices (e.g., coal and transport fuels) being made in the developing and developed worlds in light of global efforts to address climate change; and the array of emerging fuels and technologies coming forward to improve efficiency and reduce greenhouse gases. HEI's strategic activities on these and other elements of the new Plan, as well as a new initiative on the potential impacts of oil and natural gas development, are described in detail in this *Annual Report.*

While HEI should plan for specific actions it will take in the next five years, we should do so with attention to much longer time frames for future air quality and climate decisions.

But the current Strategic Plan also contains a new element with important implications for the future. In reviewing future directions with HEI's sponsors, and in the Board of Director's review of the draft plans, one consistent theme arose again and again. The key decisions on technologies, air quality, and climate increasingly do not take place on a simple five-year cycle, but rather stretch over decades, and the science produced in the near term can help to inform decisions occurring well beyond the next five years. Challenging private and public sector decisions on technology to meet greenhouse gas goals (e.g., for vehicles and stationary sources) are already aimed at meeting standards set for 2025 — and those standards are likely to be extended well beyond that date. Thus it was clear that while HEI should plan for specific actions it will take in the next five years, we should do so with attention to much longer time frames for future air quality and climate decisions.

To respond, the Plan includes a new element: *Vision 2020*. At the Plan's midpoint HEI will cast a broad net to reassess our strategy, to anticipate what major future trends may be emerging, and to begin initial efforts during these five years to shape a vision for HEI to best contribute in the decades ahead.

This kind of advance strategic thinking and planning will be no small undertaking, but I am confident that — given the extraordinary commitment, insight, and support of our sponsors, the scientific community, and HEI's talented staff — we can set our sights not just for this decade, but for the challenges that lie beyond.



Richard F. Celeste
Chair, HEI Board of Directors

Jay Mallin

For 35 years, the Health Effects Institute has been providing government officials, industry experts, regulators, scientists, and the environmental community with trusted and relevant science about the effects of air pollution on health. HEI takes a balanced, objective approach to scientific inquiry from end to end, with the identification and funding of high-priority research projects, intensive review of the findings, placement of them in the context of other studies, and communication of the findings to decision makers both in public agencies and private industry.

Since its inception, HEI has funded more than 330 research projects worldwide and published over 260 comprehensive reports, 85 of which were active between 2010 and 2015. In addition, HEI's studies have resulted in the publication of more than 1000 peer-reviewed journal articles. The results of these investigations have informed decisions about air pollution, from diesel exhaust to carbon monoxide, particulate matter, and more.

Proof of HEI's influence comes from clear signs that the scientific results from studies HEI funds are being put to use. As an example, HEI's publications from April 2010 to March 2015 generated thousands of citations from other researchers, averaging 89 citations per report. HEI science has also informed U.S. Environmental Protection Agency decisions, with the EPA referencing an increasing number of HEI reports over time in its reviews of National Ambient Air Quality Standards, among other regulations.

A LOOK AHEAD

As HEI plans for the next five years, its sights are set on the year 2020, and the years beyond. Air quality challenges continue to arise, and upcoming decisions about air quality and climate will occur on a continuum that extends beyond the five-year horizon. In fact, many upcoming decisions are aiming to meet standards set for 2025 and later years.

Proof of HEI's influence comes from clear signs that the scientific results from studies HEI funds are being put to use.

Not only are air quality solutions stretching out over longer terms, but also the range and complexity of decisions ahead are growing. For instance, questions are being asked now about the effects of low concentrations of pollutants in parts of the world where air pollution levels have dropped. Questions are also being posed about the vulnerability of children and other sensitive populations to exposure to air pollution, the integration of air quality decisions with climate change concerns, and emerging concerns about air quality from new sources such as new fuels and new methods of extracting natural gas and oil from the ground.

Now more than ever, HEI needs a clear path forward that identifies critical milestones and key research priorities. For 2020 and beyond, those include

- Multipollutant studies that examine the health effects of exposure to low levels of pollutants and pollution from mobile sources, such as traffic on roadways and around ports;
- Emerging fuel and technology studies that investigate any potential health consequences of the fuels and technologies that are being introduced to address concerns about air pollution, climate change, and energy security; and
- Global health science, with studies in Europe and Asia that aim to inform efforts to reduce the global burden of disease linked to poor air quality.

In addition to these core areas of investigation, HEI will continue to advance "accountability" studies designed to determine if new air quality regulations and interventions are having the intended positive effects on health. Because of HEI's track record and unique approach, it has also been tapped and separately funded to investigate the potential impact of 21st century oil and natural gas development (see page 8 for discussion).

TRACKING PROGRESS AT HEI AND IN THE AIR

A key component of HEI's success so far has been its track record for delivering on what it promises. To continue to provide reliable and timely science, HEI has developed a time line for its efforts over the coming five years, with a built-in review midway to reassess its plans in light of new information and evolving needs.

A recently completed study, funded by HEI and conducted by Dr. Frank Gilliland of the University of Southern California, analyzed data gathered beginning in the early 1990s in southern California to assess how the health of children changed as air pollutant levels went down. In 2015, Gilliland and his colleagues published their results in the *New England Journal of Medicine*. As air pollution decreased over the years, the researchers observed significant improvements in lung function in children both with and without asthma. In addition, the number of children under age 15 with impaired lung function decreased with improved air quality. The study is slated for publication in 2016.

FOR 35 YEARS, THE HEALTH EFFECTS INSTITUTE HAS BEEN PROVIDING GOVERNMENT OFFICIALS, INDUSTRY EXPERTS, REGULATORS, SCIENTISTS, AND THE ENVIRONMENTAL COMMUNITY WITH TRUSTED AND RELEVANT SCIENCE ABOUT THE EFFECTS OF AIR POLLUTION ON HEALTH.

37
HEI RESEARCH REPORTS PUBLISHED

127
peer-reviewed papers published:
3.4 papers per report

356
citations of the 37 reports:
9.6 citations per report

2942
secondary citations:
79.5 citations per report

3298 Total
citations from 37 reports:
89.1 citations per report

HEI Science Impact: Scientists and regulators alike draw on trusted HEI science to drive new research and decisions (data from 2010–2015).

New Look: HEI Online

In 2016 HEI is unveiling its redesigned Web site, which will more effectively engage and inform our online visitors. New features include topics pages to guide visitors to specific research programs and quick links to specific documents and other important information. The renovated site will also be adapted for mobile platforms and will provide easy links to social media.

EMERGING FUELS AND TECHNOLOGIES

A key goal shared among HEI, its sponsors, and the scientific community for 2020 and beyond is to find new fuels and technologies that address concerns about air pollution, climate change, and energy security. Increasing fuel efficiency standards and reducing greenhouse gas emissions are prime drivers. Efforts are under way to meet U.S. Corporate Average Fuel Economy standards of a fleet average of 35.5 miles per gallon by 2017 and 54.5 miles per gallon by 2025. HEI has been at the forefront of efforts to evaluate the health effects of emerging technologies, with, for example, the Advanced Collaborative Emissions Study (ACES), an effort to characterize emissions from new heavy-duty diesel engines designed to meet 2007 and 2010 standards and test the health effects in laboratory animals after lifetime exposure.

More recent efforts include those of HEI's Diesel Epidemiology Panel to evaluate two 2012 studies of the effects of diesel exhaust exposure on lung cancer mortality, the first results of which were presented at HEI's 2015 annual conference. One study, conducted by the National Cancer Institute and the National Institute for Occupational Safety and Health, examined more than 12,000 miners working in underground mines where they were exposed to diesel exhaust and low concentrations of other carcinogens. The other study, by Dr. Eric Garshick and colleagues, looked at the health of more than 50,000 truckers over time. The studies were evaluated to determine their strengths and weaknesses and also for their utility as a basis to calculate the risk of lung cancer from exposure to diesel emissions. Future work will involve efforts to determine what these findings about risk for very specific segments of the population mean for the public in general.

As new fuels increase in the marketplace, questions will arise about their health effects. For instance, ethanol is being used to comply with the Energy Policy Act of 2005, which requires an increase in the use of renewable fuels. However, ethanol emissions may be more complex than expected, so there is a need for better characterization of particulate matter emissions and aromatics, which may contribute to both air toxics exposures and formation of fine-particle air pollution. To answer this need, HEI is planning a workshop in the near future to evaluate the current knowledge and identify key unknowns.

The HEI Diesel Epidemiology Panel

HEI HAS BEEN AT THE FOREFRONT OF EFFORTS TO EVALUATE THE HEALTH EFFECTS OF EMERGING TECHNOLOGIES, WITH, FOR EXAMPLE, THE ADVANCED COLLABORATIVE EMISSIONS STUDY (ACES).

TRAFFIC AND HEALTH

In 2010, HEI published a comprehensive review of the current knowledge on traffic-related air pollution. That review concluded that although there is much still to be learned about exposure to and the health effects of traffic, the data do make clear that the zone within 300 to 500 meters of a highway or major roadway is most dramatically affected by traffic emissions. Approximately 30% to 45% of people living in North American cities live within these high-exposure zones.

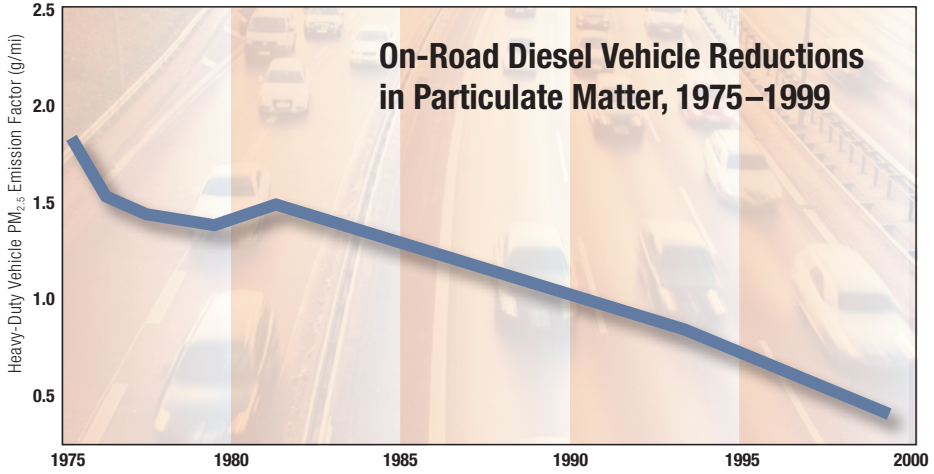
Since then, HEI has funded five studies to fill a key gap identified in the review and to investigate the best ways to measure exposure to traffic pollution. These studies began in 2014 and are expected to conclude in late 2016. They include efforts to measure traffic-related air pollution near freeways and in less-trafficked areas in Detroit, Michigan; Hong Kong; and Raleigh/Durham, North Carolina, and will encompass the development of new methods for predicting and modeling air pollution exposure.

A fourth study attempts to understand the traffic exposures of students living in two dormitories in Atlanta, Georgia—one near a freeway, the other more distant. A fifth study in San Francisco, California, will collect air pollution data year-round using a dense network of real-time sensors at sites around the city. That study will also monitor personal exposures by outfitting individuals with low-cost wearable sensors and sending them on scripted walks to mimic typical commutes through urban and residential areas and under differing weather and traffic conditions.

HEI has since identified a need for new research in two additional areas: the characterization of non-tailpipe emissions from motor vehicles and the use of tunnels as study locations to learn how traffic emissions change over time. As a result, HEI recently funded two studies to address these areas. Under the new Strategic Plan, HEI will also plan and launch new comprehensive studies of traffic exposure and health, building on the ongoing exposure studies.

In 2017, HEI will begin a multiyear project to update its 2010 review of traffic-related air pollution studies. Many investigations have been completed in the intervening years, and technologies and regulations have changed. This updated review will provide HEI's sponsors and other stakeholders with the latest knowledge about traffic effects and offer HEI's scientists guidance in making informed decisions about the areas of greatest need for new investigations going forward.

The reductions in $PM_{2.5}$ through the late 1990s shown here were observed in an earlier HEI study (Gertler et al. 2002) of diesel emissions in a tunnel. A newly funded HEI study will assess the influence of the latest new-technology diesel engines on air pollution.



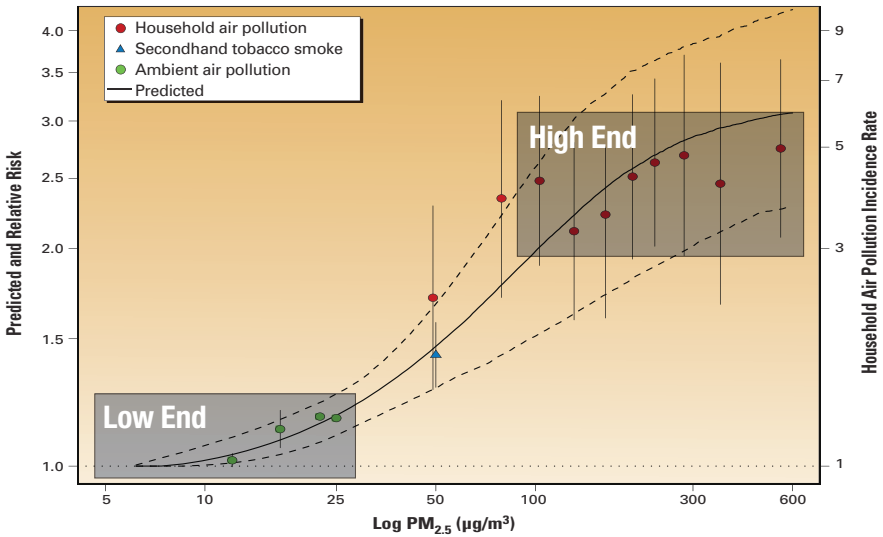
Ambient air pollution levels have dropped in North America and Europe over the past few decades; yet there are questions about possible adverse health effects persisting even at the now-prevailing low levels of exposure. At the same time, exposure to high levels of air pollution still occur in some circumstances, such as in ports and high-traffic areas, and also in developing regions of the world, such as China and India. To better understand the health risks of both low and high levels of exposure, HEI has launched a series of new studies.

THE LOW ROAD

This year, HEI selected two new low-exposure studies to fund from responses to a 2014 request for applications. One team, led by Francesca Dominici of Harvard University, will investigate health effects in millions of people exposed to low levels of air pollution in the United States, relying on information from Medicaid and Medicare. The second team, led by Michael Brauer of the University of British Columbia, will do the same using the Canadian census. Both studies will use state-of-the-art hybrid exposure models and will also develop and apply new methods.

THE HIGH ROAD

While individuals living in some areas of the world have seen a decline in air pollution and exposure, others still experience high-level exposures. New assessments suggest that these high levels result in significant increases in health risks, although it appears that the effects plateau at the very highest levels.



Relationship between particulate matter exposure and health (pneumonia in infants) from very low to very high levels (integrated exposure–response curve from GBD; Burnett et al., *Environmental Health Perspectives*, 2014).

One such project, the Global Burden of Disease (GBD), is a systematic effort to quantify the loss of health around the world and trace it to a wide range of potential causes. HEI co-leads the assessments related to outdoor air pollution. The latest GBD results, updated in 2013 from 2010, are based on new data about the actual exposures to air pollution in China and new information about the health risks of particulate matter exposure. The GBD 2013 results rank outdoor air pollution seventh worldwide among mortality risks and rank household air pollution (from coal- or wood-fired stoves, for example) tenth. In China, outdoor air pollution is the fifth leading cause of death.

Because there are many sources of air pollution in China, HEI has launched a new initiative called GBD MAPS (Global Burden of Disease from Major Air Pollution Sources) to understand the health effects of sources such as coal burning, transportation emissions, industrial emissions, household biomass emissions, agricultural sources, and others. The effort, funded by foundations and being carried out in partnership with Tsinghua University and other Chinese institutions, is now under way, with results expected in early 2016. The GBD MAPS project will then turn its attention to estimating the health burdens from major sources of air pollution in India.

HEI's work toward a better understanding of the sources of air pollution in China and India and their potential health effects will help inform measures to control air pollution and improve health.

HEI'S WORK TOWARD A BETTER UNDERSTANDING OF THE SOURCES OF AIR POLLUTION IN CHINA AND INDIA AND THEIR POTENTIAL HEALTH EFFECTS WILL HELP INFORM MEASURES TO CONTROL AIR POLLUTION AND IMPROVE HEALTH.

HEI President Dan Greenbaum presents GBD MAPS results at the International Workshop on China Coal Cap Strategy in Beijing in November 2015.

Understanding Low-Level Ozone Exposure: The HEI MOSES Project

Jay Mallin

MOSES principal investigators (from left) Paul Stark, Mark Frampton, John Balmes, and Philip Bromberg, with HEI principal scientist Maria Costantini.

In April 2015, testing of subjects in HEI's Multicenter Ozone Study in Elderly Subjects (MOSES) was completed. This is a major effort to understand the effects of ozone exposure on autonomic balance, heart and vascular function, and blood clotting. Subjects included men and women between the ages of 55 and 70 who were exposed alternately to low concentrations of ozone and clean air for 3 hours on 3 separate visits to study sites at the University of California–San Francisco, University of North Carolina–Chapel Hill, and University of Rochester Medical Center, Rochester, New York. A total of 87 subjects completed all 3 exposures. Analysis of the data began in August 2015, with final findings expected to be submitted for HEI review in early 2016 and results produced in time for the next EPA review of the ozone National Ambient Air Quality Standard (NAAQS) beginning in 2017.

HEI's model for providing trusted science to industry, government, and other decision makers has attracted the interest of a new audience: the Pennsylvania-based Shale Gas Roundtable. In response to concerns about the expansion in use of new ways of extracting oil and natural gas from the ground in the mid-Atlantic Appalachian Basin of the United States, this group of government, industry, academic, and environmental leaders approached HEI to draw up an agenda for learning more. The goal? Apply trusted science to decisions about the future of 21st century oil and natural gas development.

21ST CENTURY OIL AND GAS

The Appalachian Basin begins deep in the south of Alabama and stretches northward far into New York State. Over the past five years, the number of new oil and natural gas wells in some regions within the basin has increased dramatically with increased use of the extraction technique of hydraulic fracturing combined with horizontal drilling. Hydraulic fracturing involves the injection of large volumes of fluid into rock. The pressure creates cracks in geologic formations and allows the oil and natural gas within to be extracted. While this practice has been in use for decades, it has been combined with horizontal drilling to increase yields such that its scale has increased markedly in recent years.

Wells delve thousands of feet across rock to access oil and natural gas reserves previously not economically viable. Since the early 2000s, about 13,000 new wells have been drilled in Pennsylvania, Ohio, and West Virginia alone. Many people living in these regions were familiar with conventional oil and natural gas development (OGD), but not with the pace, scale, or type of the recent OGD. The industry and regulators have protocols to protect workers, neighbors, and the environment. However, given the rapid pace and technological changes associated with OGD, knowledge of its potential impacts and whether protocols and regulations are sufficient to prevent or minimize potential effects has, in some cases, lagged behind.

HEI'S RESPONSE

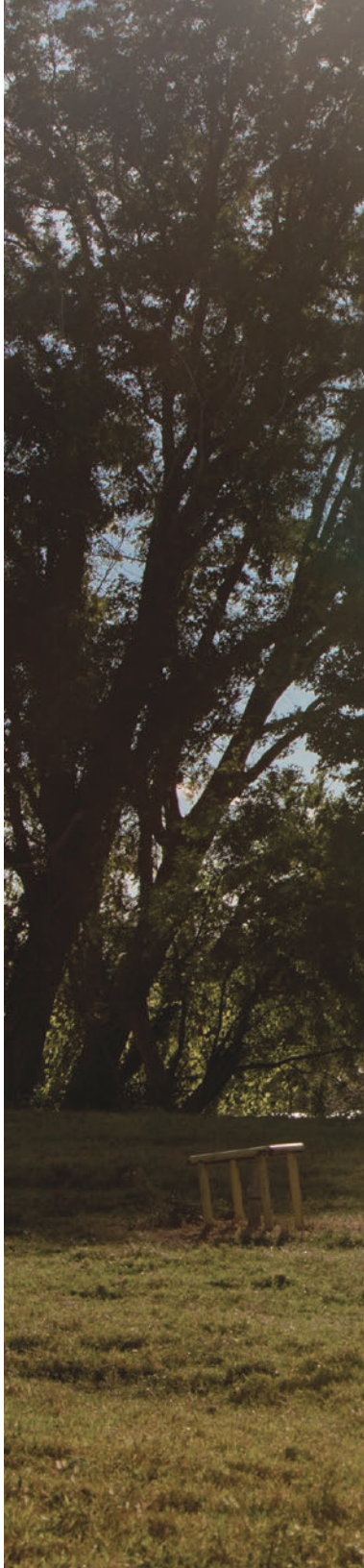
In response to recommendations from the multi-stakeholder Pennsylvania-based Shale Gas Roundtable for "efforts to increase balanced research and rigorous monitoring of the possible impacts of unconventional oil and gas development," HEI formed an expert committee dedicated to developing a strategic scientific research agenda to better understand the potential impacts of OGD. HEI's efforts in the area of 21st century oil and natural gas development are funded independently by foundations in the Appalachian Basin.

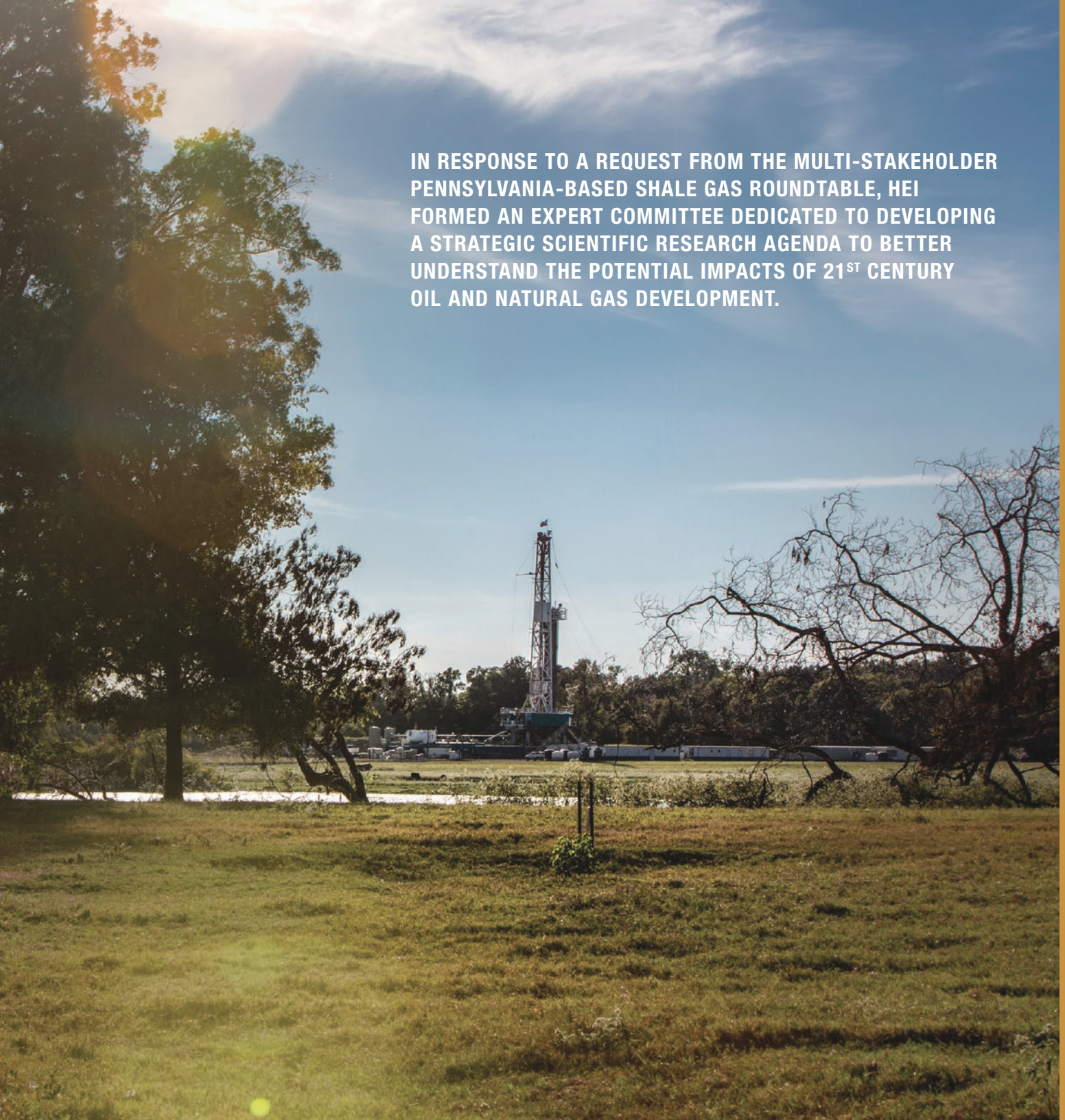
HEI's model for providing trusted science to industry, government, and other decision makers has attracted the interest of a new audience.

HEI's Special Scientific Committee on Unconventional Oil and Gas Development reviewed some 1000 articles and reports about oil and natural gas development in the Appalachian Basin. It also convened a series of public workshops in the region so that scientific experts, government officials, industry representatives, and nongovernmental environmental and community organization representatives could provide their own recommendations for research as well as feedback on the committee's work.

The resulting Research Agenda recommends research to better understand and to prevent or minimize potential impacts on human health and well-being, communities, ecological health, and the environment. The Committee recognized that OGD can generate important energy and other potential benefits. At the same time, the rapid escalation of these activities has raised questions about potential impacts in the communities where it's occurring. The Committee found that, although there have been many papers published with some relevance to these questions, few studies have evaluated the actual levels of human exposure to OGD stressors and whether they might lead to adverse health effects

The committee released its draft Strategic Research Agenda in July 2015 and its final Agenda in October 2015. In view of the importance of implementing the Research Agenda as quickly as possible, HEI has already begun outreach to key potential partners and sources of funding from government, industry and the foundation community. The Research Agenda will form the basis of a targeted HEI Research Program.





IN RESPONSE TO A REQUEST FROM THE MULTI-STAKEHOLDER PENNSYLVANIA-BASED SHALE GAS ROUNDTABLE, HEI FORMED AN EXPERT COMMITTEE DEDICATED TO DEVELOPING A STRATEGIC SCIENTIFIC RESEARCH AGENDA TO BETTER UNDERSTAND THE POTENTIAL IMPACTS OF 21ST CENTURY OIL AND NATURAL GAS DEVELOPMENT.

At the Cutting Edge: New Statistical Studies

The air we breathe is a complex mix of pollutants. Scientists are beginning to believe that certain mixes may be more toxic than others, with some pollutants combining to be more toxic than individual pollutants alone. Teasing out these dangerous mixtures may be easier now with results from two HEI-funded studies that propose two new statistical methods for analyzing pollutant mixtures. One study, by Brent A. Coull of the Harvard T.H. Chan School of Public Health and colleagues, presents a method that allows a researcher to select pollutants to include in models used to study health effects. Another study, by Eun Sug Park of Texas A&M Transportation Institute and colleagues, developed new Bayesian statistical models for assessing health effects from specific sources. A third study, led by John Molitor of Oregon State University, to be published in 2016, developed and applied statistical methods to examine associations among geographically based patterns of air pollutant concentrations, birth outcomes, and socioeconomic status. While these investigations have advanced methods for multipollutant studies, further work is required to evaluate their suitability in a broader range of settings than those used during the development of the methods.

HEALTH RESEARCH COMMITTEE

David L. Eaton, *Chair*
Dean and Vice Provost of the Graduate School, *University of Washington–Seattle*

David Christiani
Elkan Blout Professor of Environmental Genetics,*Harvard T.H. Chan School of Public Health*

Francesca Dominici
Professor of Biostatistics and Senior Associate Dean for Research, *Harvard T.H. Chan School of Public Health*

David E. Foster
Phil and Jean Myers Professor Emeritus, Department of Mechanical Engineering, Engine Research Center, *University of Wisconsin–Madison*

Uwe Heinrich
Professor, Medical School Hannover; Executive Director, *Fraunhofer Institute for Toxicology and Experimental Medicine, Hanover, Germany*

Barbara Hoffman
Professor of Environmental Epidemiology and Head of Environmental Epidemiology of Aging, IUF-Leibniz Research Institute for Environmental Medicine; Professor, Medical Faculty, *Heinrich Heine University of Düsseldorf, Germany*

Allen L. Robinson
Raymond J. Lane Distinguished Professor and Head, Department of Mechanical Engineering; Professor, Department of Engineering and Public Policy, *Carnegie Mellon University*

Richard L. Smith
Director, Statistical and Applied Mathematical Sciences Institute, *University of North Carolina–Chapel Hill*

HEALTH REVIEW COMMITTEE

James A. Merchant, *Chair*
Professor and Founding Dean, College of Public Health, *University of Iowa*

Michael Brauer
Professor, School of Environmental Health, *University of British Columbia, Canada*

Bert Brunekreef
Professor of Environmental Epidemiology, Institute of Risk Assessment Sciences, *University of Utrecht, the Netherlands*

Mark W. Frampton
Professor of Medicine and Environmental Medicine, *University of Rochester Medical Center*

Stephanie London
Senior Investigator, Epidemiology Branch, *National Institute of Environmental Health Sciences*

New HEI Research Committee Members

The HEI Board of Directors recently appointed three new members to the Health Research Committee: Jeffrey R. Brook, a senior research scientist in the Air Quality Research Division of Environment Canada, and an assistant professor at the University of Toronto, Canada; Ivan Rusyn, a professor in the Department of Veterinary Integrative Biosciences at Texas A&M University; and Amy H. Herring, the Carol Remmer Angle Distinguished Professor of Children's Environmental Health, and associate chair in the Department of Biostatistics, Gillings School of Global Public Health, University of North Carolina–Chapel Hill.


Jay Mallin
Jeffrey R. Brook


Jay Mallin
Ivan Rusyn


Amy H. Herring

Roger D. Peng
Associate Professor, Department of Biostatistics, *Johns Hopkins Bloomberg School of Public Health*

Armistead Russell
Howard T. Tellepsen Chair of Civil and Environmental Engineering, School of Civil and Environmental Engineering, *Georgia Institute of Technology*

Lianne Sheppard
Professor of Biostatistics, School of Public Health, *University of Washington–Seattle*

PUBLICATIONS 2014–2015

***Unpublished report**
JULY 2014
Impact of Outdoor Air Pollution on Children's Health in Taiwan
Yungling Leo Lee

Research Report 182
NOVEMBER 2014
Synergistic Effects of Particulate Matter and Substrate Stiffness on Epithelial-to-Mesenchymal Transition
Thomas H. Barker

Request for Applications 14-3
Assessing Health Effects of Long-Term Exposure to Low Levels of Ambient Air Pollution
Health Effects Institute

Request for Applications 14-4
Walter A. Rosenblith New Investigator Award
Health Effects Institute

Research Report 184
JANUARY 2014
Advanced Collaborative Emissions Study (ACES): Lifetime Cancer and Non-Cancer Assessment in Rats Exposed to New-Technology Diesel Exhaust

Part 1. Assessment of Carcinogenicity and Biologic Responses in Rats After Lifetime Inhalation of New-Technology Diesel Exhaust in the ACES Bioassay
Jacob D. McDonald

Part 2. Assessment of Micronucleus Formation in Rats After Chronic Exposure to New-Technology Diesel Exhaust in the ACES Bioassay
Jeffrey C. Bemis

Part 3. Assessment of Genotoxicity and Oxidative Damage in Rats After Chronic Exposure to New-Technology Diesel Exhaust in the ACES Bioassay
Lance M. Hallberg

Part 4. Assessment of Plasma Markers and Cardiovascular Responses in Rats After Chronic Exposure to New-Technology Diesel Exhaust in the ACES Bioassay
Daniel J. Conklin and *Maiying Kong*

Strategic Plan
APRIL 2015
HEI Strategic Plan for Understanding the Health Effects of Air Pollution, 2015–2020
Health Effects Institute

***Unpublished report**
JUNE 2015
Immune Effects of Episodic Ozone and Particulate Matter Exposure During Postnatal Development
Fern Tablin

Research Report 183
JUNE 2015
Development of Statistical Methods for Multipollutant Research

Jay Mallin

Lydia Contreras, University of Texas–Austin, receives the Walter A. Rosenblith New Investigator Award from David Eaton, chair of the HEI Research Committee.

Part 1. Statistical Learning Methods for the Effects of Multiple Air Pollution Constituents
Brent A. Coull

Part 2. Development of Enhanced Statistical Methods for Assessing Health Effects Associated with an Unknown Number of Major Sources of Multiple Air Pollutants
Eun Sug Park

** Not published, but available upon request.*

ONGOING STUDIES AND REPORTS UNDER REVIEW 2014-2015 AND IN PRESS

DIESEL

*Diesel emissions and lung cancer: an evaluation of recent epidemiological evidence for quantitative risk assessment. *HEI Diesel Epidemiology Panel*

HEALTH OUTCOMES

*The effects of policy-driven air quality improvements on children's respiratory health. *Frank Gilliland, University of Southern California*

Improvements in air quality and health outcomes among California Medicaid enrollees due to goods movement actions. *Ying-Ying Meng, University of California–Los Angeles*

Impact of emissions changes on air quality and acute health effects in the Southeast, 1993–2012. *Armistead Russell, Georgia Institute of Technology*

*Causal inference methods for estimating long-term health effects of air quality regulations. *Corwin Zigler and Francesca Dominici, Harvard University*

OIL AND NATURAL GAS DEVELOPMENT

*Strategic research agenda on the potential impacts of 21st century oil and gas development in the Appalachian region and beyond. *HEI Special Scientific Committee on Unconventional Oil and Gas Development in the Appalachian Basin*

OZONE

Effects of ozone in human volunteers exposed to low levels of ozone in a laboratory. *John Balmes, University of California–San Francisco; Philip Bromberg, University of North Carolina –Chapel Hill; Mark Frampton, University of Rochester; Paul Stark, New England Research Institute*

*Air pollution and systemic inflammation of autonomic nerves. *Allison Fryer, Oregon Health and Science University*

PARTICULATE MATTER AND AIR POLLUTION

Epidemiology

*Particulate air pollutants, risk of cognitive disorders, and neuropathology in the elderly. *Jiu-Chiuan Chen, University of Southern California*

*Air pollution and adverse pregnancy outcomes in Wuhan, China. *Zhengmin Qian, Saint Louis University*

*Adverse reproductive outcomes and exposures to gaseous and particulate matter air pollution in pregnant women. *Jun Wu, University of California–Irvine*

Emissions and Exposure Assessment

The Hong Kong D3D study: a dynamic three-dimensional exposure model for Hong Kong. *Benjamin Barratt, King's College London*

Enhancing models and measurements of traffic-related air pollutants for health studies using Bayesian melding. *Stuart Batterman, University of Michigan*

Use of real-time sensors to assess misclassification and to identify main sources contributing to peak and chronic exposures. *Juana Maria Delgado-Saborit, University of Birmingham*

Characterizing the determinants of vehicle traffic emissions exposure: measurement and modeling of land-use, traffic, transformation and transport. *Christopher Frey, North Carolina State University*

Chemical and physical characterization of non-tailpipe and tailpipe emissions at 100 locations near major roads in the Greater Boston area. *Petros Koutrakis, Harvard University*

*Analysis of personal and home characteristics associated with the elemental composition of $PM_{2.5}$ in indoor, outdoor, and personal air in the RIOPA study. *Patrick Ryan, University of Cincinnati*

Developing multipollutant exposure indicators of traffic pollution: the Dorm Room Inhalation to Vehicle Emissions (DRIVE) study. *Jeremy Sarnat, Emory University*

Evaluation of alternative sensor-based exposure assessment method. *Edmund Seto, University of Washington*

Real-world vehicle emissions characterization for the Shing Mun Tunnel in Hong Kong and Ft. McHenry Tunnel in the U.S. *Xiaoliang Wang, Desert Research Institute*

Mechanisms of Health Effects

Understanding the impact of air quality on the changing chemistry of ribonucleic acid. *Lydia Contreras, University of Texas–Austin*

Air quality by genomics interactions in a cardiovascular disease cohort. *William Kraus, Duke University*

Composition and oxidative properties of particulate matter mixtures: effects of particle phase state, acidity, and transition metals. *Nga Lee (Sally) Ng, Georgia Institute of Technology*

Development of a new method for measurements of reactive oxygen species associated with $PM_{2.5}$ exposure. *Richard Peltier, University of Massachusetts–Amherst*

Report in the HEI review process as of June 30, 2015.

*Ambient and controlled particle exposures as triggers for acute ECG changes, and the role of antioxidant status. *David Rich, University of Rochester, and Annette Peters, Helmholtz Zentrum München, Germany*

Understanding the health effects of isoprene-derived particulate matter enhanced by anthropogenic pollutants. *Jason Surratt, University of North Carolina–Chapel Hill*

STATISTICAL METHODS

*Modeling of multi-pollutant profiles with applications to RIOPA study data and indicators of adverse birth outcomes using data from the UCLA Environment and Pregnancy Outcome Study. *John Molitor, Oregon State University*

Current and past recipients of the Walter A. Rosenblith New Investigator Award, from left: Juana Maria Delgado-Saborit, University of Birmingham, United Kingdom; Richard Peltier, University of Massachusetts–Amherst; Nga Lee (Sally) Ng, Georgia Institute of Technology; Jason Surratt, University of North Carolina–Chapel Hill; Lydia Contreras, University of Texas–Austin; and Jun Wu, University of California–Irvine.

John Wall, vice president and chief technical officer of Cummins, receiving a plaque from HEI President Dan Greenbaum inscribed with appreciation for his "35 years of dramatic progress toward clean air."

Christopher Grundler, U.S. EPA, luncheon keynote speaker at HEI's 2015 Annual Conference.

Photos by Jay Mallin

FINANCIAL SUMMARY
2014–2015

HEI made significant progress in fiscal year 2015 on initiatives in our Health Effects of Air Pollution program and our global efforts. These activities were made possible by our core sponsors with additional funding from government, industry, and foundations. We also moved forward with our Shale Gas activities, supported by separate funding. Our goal continues to be to make maximum use of our resources for funding scientific expenditures.

Statements of Financial Position

	June 30	
	2015	**2014**
Assets		
Cash and cash equivalents	$607,313	$358,596
Restricted cash	147,099	146,978
Contributions receivable	325,714	333,275
Unbilled incurred costs on grants	2,265,382	2,130,454
Prepaid expenses	5,196	109,442
Office equipment, office furniture and fixtures, and leasehold improvements, net	57,500	77,935
Total assets	**$3,408,204**	**$3,156,680**
Liabilities and Net Assets		
Liabilities:		
Contracted research payables	$1,724,398	$463,064
Accrued contracted research	790,000	884,607
Estimated contracted research	798,266	—
Other accounts payable and accruals	400,000	511,644
Line of credit	—	—
Total liabilities	**$3,712,664**	**$1,859,315**
Unrestricted net assets:		
Operating	(304,460)	173,340
Board-designated reserve fund	—	657,645
	(304,460)	830,985
Temporarily restricted net assets:	—	466,380
Total net assets	**(304,460)**	**1,297,365**
Total liabilities and net assets	**$3,408,204**	**$3,156,680**

The HEI Financial Statement and the Mayer Hoffman McCann P.C., Tofias New England Division Auditors' Report may be obtained by contacting Jacqueline C. Rutledge at jrutledge@healtheffects.org.

Statements of Activities

	Year Ended June 30	
	2015	2014
Assets		
Revenues and support:		
EPA grants for Health Effects of Air Pollution program	$4,365,382	$4,000,000
Industry contributions	4,096,236	4,101,564
U. S. Department of Energy grants for ACES program	—	100,000
U. S. Federal Highway Administration grants	6,778	34,838
Non-federal grant and contract revenue	562,275	200,000
Shale Gas foundation support	525,000	650,000
Other revenues	45,978	197,618
Total revenues and support	**$9,601,649**	**$9,284,020**
Expenses:		
Research programs:		
Research studies	$5,298,942	$4,713,734
Research planning and study selection	552,017	633,562
Scientific study management	303,282	286,303
Scientific study review	411,437	315,390
Scientific publication and communication	895,812	1,174,845
	7,461,490	7,123,834
Special scientific projects:		
Air Quality	24,161	60,023
Diesel Epidemiology	247,867	301,352
Shale Gas	535,008	170,487
Global Health Science	477,678	197,498
	1,284,714	729,360
Total research and scientific expenses	8,746,204	7,853,194
Administration	2,457,270	2,285,592
Total expenses	**11,203,474**	**10,138,786**
Net increase (decrease) in net assets	**(1,601,825)**	**(854,766)**
Net assets at beginning of year	**1,297,365**	**2,152,131**
Net assets at end of year	**$(304,460)**	**$1,297,365**

SPONSORS 2014–2015

Melissa Ostrow

Susan Collet of Toyota, Bryan Hubbell of the U.S. EPA, and Howard Feldman of the American Petroleum Institute at the 2015 HEI sponsors meeting.

CORE SPONSORS

U.S. Environmental Protection Agency

Office of Research and Development

- *National Center for Environmental Research*
- *National Health and Environmental Effects Research Laboratory*
- *National Center for Environmental Assessment*

Office of Air and Radiation

- *Office of Air Quality and Planning Standards*
- *Office of Transportation and Air Quality*
- *Office of Atmospheric Programs*
- *Office of Radiation and Indoor Air*

Office of International Affairs

MOTOR VEHICLE INDUSTRY

BMW of North America, LLC

Caterpillar, Inc.

Chrysler, LLC

Cummins Engine Company

Daimler AG

Detroit Diesel Corporation

Ford Motor Company

General Motors Corporation

Hino Motors, Ltd.

American Honda Motor Company, Inc.

Hyundai America Technical Center, Inc.

Isuzu Motors, Ltd.

Jaguar Land Rover North America, LLC

John Deere and Company

KIA Motors America, Inc.

Mazda Motor Corporation

Mitsubishi Motors Corporation

Navistar

Nissan Motor Company, Ltd.

PACCAR, Inc.

Subaru Research and Development, Inc.

Toyota Motor Corporation

Volkswagen of America, Inc.

Volvo Cars of North America, LLC

Volvo Powertrain North America

OTHER SPONSORS

Claude Worthington Benedum Foundation

Conservation of Clean Air and Water in Europe (CONCAWE)

Exxon Mobil

William and Flora Hewlett Foundation

Henry L. Hillman Foundation

Richard King Mellon Foundation

Oak Foundation

The Pittsburgh Foundation

U.S. Federal Highway Administration

REPORT CREDITS

Writing
Elizabeth Dougherty

Art Direction/Design
Glenn Ruga

Project Management and Editing
Hilary Selby Polk

Printing
Quad Graphics, Inc., Woburn, MA

UL ECOLOGO
PRODUCT CERTIFIED FOR REDUCED ENVIRONMENTAL IMPACT. VIEW SPECIFIC ATTRIBUTES EVALUATED: UL.COM/EL
UL 2771

Printed using UV inks on 100% post-consumer recycled fiber. UV inks cut down on volatile organic compounds produced during the printing process.

HEI STAFF AND BOARD OF DIRECTORS
2014–2015

OFFICERS AND STAFF

Daniel S. Greenbaum
President

Robert M. O'Keefe
Vice President

Rashid Shaikh
Director of Science

Jacqueline C. Rutledge
Director of Finance and Administration

April Rieger
Corporate Secretary

Zachary Abbott
Research Assistant

Hanna Boogaard
Staff Scientist

Sarah Benckart
Science Administration Assistant

Adam Cervenka
Research Assistant

Aaron J. Cohen
Principal Scientist

Maria G. Costantini
Principal Scientist

Philip J. DeMarco
Compliance Manager

Hope Green
Publications Associate

Anny Luu
Administrative Assistant

Hilary Selby Polk
Managing Editor

Evan Rosenberg
Staff Accountant

Robert A. Shavers
Operations Manager

Geoffrey H. Sunshine
Senior Scientist

Annemoon M.M. van Erp
Managing Scientist

Donna J. Vorhees
Senior Scientist

Katherine Walker
Senior Scientist

Jay Mallin

HEI Board of Directors: (standing left to right) Michael Clegg, Richard Celeste (chair), Jared Cohon, and Henry Schacht; (sitting left to right) Purnell Choppin, Enriqueta Bond, Linda Rosenstock, and Sherwood Boehlert (not pictured, Stephen Corman and Warren M. Washington).

BOARD OF DIRECTORS

Richard F. Celeste, *Chair*
President Emeritus, Colorado College

Sherwood Boehlert
Of Counsel, Accord Group; Former Chair, U.S. House of Representatives Science Committee

Enriqueta Bond
President Emerita, Burroughs Wellcome Fund

Purnell W. Choppin
President Emeritus, Howard Hughes Medical Institute

Michael T. Clegg
Donald Bren Professor of Biological Sciences, University of California–Irvine

Jared L. Cohon
President Emeritus and Professor, Civil and Environmental Engineering and Engineering and Public Policy, Carnegie Mellon University

Stephen Corman
President, Corman Enterprises

Linda Rosenstock
Dean Emerita and Professor of Health Policy and Management, Environmental Health Sciences and Medicine, University of California–Los Angeles

Henry Schacht
Managing Director, Warburg Pincus; Former Chairman and Chief Executive Officer, Lucent Technologies

Warren M. Washington
Senior Scientist, National Center for Atmospheric Research; Former Chair, National Science Board

---

Archibald Cox
Founding Chair, 1980–2001

Donald Kennedy
Vice Chair Emeritus, 1980–2003; Editor-in-Chief Emeritus, Science

HEALTH EFFECTS INSTITUTE
101 Federal Street, Suite 500
Boston, MA 02110-1817
USA
Phone: + 1 617 488 2300
Fax: 1 617 488 2335
www.healtheffects.org