AAPCA Fall Business Meeting

August 27, 2019

Update on Air Quality Research at the Health Effects Institute (HEI)

Session: Air Quality Research & Health Science Updates

Overview of Presentation

1. HEI and its Mission
2. HEI's Research
   → Air Pollution (Original science, reviews, and reanalyses)
   → Accountability (Do air regulations work?)
   → Global Health (Air quality impacts and trends around the world)
3. New Venture: HEI-Energy

HEI's Mission and Research

Mission

Since 1980, providing impartial, high-quality science on health effects of air pollution to inform often controversial decisions

Funding

- Government (U.S. EPA) and Industry (Worldwide Vehicle and Engine Manufacturers)
- Also expanded partnerships with:
  - European Union, WHO, California, other agencies
  - Oil, chemical, and other industries
  - Foundations and Development Banks (Global Work)

HEI energy

HEI is Structured for Credibility and Transparency

Independence

- Board and Expert Science Committees are not affiliated with sponsors
- Scientific Research Committee selects all research competitively
- Separate Scientific Review Committee intensively peer reviews all results

Data Access

All results and data – both positive and negative reported

HEI does *not* take policy positions

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Air quality research topics

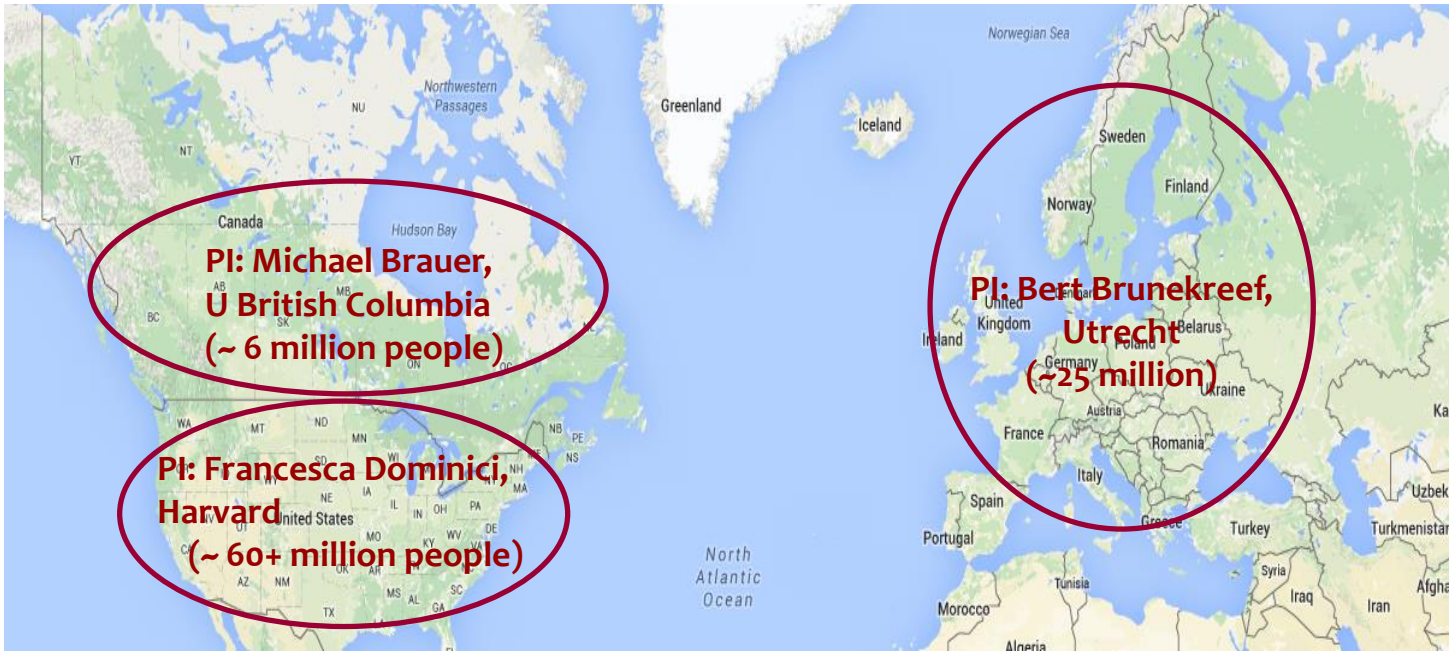
- Effects of low-level chemical concentrations in air
- Traffic-related air pollution: exposure and health
- Non-tailpipe emissions and exposures near roadways and in tunnels

Just a few examples…

For more information about all research:

www.healtheffects.org

Estimating the health effects of exposure to low-level chemical concentrations in air



- Satellite data and ground level exposure measurements
- High quality exposure assessment models at high spatial resolutions
- Development and application of novel statistical methods
- *HEI oversight*: Progress reports every 5 months, QA/QC audits, etc.

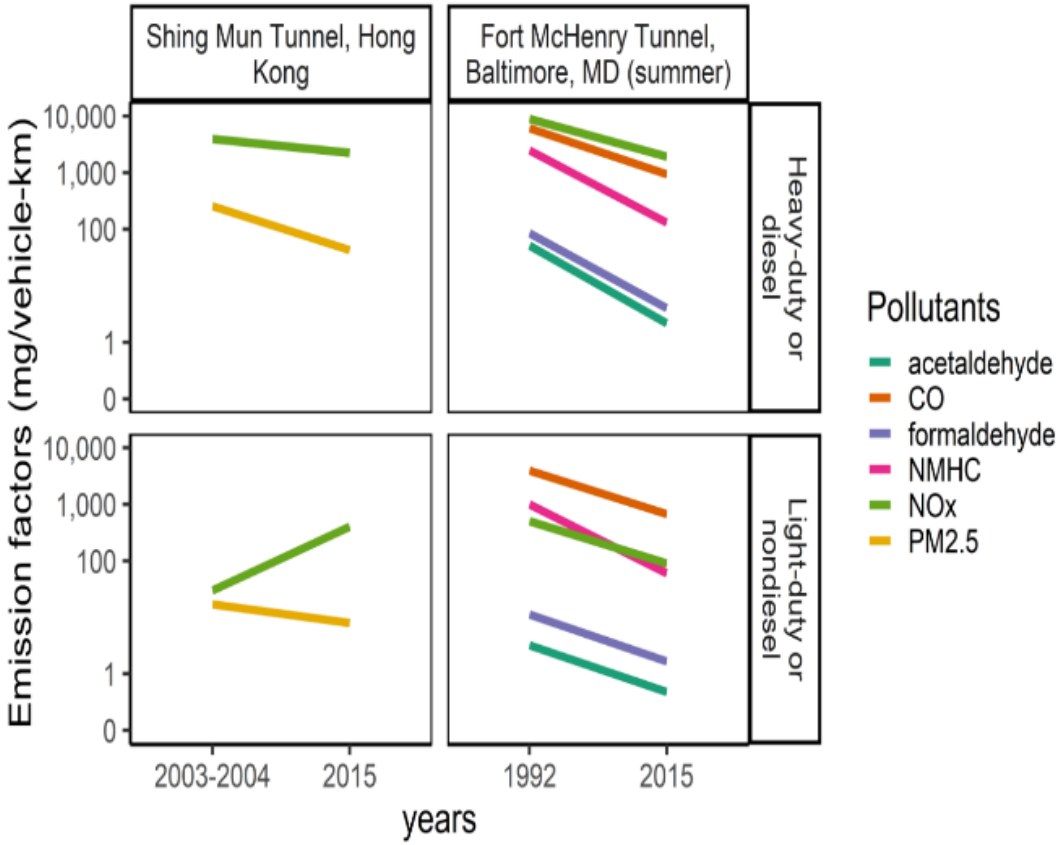
Review of the Traffic Literature

- HEI published a comprehensive review in 2010
- Following up on this review:
  - A new HEI panel is *systematically* evaluating the epidemiological evidence about the associations between long–term exposure to traffic-related air pollution and selected adverse health outcomes
  - After peer-review, target publication in late 2020

HEI energy

Vehicle emissions in tunnels in Hong Kong and Baltimore

- In 2015, both tunnels had lower emissions from light-duty and heavy-duty vehicles for most pollutants compared to earlier studies in the same tunnels
- Data will be made available



From Wang et al., 2019 (in press)

The Next Phase of HEI Traffic Research

Non-tailpipe emissions and noise and children's respiratory health

- Building on the Children's Health Study in *Southern California* (N=5000); includes non-tail pipe emissions

USC University of Southern California

Intersections as hot spots: Assessing the contribution of localized non-tailpipe emissions and noise on the association between traffic and children's health

Meredith Franklin, Rob McConnell, Robert Urman, Scott Fruin

University of Southern California, Los Angeles, CA

Particulate Matter Air Pollution: The Intra-Community Variability (ICV) Study

In the eight Southern California communities, monitoring of quasi-ultrafine (<0.2 um), fine and coarse (2.5 to 10 um) PM was conducted using modified Harvard Cascade Impactors at homes and schools of participating children in month-long integrated samples in the cool (Oct-Mar) and warm (Apr-Sep) seasons. Chemical speciation was conducted on each size fraction, providing a unique spatially rich dataset (Figure 2). For more detail see Fruin et al. [1]

Noise

The most recent version of the U.S. Federal Highway Administration (FHWA) Traffic Noise Model (TNM) version 2.5 uses roads, traffic volume, posted road speeds, pavement type, and vehicle type (cars, heavy trucks, light trucks, buses and motorcycles) to estimate traffic noise in decibels (Figure 3). We will supplement the modeled data with measurements at different road types and intersections in the 8 ICV communities using two 2238 MediatorTM, Class 1 Integrating Sound Level noise meters manufactured by Brüel & Kjær.

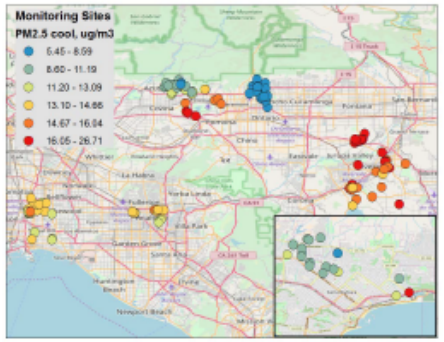


Figure 2. Map of study region: the ICV

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Scalable exposure assessment using routine mobile monitoring platforms

- Josh Apte (University of Texas, Austin): Builds on and furthers research in West Oakland, and applications in Bengaluru, India

What Can We Learn From Mobile Air Pollution Measurements?
Validation, Comparison, and Data Mining

The 100×100 Study: comparing mobile and fixed measurements

In Summer 2017, more than 100 fixed-site black carbon (BC) samplers were deployed for 100 days in West Oakland, CA. Monitors were sited at a mixture of residential and commercial properties. Sampling sites were chosen to incorporate a diverse array of land uses, including upwind sites and locations near industries, busy roads, and a major port. Measurements were made using a novel low-cost light absorption BC sensor, the Aerosol Black Carbon Detector (ABCD, Caubel et al., 2018), which was extensively validated against reference techniques.

During the 100×100 campaign, two Google Street View (GSV) cars repeatedly sampled every city street in West Oakland on 35 distinct days, collecting over 330 h of measurements, and repeatedly passing each of the fixed ABCD monitoring sites. We devised three approaches to comparing mobile and fixed measurements:

• **Laboratory co-location**: We co-located 3 ABCD sensors next to the night-time parking

Source identification: temporal and chemical signatures

Using existing data collected with Google Street View cars in Oakland, we will test whether we can identify spatial and temporal emissions source signatures by applying time series data mining techniques to mobile measurements. For example, Figure 3 separates local traffic emissions peaks from the ambient background. To validate these findings, we will compare data-mined patterns to a spatially resolved PM$_1$ source apportionment derived from a specially equipped mobile laboratory with a high-resolution aerosol mass spectrometer (HR-AMS) that was used in Oakland in concert with the GSV cars in Summer 2017 (Figure 4-5).

Figure 4. As part of the EPA Center for Air, Climate and Energy Solutions, Carnegie Mellon's "Breathemobile" mobile lab joined the Oakland sampling campaign in Summer 2017.

Figure 3. Identification of localized concentration peaks using time-resolved GSV measurements. a. Example 10 min time series of NO and NO$_2$. Baseline fitting algorithm decomposes measurements (solid traces) into an ambient

New Request for Applications:

Applying novel approaches to improve long-term exposure assessment of outdoor air pollution for health studies

- Origin: A lot of interest in new (low-cost) sensors; and their applications for community science
- HEI's Interest: How to harness new technologies for more precise health studies
- Schedule: Studies begin 2020

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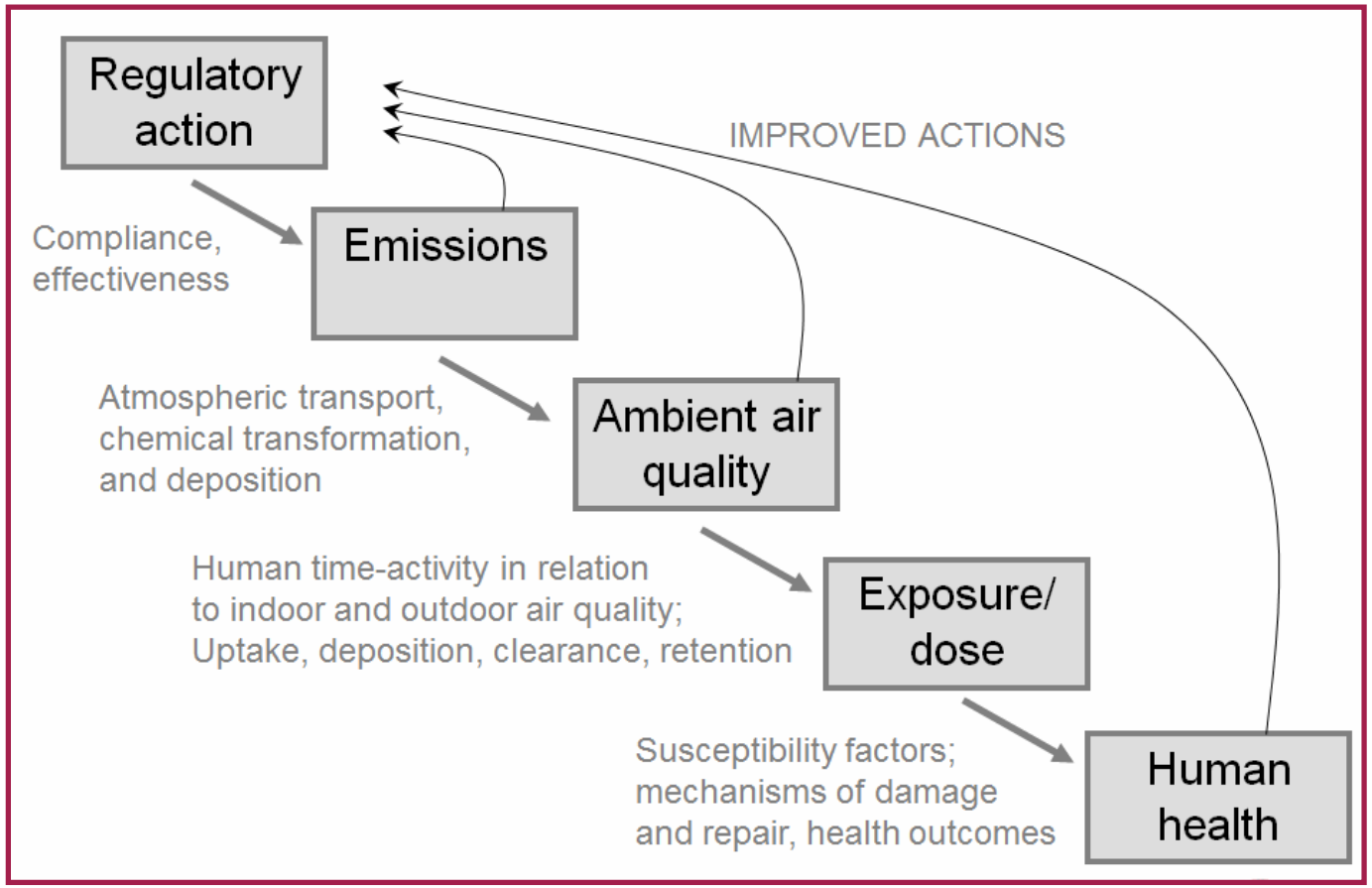
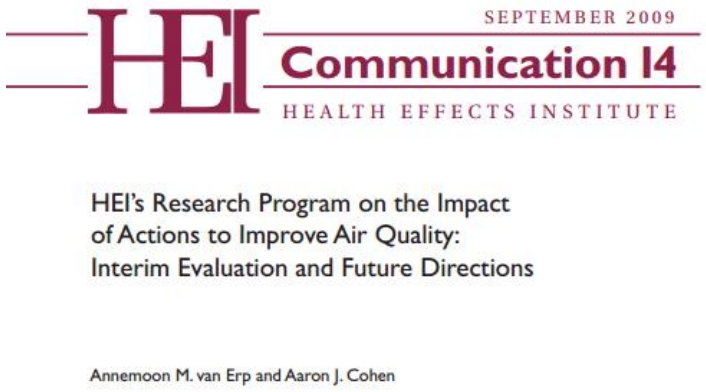
Accountability Research

Showing relationship of regulatory action to health effects of air pollution



Accountability Research at HEI



15+ publications; four examples of studies on large-scale, multi-year regulatory programs

Some examples…

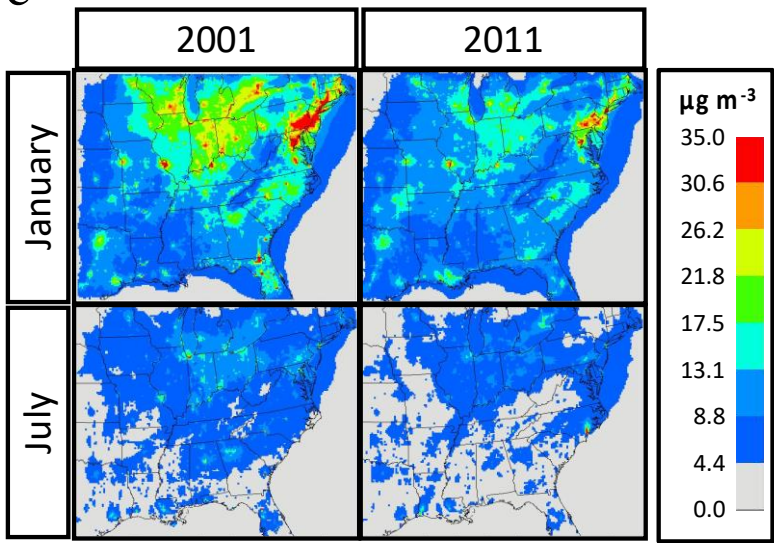
Latest Published Study

Impacts of Federal and State Regulation of Power Plants and Mobile Sources on Emissions, Air Quality and Emergency Department Visits

Methods: Compared actual conditions during 1999–2013 to estimated quantitative projections (counterfactual scenarios) of emissions, air quality, and ED visits that would have occurred in the absence of regulation

Results:

- Emissions and air concentrations decreased
- Fewer ED visits for asthma and other respiratory conditions vs. scenarios without regulation
- Regulations targeting power plants appeared more effective in improving air quality than those targeting mobile sources



Russell et al. 2018: *Substantial PM reductions in SE United States*

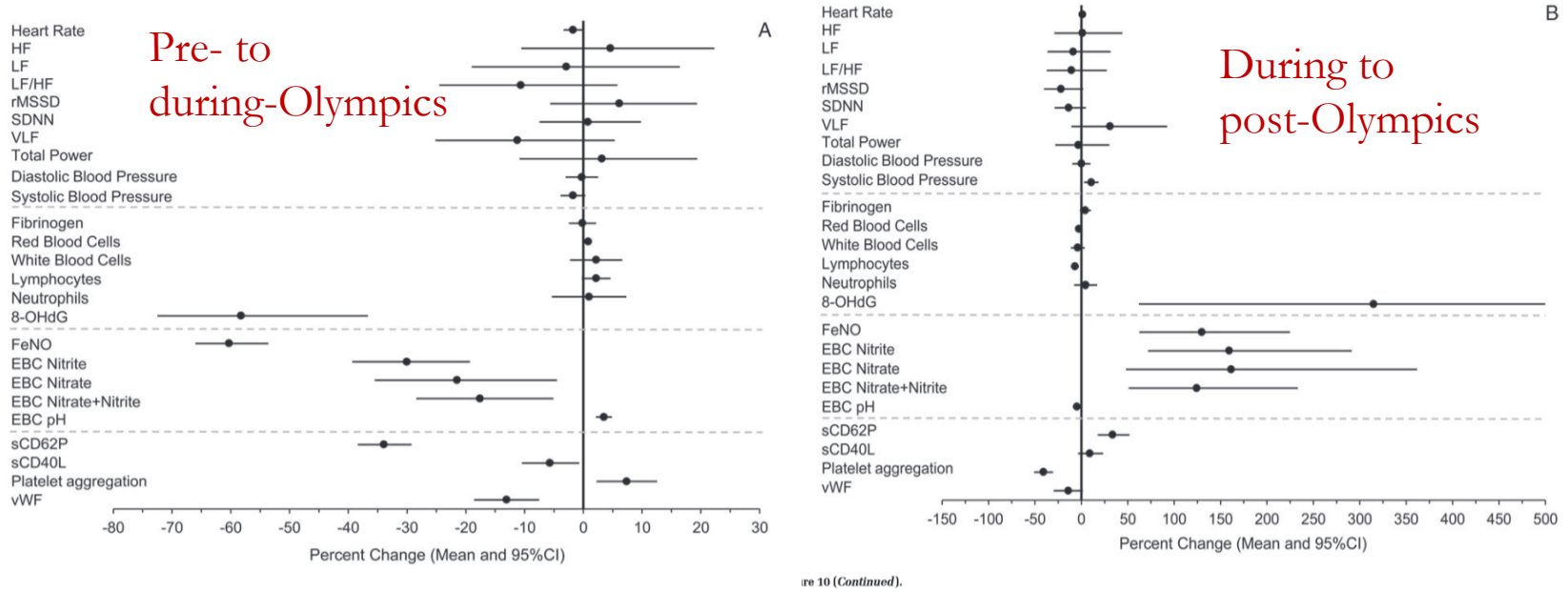
A Short Term Study
2008 Olympic Games (Beijing)

PI: Jim Zhang, University of Medicine and Dentistry of New Jersey

Chinese government mandated rules to control traffic and industrial sources in period leading up to and during the July Olympic Games

-Follow medical students before, during, and after Olympics to measure blood coagulation, systemic inflammation, and other endpoints

Changes in Biomarkers



ıre 10 (*Continued*).

Along with decreased air concentrations, decreases in markers of:

- Coagulation in blood (sCD62P and vWF)
- Airway Inflammation (FeNO, EBC pH, nitrite, and nitrate)
- Activation of oxidative stress (urinary 8-OHdG)

Unexpected Increase:

- Platelet aggregation

No Changes

- HRV markers

New Request for Applications to Conduct Accountability Research

- "Assessing improved air quality and health from national, regional, and local air quality actions"
- Areas of particular interest:
  - Long-term, complex regulatory programs
  - Interventions at the local level
  - Ports and global transport
  - Methods development
- 3 to 5 studies to begin in 2020; total $5 to 6 million for the program

Looking Ahead to More Accountability Research

- Provides a useful construct to assess the effectiveness of regulatory actions
- Important to pursue unique opportunities (intentional and unintentional)
- Regulatory changes often overlap with health and environmental changes and trends; important – and difficult – to dissect these out
- Consider how accountability studies can provide stronger tests of causal relations and contribute to scientific research on health effects of specific sources

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STATE OF GLOBAL AIR /2019

A SPECIAL REPORT ON GLOBAL EXPOSURE TO AIR POLLUTION AND ITS DISEASE BURDEN

Report and interactive web site:

- What is the level of the air quality in each country and what effects is it having?
- How does it compare to neighboring countries?
- What are the trends since 1990? (With annual updates)

More information: www.stateofglobalair.org

Contact us: contactsoga@healtheffects.org

HEI IHME Measuring what matters UBC TEXAS The University of Texas at Austin

Funded by Bloomberg Philanthropies and the William and Flora Hewlett Foundation.

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State of Global Air

Our goal: To make data accessible

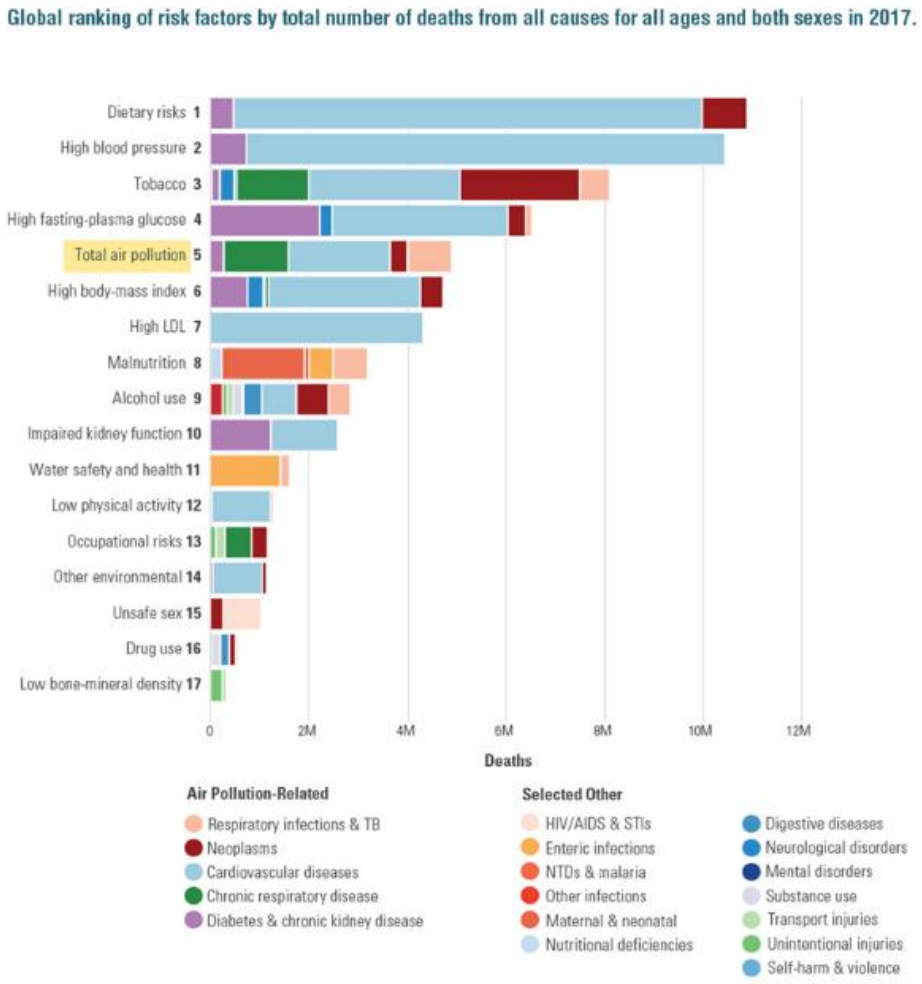
Exposure

Health Impacts

- Mortality
- Disability Adjusted Life Years – a measure of years of healthy life lost
- Age-adjusted mortality and DALY rates
- Life expectancy at birth

State of Global Air 2019

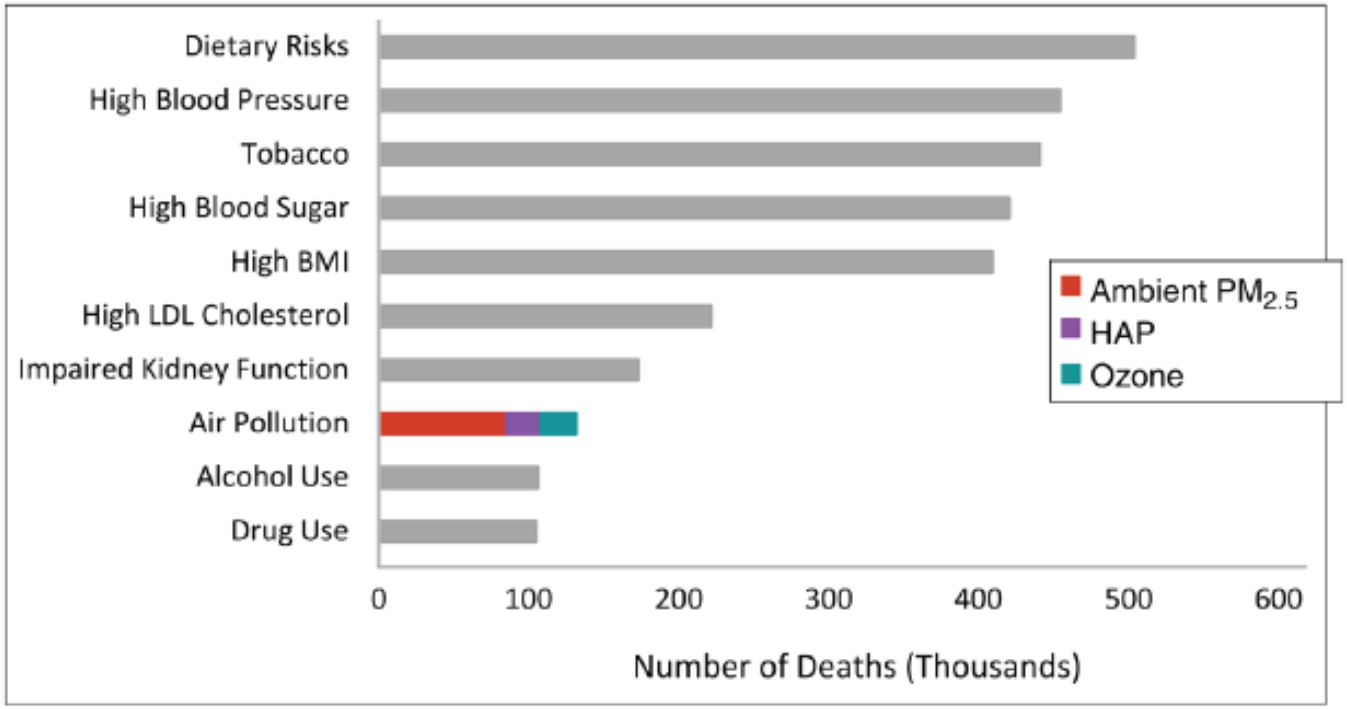
Air Pollution the 5th Highest Risk Factor Globally



State of Global Air 2019

Air Pollution as a Risk Factor in the United States

Leading risk factors for death and disability in the United States in 2017.



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HEI Energy Research Program

Purpose:

A new national research program, focused initially on two critical topics:

- Measure population exposures (such as from potential air and water exposure pathways) in major unconventional oil and natural gas-producing regions across the United States
- Assess the potential health effects that might result from exposures (as feasible and appropriate based on findings from the exposure studies)

Supported by balanced funding from Industry and Government

HEI Energy Research Committee

George Hornberger
Vanderbilt University

Shari Dunn-Norman
Missouri University

Howard Hu
University of Washington

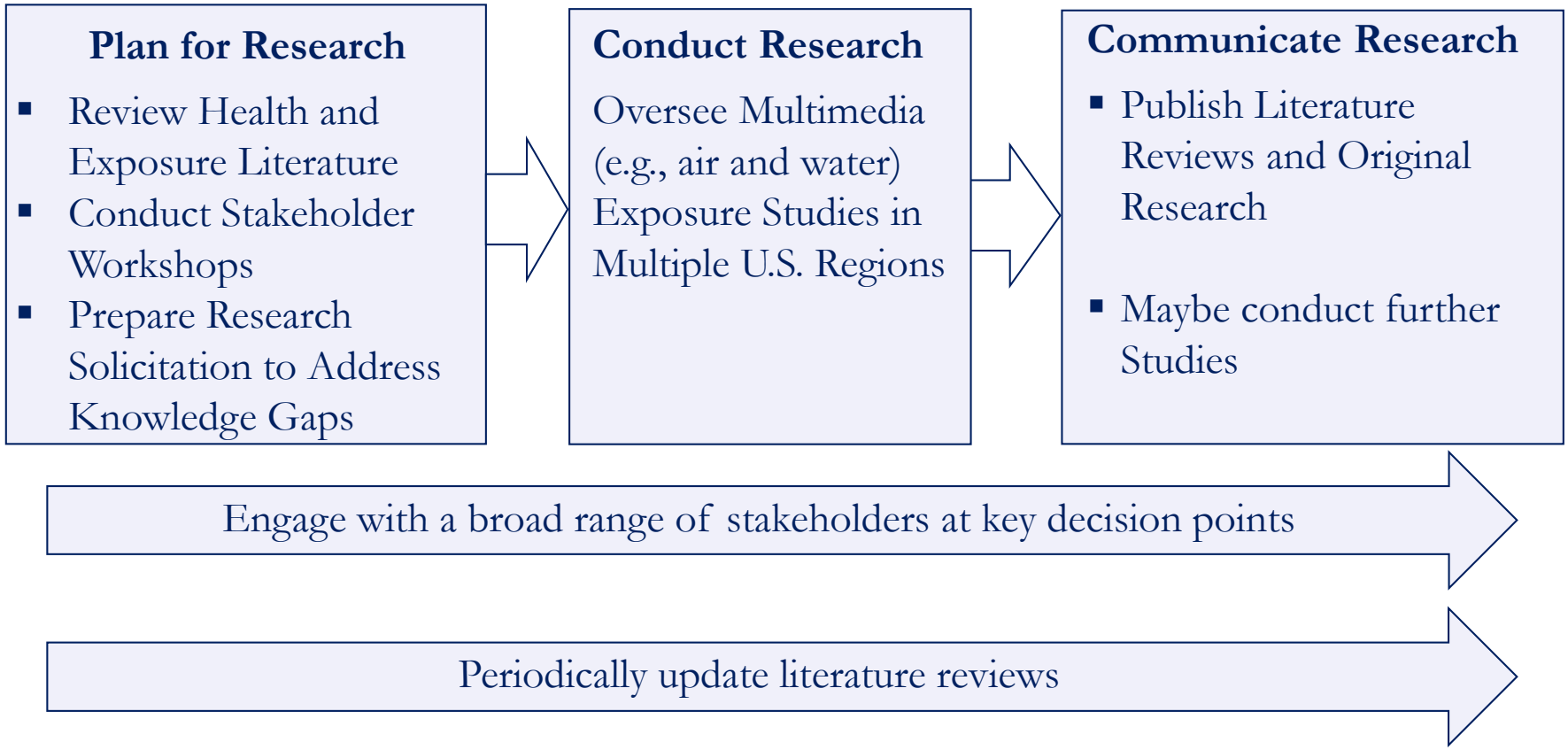
Judy S. LaKind
LaKind Associates and University of Maryland

Armistead (Ted) G. Russell
Georgia Institute of Technology

Stefanie Ebelt Sarnat
Emory University

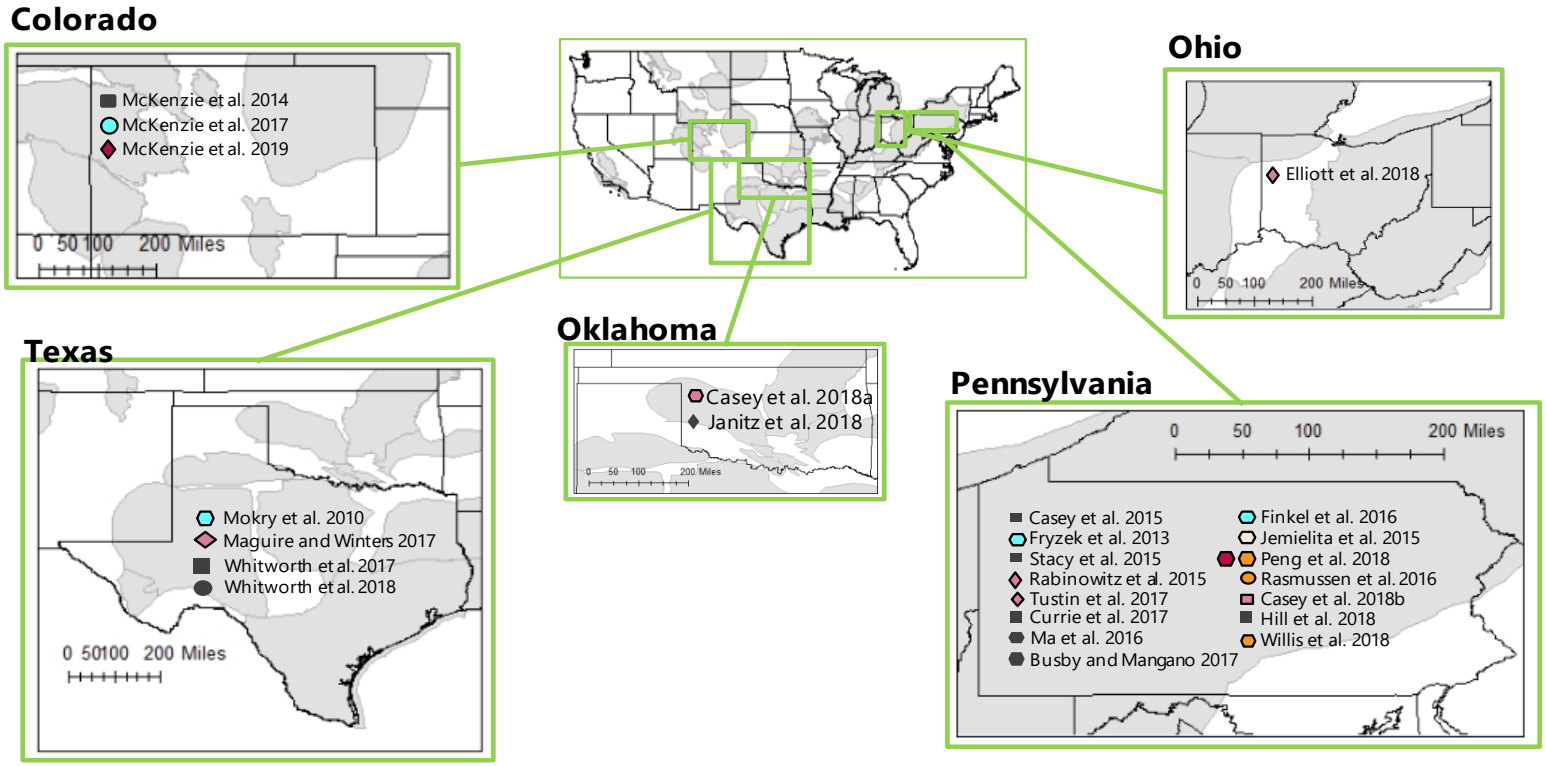
Peter Thorne
University of Iowa

Vision for a Multi-Year Energy Research Program



Planning for Research

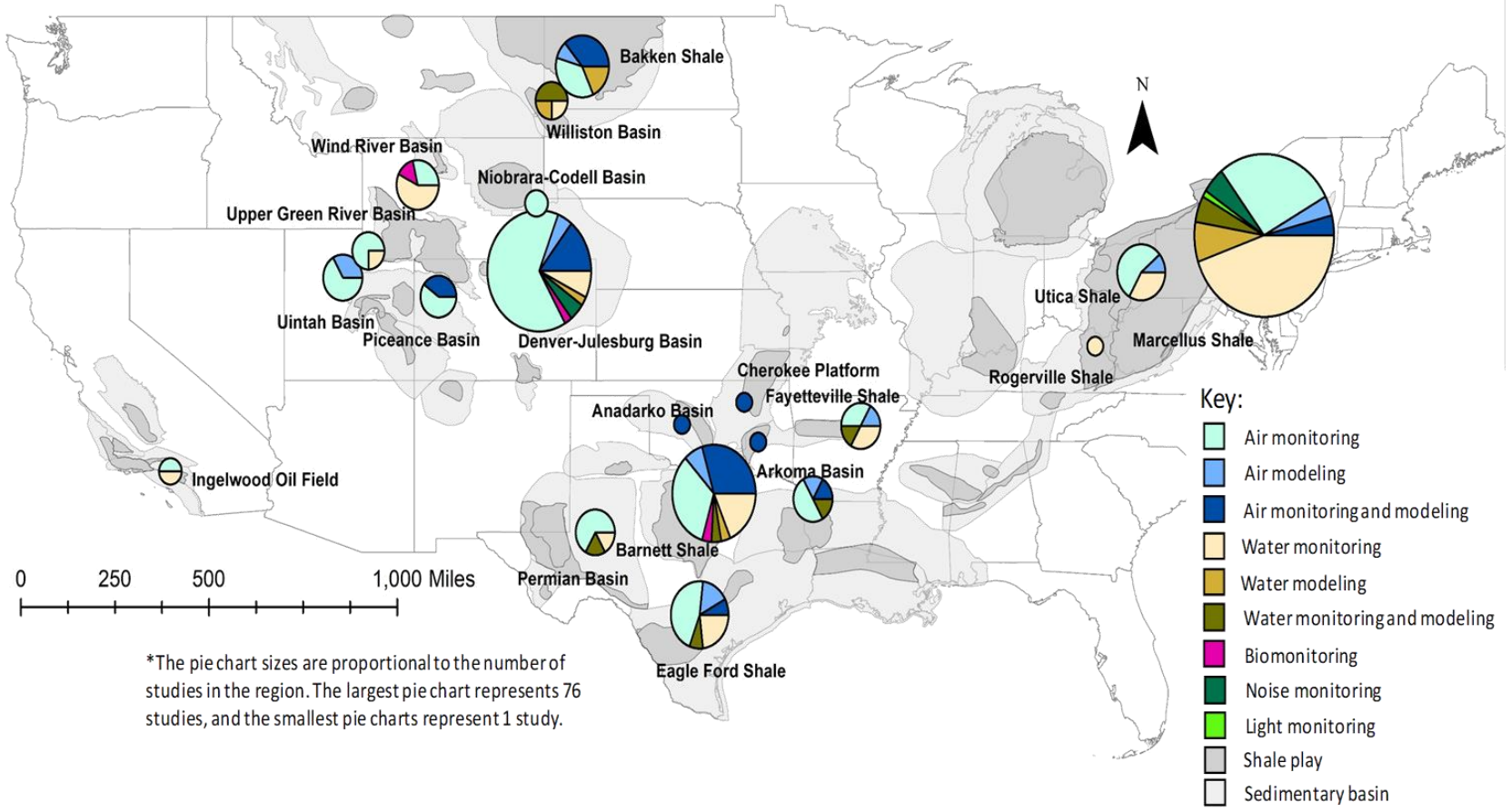
Systematic Review of Epidemiology Literature



Study Design	Outcome Assessed	
Retrospective Cohort	Perinatal	Shale Play
Case-Control	Cancer	
Cross-Sectional	Respiratory	
Ecological	Cardiovascular	
	Symptoms	
	Other	

Planning for Research

Survey of Exposure Literature



Planning for Research

Recommendations for Research from Workshop Participants

- Study community-based exposures
- Capture heterogeneity across populations, operations and regions and over time as industry practices change
- Conduct exposure characterization of chemical and non-chemical agents using quantifiable measures
- Distinguish between UOGD and non-UOGD sources
- **Provide information that is useful to regulators**
- Leverage partnerships among multiple expert groups

Planning for Research

HEI-Energy's Research Solicitation

- Fund exposure research in multiple oil- and gas-producing regions of the United States
- Address the most important knowledge gaps about potential community exposures to UOGD (e.g., useful to decision-making by regulators, communities, operators, etc.)
- Establish a clear link between UOGD and measures of exposure:

Planning for Research

Workshops in Study Areas Before Research Begins

Next Steps

- Complete reviews of the health and exposure literature related to UOGD ***(public release Sep 2019)***
- Seek public comment on the exposure literature review to inform preparation of the Research Solicitation ***(online comments solicited Sep 2019)***
- Prepare a Research Solicitation for population-level exposure research - what, where, and how ***(public release Dec 2019)***

More information: www.hei-energy.org

Contact us: energy@healtheffects.org

Thank you

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