



Health Effects Institute

DRAFT

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STRATEGIC RESEARCH PLAN

2025–2030

Strategic Research Plan 2025–2030

Health Effects Institute

Boston, Massachusetts

CONTENTS

SUMMARY	3
THE HEALTH EFFECTS INSTITUTE	4
HIGHLIGHTS FROM 2020–2025	11
THE CHALLENGES AHEAD	19
STRATEGIC PLANNING PROCESS	20
MAJOR THEMES FOR 2025–2030	21
MEETING THE CHALLENGES AHEAD	29
ACRONYMS AND ABBREVIATIONS	30
HEI BOARD, COMMITTEES, and STAFF	31

SUMMARY

As the effects of climate change accelerate and the world responds by transitioning its energy supply and systems, the distribution and type of environmental risks to human health are changing. In parallel, major transitions are underway to decarbonize the transportation sector. These changes are disrupting the balance of many traditional drivers of environmental quality. Some changes, such as technological advances, bring opportunities to reduce exposures and thus improve health. At the same time, emerging sources of pollution, such as wildland fires, pose new health threats.

These developments amplify the urgency and importance of the work of the Health Effects Institute (HEI). HEI is a nonprofit, independent research organization that provides impartial science to inform decisions that foster a healthier environment and better health for all. With joint funding from government and industry, HEI funds, oversees, and evaluates research with a rigorous model that — applied over more than four decades — has yielded credible research for informing important technology and policy decisions. HEI's research is directed by five-year strategic plans. Implementation of HEI's Strategic Research Plan for 2020–2025 resulted in substantial advances in scientific knowledge as well as methods and use of this knowledge in decision-making, such as setting the U.S. and European Union air quality standards.

Looking ahead, HEI must meet the moment by engaging individuals and organizations with a diversity of expertise and perspectives to address pressing questions with the same rigor and impartiality that have long been its hallmark. Responding to today's evolving economic, social, and technology landscape, HEI's leadership and staff have collaborated with HEI's sponsors, other government officials and industry representatives, community members, and researchers over the course of more than a year to identify key themes and priority research topics.

In this Strategic Plan for 2025–2030, HEI remains committed to its longstanding leadership in providing credible insights into air pollution and health in the United States and around the world. It will continue to refine methods for assessing exposures, investigate air pollution's health effects and underlying biological mechanisms, and assess the efficacy of policies designed to improve air quality and health.

In recognition of the evolving challenges to public health, HEI will take up critical questions about a larger range of environmental exposures that can adversely affect health and investigate those that can benefit health. HEI will simultaneously chart a path to address inequities that have resulted in disproportionate exposures and adverse health outcomes in certain groups; this path includes the development of methods to assess and respond to the totality of exposures experienced by communities. HEI will translate its science using tools and resources that support greater awareness about air pollution, stronger technical capacity, and targeted policy development, including in places that suffer heavy health burdens from air pollution. To support this extensive scope of work, HEI is engaging broadly to expand its base of sponsors and funders.

Taken together, HEI's programs provide an increasingly cohesive and expansive body of credible research that advances its mission to inform health-protective policies. HEI is expanding its role as a leader in advancing public health around the world by anticipating future challenges, needs, and capabilities; investing strategically in the most critical public health issues; and embodying the fundamental values of quality and impartiality that have always driven its work.

THE HEALTH EFFECTS INSTITUTE

Overview: Mission and Programs

HEI is a nonprofit corporation chartered in 1980 as an independent research organization that provides impartial science to inform decisions that foster a healthier environment and better health for all. We achieve our mission by

- funding and supporting policy-relevant scientific research
- convening independent experts to select, oversee, and review scientific research
- bringing together government, industry, nongovernmental organizations, academia, and communities to help guide research priorities
- synthesizing, interpreting, and communicating scientific evidence to audiences in the United States and around the world
- engaging with HEI audiences to facilitate use of its science in decision-making.

Although originally focused on emissions from motor vehicles, HEI has broadened its scope over the past several decades. HEI now fulfills its mission with three programs that provide a complementary body of research to understand exposures and health effects associated with various sources of pollution in different contexts worldwide. HEI's programs also communicate the research to facilitate its use in formulating health-protective policies.

Environment and Health

Since HEI's founding, our primary research program has focused on elucidating the health effects of air pollution and putting the findings into the context of current science and policy discussions. For decades, this research has played a critical role in informing the National Ambient Air Quality Standards (NAAQS) in the United States, and more recently, the air quality directives in Europe. Over the years, our research focus has expanded beyond tailpipe emissions to assess traffic-related air pollution in the context of other pollution sources, such as power plants, indoor sources, and wildland fires. The program has also conducted independent in-depth reviews on the health effects of diesel emissions, traffic pollution, and other topics.

Funding sources: U.S. Environmental Protection Agency and the worldwide automotive industry

Information and products: <https://www.healtheffects.org>

Global Health Initiatives

Since 2002, HEI has built on science from its Environment and Health program to expand its air pollution and health effects initiatives beyond the United States to include areas around the globe. This work ranges from efforts to use available scientific evidence to inform policy action globally to geography-specific initiatives aimed at addressing local science and policy needs and strengthening local capacity. The program's flagship initiative, [State of Global Air \(SoGA\)](#), tracks annual air pollution exposures for fine particles, ozone, and household air pollution in addition

to the burden of disease attributable to air pollution in cities and countries around the world. The program is especially active in Asia and Africa, where several projects apply science to improve understanding of the health effects of air pollution and strengthen local evidence, capacity, and public awareness.

Funding sources: Philanthropies, development agencies, and others

Information and products: <https://www.healtheffects.org/about/global>

Energy and Health

In 2019, HEI initiated its Energy and Health program to improve understanding of potential community exposures and health effects from unconventional oil and gas development in the United States. This development grew rapidly starting in the early 2000s, and along with it, community concerns about its possible effects on their health. This program was formed to provide the impartial science needed to address these concerns. It launched with an extensive planning process that included preparing reviews of the scientific literature, hosting multisector and multidisciplinary workshops to learn about research priorities, and developing an online curated database and spatial bibliography to advance both public and scientific understanding. In 2022, the program awarded its first round of research funding to projects assessing human exposures arising from air emissions, noise, and releases to water from oil and gas development and the cumulative impact of health stressors associated with these activities on communities.

Funding sources: U.S. Environmental Protection Agency, oil and gas industry, and private foundations

Information and products: <http://www.heienergy.org>

In the United States, historically marginalized communities often experience disproportionate levels of environmental exposures and health effects. In 2022, HEI launched its **Program to Reduce Environmental Inequities** to facilitate, support, and fund scientific research, special projects, and research translation that address these environmental inequities. Program activities include convening individuals and organizations that represent multiple sectors, partnering with communities to find solutions to environmental inequities, developing tools and research translation mechanisms for use in decision-making, and tracking progress in reducing exposures.

Taken together, HEI's programs provide a cohesive body of highly credible environmental health research and interpret the research to help guide government and industry actions and inform the broader public about the health effects of pollution (Figure 1). Although each HEI program has a distinct focus, all programs pursue the same mission and are unified in their approach to achieving that mission. In the science that is funded and the initiatives supported, the programs complement and build on each other to strengthen scientific evidence and promote its use in decision-making through educational initiatives, research synthesis and translation, and global technical capacity strengthening. Together, the programs are well-aligned to address the many challenges ahead.

HEI Commitment to Young Investigators and Diversity, Equity, and Inclusion

HEI is committed to promoting diversity, equity, and inclusion at all stages of the research process and encourages all applicants for research funding to diversify their research teams by including individuals from groups that are underrepresented in environmental exposure and health research. We also fund several awards and fellowships to support undergraduates, graduate students, and early career scientists in environmental health research.

Summer Fellowships: This paid fellowship pairs undergraduate students from backgrounds underrepresented in the environmental health sciences in the United States with an HEI research mentor for a summer project.

Jane Warren Award: This award provides an honorarium and travel support to graduate students and postdoctoral fellows from institutions in the United States to attend and present their research at HEI's Annual Conference.

Rosenblith Award: This award provides three years of research funding to new investigators with outstanding promise at the Assistant Professor or equivalent level with the hopes of bringing new, creative investigators into active research on the health effects of air pollution.

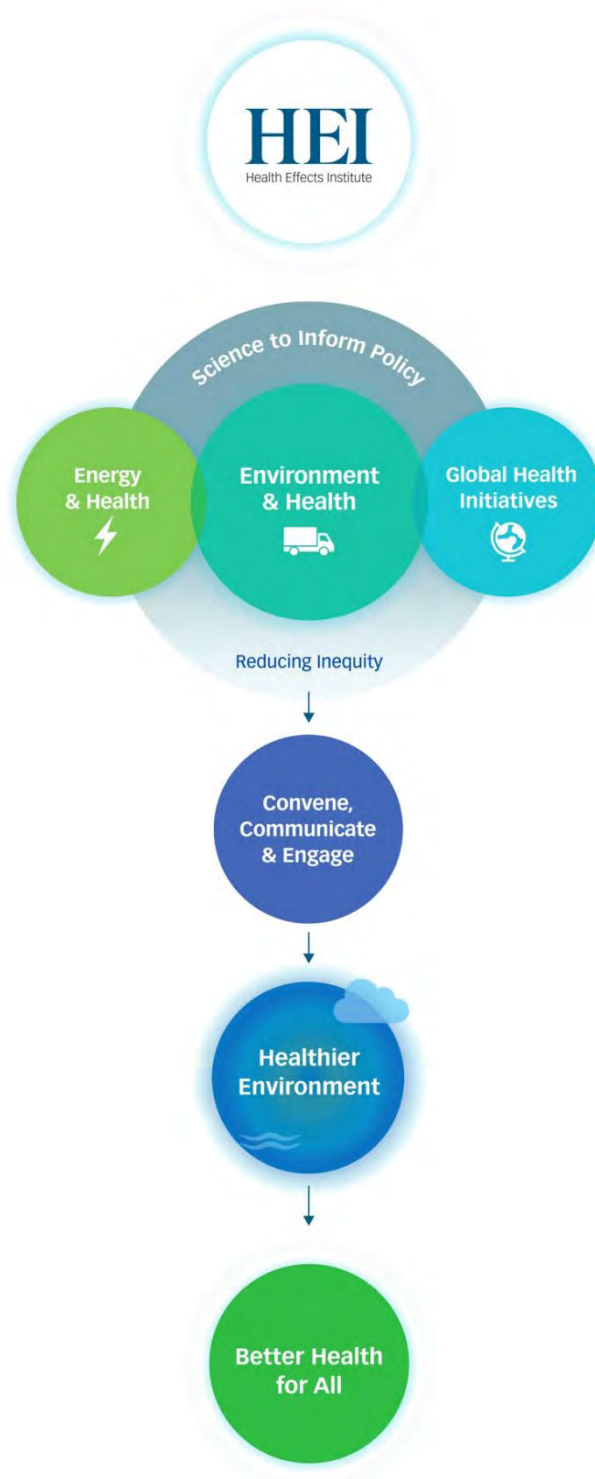


Figure 1. HEI is governed and structured to provide impartial science that fosters a healthier environment and better health for all.

Approach to Delivering Impartial, High-Quality Science

HEI funds, oversees, and evaluates research with a rigorous model that promotes its quality, impartiality, and relevance to environmental and public health policy. Applied over more than four decades, this process has yielded credible research that has informed important health-protective policy decisions. HEI staff, independent expert committees, and a Board of Directors provide extensive oversight and engage with a variety of individuals and organizations interested in or affected by our work (Figure 2). To ensure the independence of this process, Board and committee members cannot be associated with HEI's sponsors, and robust processes are used to identify and address conflicts of interest.

Scientific Research

To identify the highest-priority research questions, HEI begins by reviewing the state of the science and soliciting input from various groups, including HEI's sponsors, government, industry, nongovernmental organizations, academia, and communities. The research committee then solicits research proposals, selects and funds research projects, and provides extensive oversight as the studies are conducted.

Once findings undergo HEI's peer review, all research is made freely available on our website. HEI also engages widely to disseminate research findings and communicate their relevance for decision-making. As part of its commitment to data transparency, HEI requires that data be made accessible to the maximum extent feasible to allow for replication of the research.

Independent Oversight and Review

The research committee defines and guides the research funded by HEI. It prepares requests for applications (RFAs); selects, oversees, and ensures the quality of all funded studies; and has the added responsibility of ensuring that HEI funds a body of research that, over time, cumulatively adds to information needed for policy decisions. Although HEI sponsors often contribute research ideas, they play no role in the selection, oversight, or review of the research. All research recommended for funding by the research committee must be approved by HEI's Board of Directors, which is charged with ensuring the integrity and impartiality of the research selection and review processes.

When research is complete, investigators prepare comprehensive reports that undergo extensive peer review by the review committee, which functions independently of the research committee. The review committee conducts critical, in-depth evaluations of the investigators' final reports and, in collaboration with HEI staff, prepares commentaries that highlight each study's scientific contributions, limitations, and relevance to policy questions.

Engagement

HEI research is of interest to a broad array of audiences. We actively engage these audiences at all phases of research, from soliciting input on research priorities to disseminating study findings. When appropriate to the study aims, various audiences might also be engaged directly in research design and implementation.

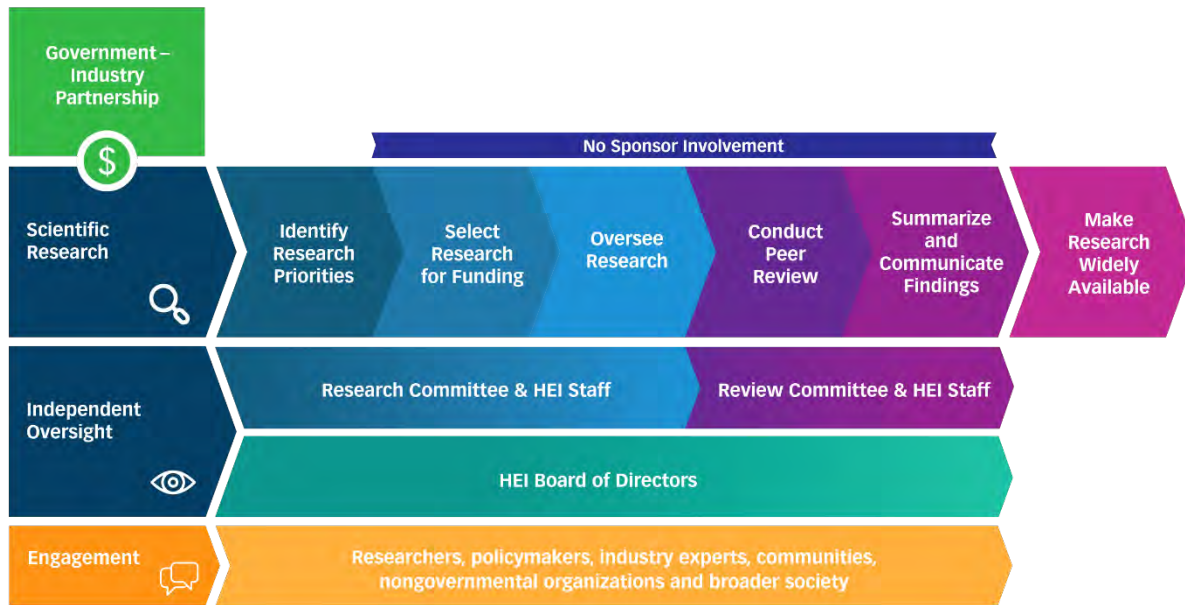


Figure 2. HEI funds, oversees, and evaluates research with a rigorous model that promotes its quality, impartiality, and relevance to public health policy. Sponsors and others with an interest in or affected by HEI’s work provide recommendations on research priorities, but the final priorities are determined by the research committee.

Approach to Facilitating Use of HEI Science in Decision-Making

Targeted, high-quality research that is relevant to policy and communicated effectively to decision-makers can provide a strong impetus for action. To enhance the impact of our programs and advance our mission of informing decisions that foster a healthier environment and better health for all, HEI complements its research with a wide array of activities aimed at facilitating use of science in decision-making (Figure 3).

HEI’s published reports, which are freely accessible on our websites, are foundational to documenting the outcomes of its funded research and provide a rich reference for anyone who uses its work. HEI staff and funded researchers also convey insights gained through the research projects in manuscripts and commentaries in peer-reviewed scientific journals for broader reach. Periodic [HEI newsletters](#) and [quarterly research updates](#) from the HEI Energy and Health program provide regular updates on ongoing projects and summarize recent research findings.

In addition to advancing individual studies, HEI also synthesizes findings across large bodies of research to elucidate broader themes, conclusions, and questions. One example is [Special Report 23](#), which analyzed over 350 studies conducted between 1980 and 2019 on the health effects of TRAP. To offer additional context on our ongoing research and help inform priorities for future research programs, HEI staff members also monitor the scientific literature around relevant topics and regularly summarize findings in [research briefs](#) and a [literature hub](#).

Public engagement is crucial to ensuring research is relevant to the people who are interested in or affected by HEI’s work. [Guiding Principles for Research and Stakeholder Engagement](#), a guide developed

by the HEI Energy and Health program, reflects HEI’s commitment to fostering the co-creation of knowledge and outlines practices for engaging with local communities throughout the research process. As exemplified in a series of in-person and virtual [community open houses](#), this process helps community members to understand what they can expect from the research and how it relates to their lives, and it helps the investigators learn from community members and use this knowledge to improve their research. The guide is now in the process of being updated as an understanding of best practices for community engagement continues to evolve.

For engaging with the public and communicating study findings, HEI has found particular success in leveraging webinars and social media, which allows HEI to engage with a wide array of audiences. For example, research reports are often released with a webinar to help explain the findings and increase visibility. HEI also uses webinars to communicate with potential applicants for research funding to ensure clarity and transparency around research priorities and guide proposal development. In 2021, the HEI Energy and Health program launched an educational webinar series, [Energy and Health](#), which explores issues around unconventional oil and gas development, cumulative impact assessment, and collaborative research approaches. In 2022, Global Health Initiatives launched [Science on the 7th](#), which features lively 30-minute conversations on issues at the forefront of air quality and global health with experts from around the world. To complement and amplify these channels of engagement, HEI also leverages social media platforms, including X, LinkedIn, Facebook, and YouTube, to share findings and events in various formats with a broad array of audiences.

In all its efforts to share the outcomes from its research programs — whether in publications, synthesis activities, engagement, or science communication — HEI takes deliberate steps to ensure the findings are relevant to and usable by decision-makers. Commentaries from expert HEI review committees that place novel scientific findings into context with current policies, technologies, and scientific literature provide one example. In addition, HEI regularly develops brief report statements and factsheets that distill complex scientific information into plain language to explain and contextualize key findings. To broaden the reach and accessibility of these materials, HEI also makes many of its communications products available in multiple languages, including quarterly research updates from the HEI Energy and Health program and various factsheets from the SoGA initiative.

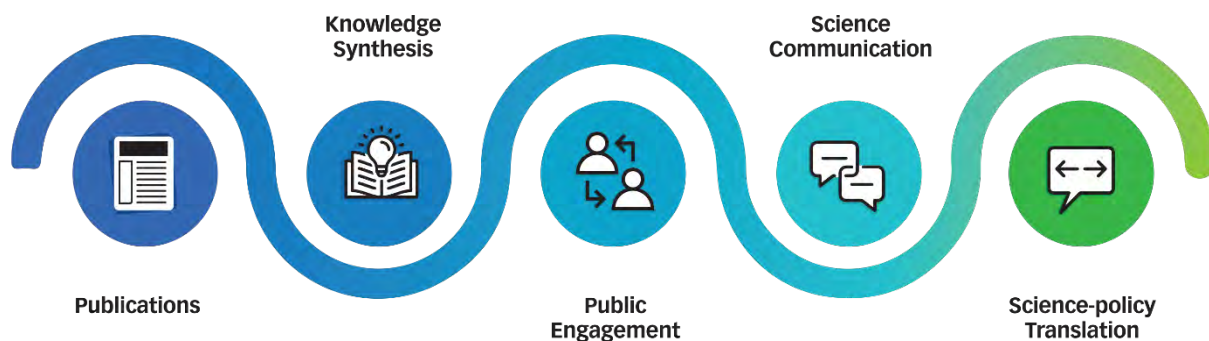


Figure 3. HEI complements its research programs with a wide array of activities aimed at fostering use of its science in decision-making.

HIGHLIGHTS FROM 2020–2025

The [HEI Strategic Plan for 2020–2025](#) has guided HEI’s research programs over the past five years. That plan included four themes — Accountability, Complex Questions for the Air Pollution Mixture, Transport and Urban Health, and Global Health—and identified additional priorities in cross-cutting areas, including data access and transparency, evaluation of statistical methods, a focus on sensitive or vulnerable populations, and enhanced exposure assessment.

Table 1 and Figure 4 summarize the status and reach of activities conducted from April 2020 to April 2024. The sections below briefly highlight selected activities in the four thematic areas, including accomplishments anticipated as of September 2024. Additional details about ongoing projects can be found at www.healtheffects.org/research/ongoing-research and published work is available at www.healtheffects.org/publications.

At the time HEI prepared its 2020–2025 Strategic Plan, the HEI Energy and Health program was under development. For this reason, the initial phase of this program has been guided by a separate 2020 Implementation Plan. This plan along with details about the program’s activities can be found at <http://www.heienergy.org>.

Table 1. HEI-Funded Research Studies, April 2020 to April 2024

Category	Studies Initiated	Reports in Review	Reports Published
Accountability	5	1	1
Complex Questions for the Air Pollution Mixture	13	4	9
Air Pollution, COVID-19, and Health	5	3	1
Low-Exposure Epidemiology			3
Wildland Fires	2		
Biological Mechanisms	1		3
Marginalized Communities	2		1
Multipollutant Epidemiology	3	1	1
Global Health^a	2		2
Transport and Urban Health	11	6	2
Disentangling Confounding or Modifying Factors of TRAP		2	
Enhanced Exposure Assessment	5	4	
Nontailpipe Emissions	2		
TRAP and Health	4		2
Community Exposure to Unconventional Oil and Gas Development^b	9	2	
Total	39	13	14

TRAP = traffic-related air pollution.

^a With funding provided by philanthropies, development agencies, and others.

^b With funding provided by the U.S. EPA, the oil and gas industry, and private foundations.

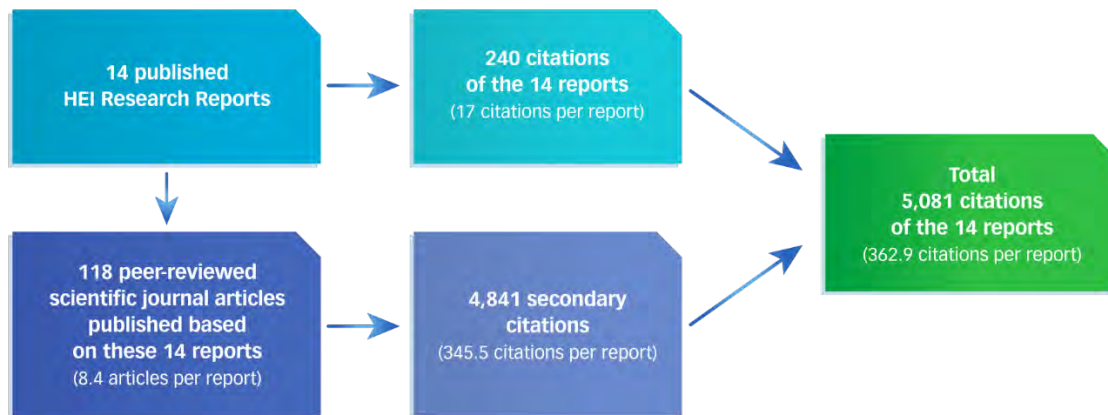


Figure 4. Citations from the 14 reports published between April 2020 and April 2024.



Environment and Health (2020–2025)

HEI built on its strong track record in studying the relationships between environmental exposures and health in several major research areas during the 2020–2025 period. Together the body of funded research studies, expert panel assessments, and convening activities helped to move the science forward and identify emerging questions in key areas.

Accountability

HEI funded several studies of local, regional, and national interventions intended to reduce air pollution emissions. Direct demonstration of benefits, or lack thereof of regulatory actions, remains challenging in many situations because of the overlapping nature of regulatory program implementation and concurrent, unrelated changes (e.g., economy, employment, and healthcare), which might also affect health. HEI-funded research in this area continues to develop new methods, and where possible, identify changes in air quality and resulting health effects. Studies completed during this period showed that actions to reduce emissions from goods movements were effective in protecting people who had chronic respiratory conditions and lived near ports and goods movement corridors. Other studies showed that replacing older diesel-powered school buses resulted in some improvements in school attendance, educational achievement, and air quality, and policies reducing exposure to traffic emissions and congestion in a large urban area might improve birth outcomes. Another study showed that reductions in a relatively small proportion of emissions could yield a large societal health benefit while targeted emission reductions in certain transportation sectors could yield climate and health co-benefits. In addition to those completed studies, two studies that are nearing completion evaluated national air quality regulations in North America and China. A third study underway is developing fine-scale metrics

for evaluating changes in fine particulate matter (PM_{2.5}) from various sources to support regulatory accountability and advance environmental justice in the United States.

Complex Questions for the Air Pollution Mixture

In 2022, HEI completed a comprehensive research initiative to investigate the health effects of long-term exposure to low levels of air pollution in the [United States](#), [Canada](#), and [Europe](#). The three studies in this research initiative considered associations between several pollutants and a variety of health outcomes and documented positive associations between mortality and exposure to PM_{2.5} below the U.S. NAAQS and current and proposed European Union limit values. The simultaneous funding and the collaborations among the investigators created by HEI fostered synergies among the teams and facilitated methodological developments and harmonization for pooled analyses. Some data have been made publicly available, thus facilitating transparency and reproducibility. All three studies addressed critical research gaps in understanding the health effects of low-level ambient air pollution and provided policy-relevant science.

In 2023, HEI hosted a workshop on the state of science for the health effects of particulate matter exposures. Convening thought leaders from around the world, the event sought to identify critical research priorities to inform interventions or policies to protect health. Participants discussed a variety of topics, including the biological plausibility of health effects from chronic low-dose exposure to particulate matter, the role of indoor air in personal exposures, the health effects of repeated exposures to fire smoke, and the shifting particulate mixture due to electrification and fleet turnover, the emergence of microplastics, and changes in bioaerosols. HEI plans to release a new RFA based on the workshop findings in late 2024.

The COVID-19 pandemic produced unprecedented conditions that lent themselves to timely and novel air pollution research. In May 2020, only two months after the World Health Organization declared the COVID-19 outbreak a global pandemic, HEI issued an RFA for studies to investigate potential associations between air pollution, COVID-19, and human health. Four studies were funded to examine the relationship between air pollution exposure and COVID-19 incidence and associated health outcomes in several populations across North America and Europe. These studies revealed positive associations between exposure to ambient air pollution and COVID-19 outcomes, particularly in those with pre-existing conditions or low socioeconomic status. A fifth study was funded to examine the short-term changes in ambient air pollution resulting from COVID-19 lockdowns and the effects on mortality in the United States, China, Germany, and Italy.

In 2022, HEI held a [workshop](#) to promote interdisciplinary exchange on the use of satellite-based remote sensing data in air quality monitoring, exposure assessment, and health applications. Participants explored approaches to incorporate satellite data products into large epidemiological studies and their application for studying the health effects of wildland fires and addressing environmental justice concerns. They also identified challenges, including the complexities of data assimilation and accessibility, and pointed to a need for more communication between data providers and data users and better characterization of limitations. HEI plans to release a new RFA in late 2024 with a focus on characterizing how limitations in satellite data might affect the results of health studies. To ensure that it uses its resources most productively, HEI actively engages with such other groups as the Health and Air Quality Applied Sciences Team of the National Aeronautics and Space Administration.

Transport and Urban Health

In 2022, an HEI expert panel completed its [systematic review](#) of the epidemiological evidence on the health effects of traffic-related air pollution (TRAP); highlights are shown in Figure 5. The large number of people exposed to TRAP, combined with the strength of the evidence for an association between long-term exposure to TRAP and several adverse health outcomes as revealed in this review, further bolstered the evidence that TRAP remains an important public health concern that warrants attention from the public and policymakers.

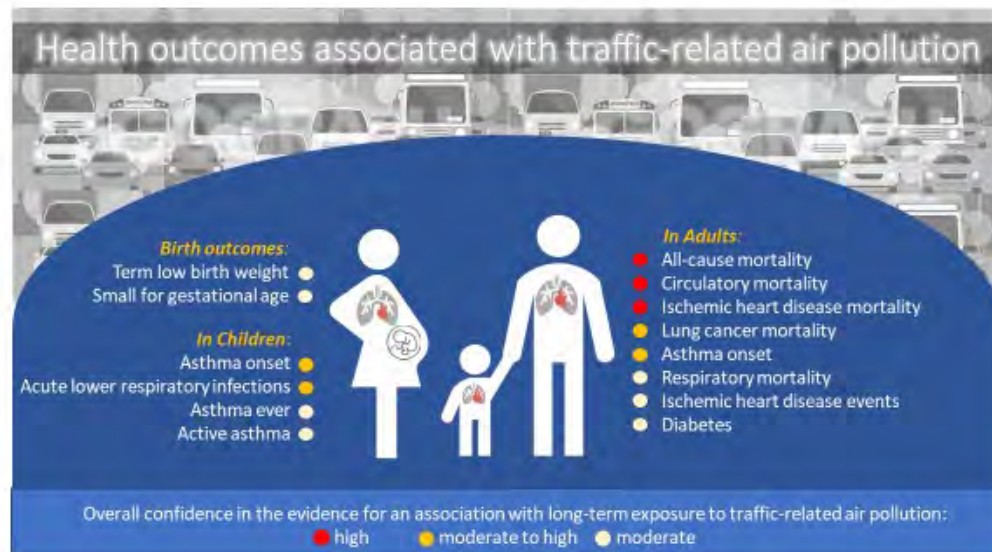


Figure 5. Highlights from a systematic review of the epidemiological evidence for associations between long-term exposure to traffic-related air pollution and selected adverse health outcomes. Outcomes for which the expert panel reported associations with high, moderate to high, or moderate confidence are shown here. Outcomes for which the overall confidence in the evidence was low to moderate, low, or very low are discussed in the panel's [report](#).

Building on the recommendations from this systematic review, HEI issued an RFA in 2023 and awarded funding to four studies examining the health effects of exposure to TRAP. These studies aim to create a framework for full-chain assessment of transportation systems and effects of TRAP on population health; examine associations of TRAP with lipids and other biomarkers to explore pathways that might mediate cardiovascular disease risk; assess consequences of future urban transportation landscapes on cardiometabolic health; and develop models for relating exposures from vehicle, rail, and aircraft sources to birth outcome data.

Research funded by HEI and others has indicated that a better understanding is needed of contextual factors that might confound or modify associations between TRAP exposure and health outcomes. Accordingly, HEI funded three studies under an RFA designed to disentangle the effects of exposure to TRAP from such spatially correlated confounding or modifying factors as traffic noise, socioeconomic status, the built environment, and green space. These studies include multiple pollutants and attempt to distinguish between tailpipe and nontailpipe motor vehicle emissions and other pollution sources while

incorporating information about relevant co-exposures to strengthen the evidence on health effects of TRAP in the context of spatially correlated factors.

A major challenge in epidemiological studies of long-term exposure to air pollution is the accuracy of exposure assessment, particularly for outdoor air pollutants that vary widely across space and time such as ozone, nitrogen dioxide, ultrafine particles, and chemical constituents of PM_{2.5}. To address this gap, HEI initiated five studies under an RFA focused on applying novel approaches to improve long-term exposure assessment of outdoor air pollution. These studies aim to assess exposures to air pollution using new and conventional exposure assessment approaches, evaluate quantitative exposure measurement error to determine the added value of the novel approaches, and apply the exposure estimates in epidemiological analyses to evaluate the potential effect of exposure measurement error on chronic health estimates. Together, these studies should provide novel insights in accounting for spatial and temporal variability in long-term outdoor air pollution exposure assessment in relation to chronic health outcomes.



Global Health Initiatives (2020–2025)

Between 2020–2025, with support from foundations, HEI greatly expanded the global health program. In addition to activities on a global scale, the organization advanced research and capacity strengthening in specific geographies, beginning new work in Southeast Europe and East Africa and expanding its presence across South Asia. These activities are supported by staff members based in the United States, India, and Kenya.

State of Global Air and Global Burden of Disease

Following the publication of its 2020 report, the SoGA initiative expanded its work to produce geographically focused reports and resources, including a [report](#) on air quality and health in more than 7,000 cities worldwide and informational resources such as a [StoryMap](#) on the role of fossil fuels in global air pollution and associated health impacts. The initiative also provides resources on air pollution and health effects, including a factsheet and a video in multiple languages (English, French, Spanish, Swahili, and Hindi). To further enhance the health data that forms the foundation for the SoGA initiative, HEI also routinely undertakes projects to assess the evidence for including additional health outcomes into the Global Burden of Disease (GBD) comparative risk framework. Since 2020, HEI has supported work on nitrogen dioxide and childhood asthma that has formed the basis for the inclusion of nitrogen dioxide as a pollutant in the GBD assessment framework. Work is also underway to assess the strength of available evidence on the association between air pollution and tuberculosis.

In 2021, HEI published the first comprehensive [global estimates](#) of contributions from the most common sources of exposure to PM_{2.5} and the associated burden of disease from various causes. The study estimated source contributions at global, regional, and national scales using updated emissions

inventories categorized by sector and fuel, satellite data and air quality modeling, and the latest insights into the relationships between air quality and health.

Southeast Europe

Between 2021 and 2023, HEI worked with technical partners in Southeast Europe to produce three [reports](#) on air quality and health focused on Southeast Europe broadly and on Bulgaria and Serbia specifically. Accompanying materials were produced in English and relevant regional languages, and HEI fostered networking among individuals and organizations working on air pollution and health to catalyze further collaborations in the region.

South Asia

In collaboration with the All India Institute of Medical Sciences, New Delhi, and the Indian Institute of Technology Delhi, HEI initiated support for a national research network focused on air pollution and health effects research in India called Collaborative on Air Pollution and Health Effects Research (CAPHER-India). To further strengthen local research and capacity, HEI is also funding two research studies led by India-based investigators to assess the association between exposure to air pollution and cardiovascular disease and between maternal and newborn health. Leveraging HEI's longstanding accountability research experience, HEI has launched a new project to assess the impact of India's National Clean Air Programme on air quality in cities.

East Africa

HEI has been working in East Africa to improve the communication of credible evidence about the effects of air pollution on people's health to inform and help drive local action toward cleaner air. In 2023, HEI co-organized a [workshop](#) on air pollution and health in East Africa in partnership with the Stockholm Environment Institute–Africa Centre, World Resources Institute, Eastern Africa GEOHealth Hub, and AirQo. To build on the momentum generated, this event was followed by a [webinar series](#) aimed at fostering engagement, collaboration, learning, and peer exchange around air quality and health research and policy in East Africa. A scoping review on the health effects of air pollution in East Africa is currently underway to identify research priorities.



Energy and Health (2020–2025)

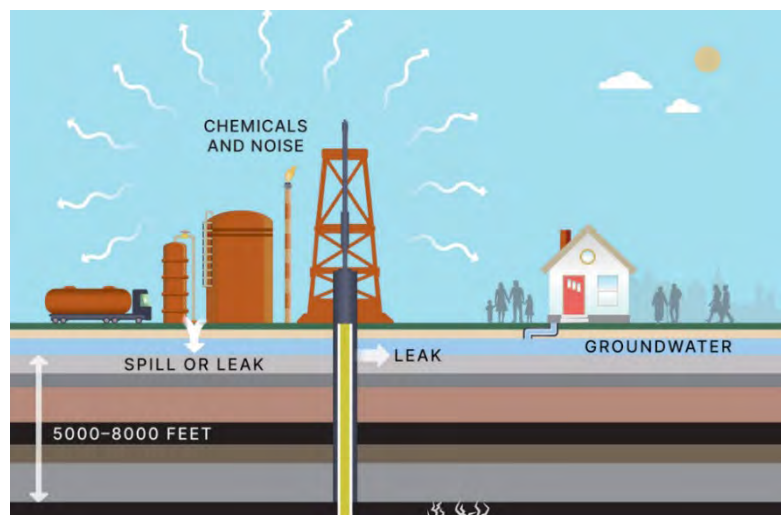
The HEI Energy and Health program has made substantial progress toward achieving objectives set out in its [2020 Implementation Plan](#) to improve understanding of community exposures and health effects associated with unconventional oil and natural gas development (UOGD). As called for in the plan, the initial program of funded research is focused on understanding community exposures and was informed by [HEI reviews of relevant literature](#) and recommendations shared at a series of [research planning](#)

[workshops](#). Studies were selected based on HEI’s longstanding requirements for high-quality, impartial, and policy-relevant research in addition to two general study design features: applicability beyond study locations and flexibility to anticipate and respond to fluctuating UOGD contexts in terms of technology, markets, and governance.

Community Exposure Research and Engagement

The overarching goal of this research program and associated community engagement is to inform policy decisions by endeavoring to identify links between specific oil and gas processes and community exposures. This information can then be used to understand how exposure varies among subpopulations, define science-based setback distances, understand how to mitigate any exposures of concern for health, and assess the efficacy and co-benefits of specific mitigation approaches. To engage local communities and others interested in the work throughout the research process, HEI shares [individual study updates](#) and hosts community open houses and webinars.

Under this program, scientific teams have been working to improve understanding of community exposures associated with air quality changes, noise, and water quality changes from UOGD and associated processes. A collaborative effort called “TRACKing Community Exposures and Releases (TRACER) from UOGD,” is underway to assess acute and chronic human exposures in three U.S. regions and develop a model that captures scientists’ collective current understanding of UOGD emission sources, predicts their influence on local and regional air quality, and can be updated as UOGD operations change over time. For this collaboration, researchers are leveraging the previously developed [Methane Emission Estimation Tool](#), adding additional UOGD operations and chemicals of concern for human health and evaluating the model with monitoring data from Colorado, Texas, and Pennsylvania in the United States. The research has benefited from data and access to monitoring locations provided by several oil and gas companies in addition to a community group that is helping to facilitate air quality monitoring.



Conceptual diagram of the community exposures under investigation by the Energy and Health program.

Early progress from the TRACER collaboration informed the selection of three additional studies in 2024 that aim to assess trends in air quality and community exposures in three major oil- and natural gas-producing states. To the extent feasible, these studies will apportion the sources of any observed trends in air quality among UOGD and other sources.

To improve understanding of water quality changes attributable to UOGD, two studies are combining existing water quality data and modeling to provide frameworks for identifying areas of potential water

contamination, apportion the sources of contamination, and identify exposure pathways. This research has benefited from state officials sharing UOGD operational and water quality monitoring data and community members participating in multiple focus group discussions. One of the research teams working in western Pennsylvania has discovered evidence consistent with relatively infrequent groundwater contamination near certain geologically problematic areas or natural gas wells, which could be locations of ongoing contamination. In 2024, the team will initiate follow-up research to evaluate its model predictions by assessing groundwater quality in these locations.

Based on [early research findings](#) that suggest the importance of UOGD-related spills to community exposures, an additional study was launched in 2024 to conduct regional groundwater quality modeling to help understand how documented spills associated with UOGD might affect groundwater used as a source of drinking water in a major natural gas-producing region. A related workshop will explore community exposures to spills and other accidental releases of UOGD wastewater (also known as produced water) in the context of growing interest in reusing produced water for applications such as crop and cattle irrigation and road application. The workshop will review what is known about these potential exposures — expanding on a [research brief](#) that summarized the literature on this topic — and assess how potential future research investments could help inform decision-making in this area.

Synthesis of Research Findings to Support Cumulative Impact Assessment

HEI occasionally initiates special projects to synthesize scientific knowledge and advance technical methods. One example is an [ongoing special project](#) to design a Cumulative Impact Assessment for a representative oil and gas community. By synthesizing research findings about the impacts of UOGD on communities and identifying those that are most important for understanding effects on the health and well-being of individuals and communities, this activity aims to advance cumulative impact assessment methods, help to support decisions about protecting the health of people in oil and gas communities, and serve as a model for similar analyses in other communities affected by the energy transition.

THE CHALLENGES AHEAD

The world has changed immensely since the development of HEI's 2020–2025 Strategic Plan. Increasingly visible signs of climate change have led to a greater urgency to examine the interactions between climate and air pollution. A global push for the adoption of electric vehicles and other modes of transportation has accelerated, along with increased momentum to shift away from fossil fuels and toward renewables and other sources of energy. At the same time, the energy transition will occur and it remains important to understand ongoing exposures and health effects, such as those associated with internal combustion engines and the legacy fleet. These changes are creating new challenges and opportunities for reducing pollution exposures. There has been a substantially renewed effort to address the environmental inequities suffered by marginalized communities.

Substantial investments are being made in technologies and policies with the potential to help address some of the challenges. For example, the Inflation Reduction Act and Bipartisan Infrastructure Law in the United States include major investments relevant to climate change, historically marginalized communities, and the energy transition. Additionally, ambitious and large-scale technological developments are being pursued by governments, academia, and the private sector to help societies mitigate and adapt to environmental changes. As these investments and developments move forward, it will be essential to understand the consequences for health and the environment as well as the possible trade-offs.

All these developments have important implications for determining where HEI should focus its attention and resources. For over 40 years, HEI has been a vital source of high-quality, impartial, and policy-relevant science on the effects of air pollution on health. Our Global Health Initiatives and Energy and Health programs have built on this success in recent years by combining HEI's rigorous process for scientific investigation with new approaches to bolster technical capacity, partner with local communities, and shed light on multiple facets of today's pollution challenges. The work that HEI started over this long history and in particular over the past five years continues to bring real value to health-protective policy decisions. HEI will continue to invest in and build on its successful work while also responding to the evolving landscape of pollution challenges, policy questions, and scientific capabilities to ask new types of questions and answer them with novel approaches.

The complex problems that lie ahead require solutions that span multiple sectors and disciplines. Communities face combined pressures from economic, environmental, social, and health standpoints; misinformation proliferates; data gaps persist; and societies grapple with conflicting priorities. The need for systematic, comprehensive, health-centered assessments of optimal solutions grows more important. HEI has a critical role to play in informing decision-making with sound science in the coming years.

STRATEGIC PLANNING PROCESS

HEI continues to welcome feedback on this draft plan; please share your recommendations before May 17, 2024, [here](#):

The process for developing HEI’s Strategic Plan for 2025–2030 as illustrated in Figure 6 has extended for more than a year to allow for a full exploration of where important knowledge gaps remain, what outstanding policy questions could benefit from HEI’s science, and where HEI could contribute to meeting the challenges ahead. After careful deliberation and discussion with sponsors, scientific committees, and other interested individuals and organizations, a draft plan was presented for discussion of recommended research priorities at HEI’s 2024 Annual Conference. The draft plan — more ambitious than any single organization could hope to accomplish — will be finalized in discussions with HEI’s research committees and will take into consideration all the suggestions and comments received throughout the process, weighing the full list of proposed focus areas against the following overarching criteria:

- The current state of knowledge about topics of potential interest.
- The importance of topics for public health to the general population and specific groups, including historically marginalized communities.
- The relevance of topics to upcoming regulatory decisions and emerging technology developments.
- The extent to which other organizations are addressing the topics.
- The likelihood that scientific work by HEI will produce useful findings about the topics within the foreseeable future.

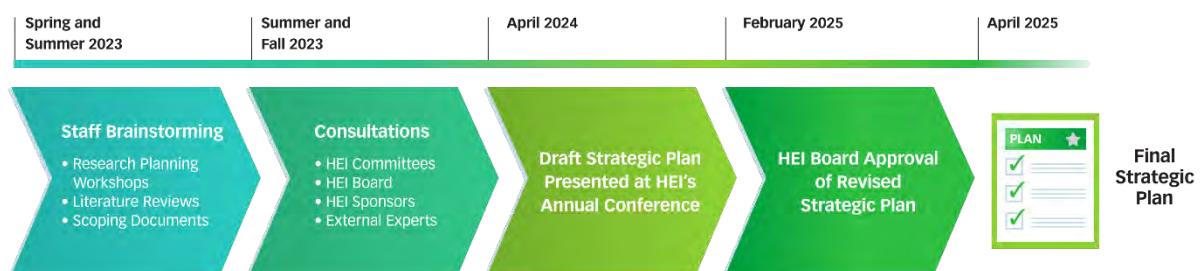


Figure 6. HEI’s strategic planning process and timeline.

MAJOR THEMES FOR 2025–2030

The strategic planning process reaffirmed that HEI's three established programs — Environment and Health, Global Health Initiatives, and Energy and Health — continue to comprise an optimal organizational structure for its activities and identified key themes and specific priority areas that will guide the efforts within each program. HEI's programs also are united by many common threads and contribute to a unified body of work. For example, accountability, exposure modeling, cumulative impacts, emerging pollutants, shifting sources of exposure, effects from climate change, and other factors that contribute to health effects are topics that span the programs and themes. To inform HEI investments and enhance programmatic impacts, HEI will continue to foster an active exchange of information, ideas, and tools among staff, expert committees, funded researchers, and the broader network.



Environment and Health (2025–2030)

Themes identified for the Environment and Health program build on the successful research that HEI has supported in the past, while also looking ahead to anticipated future societal challenges and scientific opportunities. The sections below identify overarching themes along with high-priority topics within those themes.

Transportation and Health in a Changing Landscape

Research on the health effects resulting from exposure to transportation emissions has been a foundation of HEI's work over the past decades. This research will continue to play a pivotal role in the coming years while evolving to address the changing mobility landscape.

- *Accountability.* Assessment of the effectiveness of specific policies to reduce TRAP and improve public health as well as assessment of other policies, such as those to mitigate climate change, that could also affect air pollution exposures.
- *Nontailpipe Emissions.* Evaluation of exposure to and health effects of emissions from brake and tire wear and resuspended dust and identification of better markers of nontailpipe emissions. As electric vehicle adoption advances, a focus on these emissions becomes more important. Future work in this area would build on two studies initiated in 2022 to investigate short-term respiratory health effects from exposure to these emissions and to provide real-world measurements to estimate population exposures.
- *Vehicle Fleet.* Investigation of the effects on air quality, exposure, and health of the turnover of the legacy fleet to cleaner vehicle technologies given the changing emissions of nitrogen dioxide, black carbon, ultrafine particles, and other pollutants. This topic would include estimating the

effects on urban air quality and health of the various new transportation and mobility scenarios as well as examining both trade-offs and benefits.

- *Transportation Hubs.* Assessment of air pollution exposure and health effects in areas near transportation facilities — including ports, railyards, airports, and goods distribution centers — with particular attention to the role of environmental, social, and behavioral factors.
- *Goods Movement.* Evaluation of changes in air pollutant emissions—and potential air quality and health improvements in adjacent communities—related to changes in goods movement from implementing fuel efficiency and emissions control technologies, electrification, fleet turnover, and automation and routing technologies.
- *Alternative Fuels.* Assessment of the effects on air quality and health of alternative fuels for motor vehicles, including a comparison of all alternative fuels. This topic would be addressed in conjunction with the Energy and Health program, which would investigate the corresponding effects of alternative fuel production.

Air Quality, Climate, and Health

A changing climate substantively affects air quality, including sources and composition of air pollution, geographic distribution of air pollutants, and duration of exposure. A better understanding is needed of the health effects associated with the changes in air pollution exposures related to a changing climate. In addition to exposure questions, air pollution might serve as an effect modifier or interact with other climate-related factors, such as exposure to heat.

- *The Changing Climate.* Evaluation of health effects associated with the changes in air pollution exposures related to a changing climate. This topic includes the investigation of the role of air pollution in heat-related mortality and morbidity.
- *Wildland Fires.* Evaluation of health effects of short- and long-term exposures to fire smoke, including from unintended forest fires, prescribed burning, and agricultural burning. This topic includes the investigation of long-term health effects from repeated versus low-level chronic exposures and would build on two studies initiated in 2021 that are investigating outcomes of smoke exposures with a focus on sensitive populations.
- *Sand and Dust Storms.* Investigation of health effects from short- and long-term exposures to sand and dust storms, including effects of long-range transport to neighboring regions.
- *Ozone.* Assessment of health effects of short- and long-term exposure to ground-level ozone and its interactions with other pollutants in relation to cause-specific mortality and morbidity. This topic is especially relevant in the context of climate change given that changing greenhouse gas emission patterns and high heat events are associated with changing patterns of ground-level ozone.
- *Respiratory Outcomes.* Examination of how longer aeroallergen seasons and changes in allergen spatial patterns and humidity affect such respiratory outcomes as allergies and asthma.

- *Accountability.* Assessment of the effectiveness of adaptation and mitigation measures, air quality indices, high-heat communications, and early warning systems to reduce exposures to air pollutants and prevent acute health outcomes.

Multipollutant Mixtures

A great deal of scientific literature examines how exposure to individual chemicals affects health. Less research has been devoted to understanding how exposure to chemical mixtures can affect human health. HEI will continue to invest in advancing scientific methods to address the substantive challenges that remain in assessing multipollutant exposures and associated health effects.

- *Multipollutant Models.* Development of multipollutant approaches to improve estimates of health risks and effects from multipollutant mixtures.
- *Exposure Estimation.* Improvement of air pollutant exposure estimation using novel models that can be applied in epidemiological studies and risk assessment. This topic also includes assessing indoor air exposures to improve understanding of personal exposures.
- *Particulate Matter.* Assessment of the changing nature of particulate matter, the increasing role of ammonia sources, other emerging sources (e.g., wildland fires, microplastics, and increased biologicals due to climate change), and the effects on health.
- *Cumulative Impacts.* Identification of key factors that contribute most to cumulative impacts. This work can help to inform the focus of future assessments and ensure that relevant stressors are included.
- *Toxic Pollutants.* Assessment of exposure and health effects of toxic pollutants for which sources are relatively well understood and emerging contaminants for which sources and exposures are poorly understood (e.g., PFAS, 6-PPD).
- *Biological Mechanisms.* Investigation of the relationship between air pollution exposures and disease development (e.g., frailty) versus exacerbation of disease (e.g., sequelae effects).
- *Ultrafine Particles.* Addressing questions on the effects of ultrafine particles on health and such issues as the lack of a consistent measurement method. This topic could be addressed by a workshop or other convening activity rather than funding specific research.

Reducing Environmental Inequities

Historically marginalized communities in the United States experience a disproportionate burden of environmental pollutants and other nonchemical stressors. HEI has explored how it can contribute to research aimed at reducing environmental inequities. Over the past few years, HEI hosted a workshop on the topic, assembled two advisory groups to guide its work, and funded studies on accountability research and community-academic partnerships that will investigate cumulative impacts. In addition, three Rosenblith awards recently initiated will focus on historically marginalized populations and will provide valuable insights on pollution sources, optimal policies to reduce air pollution, and the

distribution of exposure reductions across population groups. HEI will continue to expand this work in the coming years.

- *Method Development.* Development of methods to assess combined exposure to chemical and nonchemical stressors at high resolution, including characterization of uncertainties, biases, and accuracy. This effort includes the collection and evaluation of granular-level data to capture personal exposures in underserved populations that are disproportionately affected by air pollution and are not well represented in current national-level studies.
- *Contributing Factors.* Identification of factors that contribute to inequities in environmental exposures and health outcomes, especially those that can be changed. This topic will include clarifying how health effects from environmental exposures are related (e.g., historical and current factors that lead to disparate exposures, such as proximity to sources due to institutional and urban planning) and the factors that lead to disparate realizations and severities of health outcomes (e.g., access to primary healthcare and co-morbidities).
- *Solutions.* Identification of national, regional, and local policies and solutions that are most appropriate for addressing environmental inequities.
- *Accountability.* Assessment of environmental justice investments, such as those under the Infrastructure Investment and Jobs Act and the Inflation Reduction Act, to determine whether policies or actions are having the desired effects.
- *Climate Change.* Assessment of how air pollution sources, exposures (indoor and outdoor), and health outcomes are affected by climate change and extreme weather events, including temperature extremes in historically marginalized communities.
- *Resources and Tools.* Learning from community experts about their environmental health priorities and needs and providing technical assistance to historically marginalized communities to conduct research. Activities could include providing support to build and strengthen academic–community partnerships, creating an environmental justice literature database and spatial bibliography, aggregating environmental data, convening environmental justice leaders to share lessons learned and help inform best practices for research and policy development, developing methods for enhancing accessibility of research results, and developing a database for facilitating connections between academic and community groups.



Global Health Initiatives (2025–2030)

HEI's Global Health Initiatives will continue to focus primarily on low- and middle-income countries (LMICs), where the public health impacts of air pollution are the most profound and the need for solutions the greatest. Broadly, the program will continue to focus on communicating about sources and

health effects of air pollution, strengthening local technical capacity, and supporting local scientific research where possible. The program will also prioritize the exchange of ideas and knowledge across LMICs through convenings and regular dialogue.

State of Global Air Initiative

In many places, the increased availability of data has fueled growing attention to the need for credible information about air quality, the health effects of pollution, and effective solutions. However, understanding of air pollution and its health effects remains low in regions with the highest exposures and health impacts. Since its launch in 2017, the SoGA initiative has successfully informed science and air quality action at local, national, and regional scales in locations around the world. Many geographies still need further attention. HEI will continue its efforts to communicate and expand access to compelling data on air pollutant concentrations and their sources and related health impacts worldwide using the SoGA platform.

- *Reports.* Produce periodic, in-depth reports that leverage GBD and other global or local datasets on such key topics as air pollution and noncommunicable diseases, air pollution and climate, and household air pollution and energy access.
- *Evidence Synthesis.* Conduct a review of literature on new health outcomes for inclusion in GBD and other disease burden estimates (e.g., tuberculosis).
- *Resources.* Produce curated materials on air pollution and health in multiple languages and formats (e.g., factsheets, videos, infographics), leveraging GBD and other global and regional data sources.
- *Trainings.* Facilitate in-person and virtual training sessions for researchers, policymakers, and nongovernmental organizations on air pollution and health, including GBD methods and data applications, in geographies of interest.

Bolstering Technical Capacity

LMICs experience the most significant effects of air pollution but have limited voices engaged at national, regional, and global scales. Experience across many fields has shown that long-term improvement is driven by sustained local investments and engagement in funding, infrastructure, and technical expertise. HEI will continue to expand its efforts to strengthen local technical capacity toward these goals, especially through support for early career researchers.

- *Pilot and early career grants.* Award multiyear grants and mentorship to promising early career researchers based in LMICs on topics related to HEI's mission and work. Also, provide topic-driven grants for targeted, locally relevant research led by in-country investigators in geographies of interest.
- *Training.* Conduct targeted training for scientists on exposure and epidemiology research methods and methods for communication and science-policy translation.

- *Resources and tools.* Continue the maintenance of interactive literature databases on air pollution and health for target geographies of interest.

Supporting Research Synthesis

Leveraging existing knowledge and innovation can enable LMICs to progress at a substantially faster pace than higher-income countries, including the possibility of disassociating rapid economic growth and industrialization from worsening air pollution.

- *Epidemiology.* Evaluate the health effects of short- and long-term exposures to air pollution in select geographies with high pollution levels.
- *Accountability.* Assess the effectiveness of specific policies to reduce air pollution and improve public health, with a focus on target geographies of interest.
- *Sources of PM_{2.5}.* Quantify the contribution of key sources to PM_{2.5} at high temporal and spatial scales.
- *Climate and health.* Investigate health effects from short- and long-term exposures to sand and dust storms, extreme heat, and wildfires.
- *Environmental Inequities.* Map inequities in exposure patterns in target geographies of interest.



Energy and Health (2025–2030)

The initial program of UOGD exposure research funded by the Energy and Health program shows great promise for informing policy that protects the health of people in communities across the United States. Meanwhile, the global energy transition highlights the importance of expanding our scope to understand community exposures and the health effects associated with other forms of energy production. The sections below identify overarching themes along with high-priority areas of focus within those themes.

Oil and Gas Development: Direct Follow-up to the Current Program of Exposure Research

Research on community exposures and health effects associated with UOGD has been the initial focus of the HEI Energy and Health program. Given that UOGD is projected to continue for decades, this research will continue to be important in guiding health-protective policy in oil and gas communities in multiple oil- and natural gas-producing regions of the United States.

- *Exposure Modeling.* Continued development of the TRACER emissions model to quantify local and regional exposures in multiple U.S. oil and gas regions. The model has numerous applications, such as quantifying co-benefits of greenhouse gas emissions reduction.

- *Air Toxics*. Evaluation of volatile organic compound emissions reduction associated with the National Emission Standards for Hazardous Air Pollutants for Oil and Gas.
- *Noise*. Addition of noise to the TRACER model to predict exposures and to support assessments of health risks from exposure to noise from preproduction processes and flaring.
- *Abandoned and Orphaned Wells*. Assessment of the potential for emissions to air and groundwater before and after plugging abandoned and orphaned wells to understand the health value of these expenditures and the potential for the plugging process to create adverse exposures.
- *Wastewater Use*. Identification of current and planned use of oil and gas wastewater, referred to as produced water, outside the oil field for road treatment, agriculture, drinking water aquifer recharge, and other applications that might result in human exposures. This topic would include assessment of exposure and health risks from the produced water uses of greatest potential concern for health.

Oil and Gas Development: Expanded Scope and Research Methods

UOGD is just one part of the longer oil and gas supply chain. Natural gas processing facilities, cracker plants, oil refineries, and pipelines can also be associated with human exposures that might pose health concerns. Some communities experience various combinations of those sources.

- *Oil and Gas Supply Chain*. Assessment of exposure and health risks associated with oil and gas distribution and transport (e.g., leaky pipelines and combining natural gas with hydrogen), refining, processing (e.g., cracker plants), and waste streams.
- *Health Risk*. Evaluation of links between oil and gas development and adverse health outcomes using the TRACER model to improve on the exposure metrics based on proximity that dominate the current body of epidemiology literature.
- *Method Development*. Development of methods for incorporating community knowledge, including Indigenous knowledge and traditional environmental knowledge, into environmental health assessments to improve the credibility and acceptance of assessments.
- *Accountability*. Assessment of the effectiveness of specific policies to reduce exposure to air emissions from oil and gas development (e.g., EPA's methane rule).
- *Cumulative Impacts*. Identification of key factors that contribute most to cumulative impacts. This work can help to inform the focus of future assessments of the impacts of UOGD and ensure that relevant chemical and nonchemical stressors are included.

Health Effects of the Energy Transition

The energy transition is upon us. Although there is substantial uncertainty as to what the energy landscape will look like in five years, ten years, and beyond, history tells us that all change brings both beneficial and adverse consequences. To provide the research needed to maximize health benefits and

minimize adverse health consequences across all subpopulations, including historically marginalized communities, it is important to continually assess the energy transition path as it evolves. Some energy transition topics can be studied empirically today, such as electrification, the battery value chain, and alternative fuels, while others would by necessity involve projections because they do not yet exist, such as large-scale hydrogen and geothermal production and carbon capture, use, and storage.

- *Alternative Fuels.* Assessment of the health risks and benefits associated with the production of alternative fuels, such as hydrogen, corn-based biofuels, and renewable natural gas.
- *Electrification and the Battery Value Chain.* Assessment of the health risks and benefits associated with an expanded and modified electricity infrastructure, including battery manufacturing and the acquisition of critical minerals from the earth or recycled from produced water and wastes.
- *Hydrogen Hubs.* Research to determine how best to assess and respond to the health risks and benefits associated with hydrogen hubs. This work would help to inform the requirement for Community Benefits Plans specified under the federal infrastructure law in funding large-scale demonstrations of "clean" hydrogen production, storage, transport, and consumption in regional hubs.
- *Carbon Capture, Use, and Storage.* Assessment of the health risks associated with emissions and wastes from carbon capture, sequestration, and use technology in heavy industry and other applications.
- *Large-Scale Geothermal.* Assessment of the health risks and benefits associated with large-scale geothermal operations involving the same preproduction processes used for oil and natural gas development.
- *Systematic Framework for Assessing Health Benefits and Risks of Energy Choices.* Creation of a decision analytic framework that can compare health risks and benefits associated with alternative energy production pathways. The framework would require multidisciplinary collaboration and should incorporate consideration of how decisions about existing and future energy production and distribution and human responses to these decisions could create or worsen inequities.

MEETING THE CHALLENGES AHEAD

Air pollution is now widely acknowledged to be an urgent and growing threat to public health worldwide. This recognition has led to expanded efforts to improve air quality locally, nationally, and globally in recent years, and new technologies and policies offer great potential to reduce harmful emissions and their associated health effects. However, despite these encouraging developments, new pollution sources have also emerged, and new and previously unrecognized health effects have become more apparent. A scarcity of air quality and health data in certain countries and communities has left many decision-makers in the dark about the pollutants that affect them and about the optimal opportunities to intervene. Many of the hardest-hit communities suffer compounded impacts from air pollution, climate change, and socioeconomic factors.

All this underscores the continuing importance and urgency of research and policies to reduce pollution and improve health. This Strategic Plan outlines key priorities for HEI's activities to address these critical issues over the next five years. It highlights many opportunities to take its previous research investments a step further by incorporating new scientific methods, a broader array of community voices, and emerging technologies into assessments of pollution challenges and the effectiveness of solutions. It also points to opportunities to leverage a history of robust research to forge a path forward on some of the most complex and pressing issues in environmental health, such as multipollutant mixtures, climate change impacts and interactions, and inequities in environmental exposures and effects. Many of the issues cut across several HEI programs, offering opportunities to strengthen the science across multiple areas simultaneously.

HEI's aims are ambitious. In addition to the substantial research investments that are necessary to meet these goals, HEI places a high priority on maintaining sufficient flexibility in its planning and budgets to adapt to and respond to unanticipated needs, something that is highly valued by its current government and industry sponsors. In light of continued inflationary erosion, funding — even maintained at current levels — presents a challenge. However, our past success in maintaining core funding sources and raising additional funds from other private and public entities, often for specific projects or programs, suggests that a variety of organizations will continue to find value in supporting HEI's vital mission and activities.

There is a critical need for trusted science to inform evidence-based decisions. Looking ahead, HEI remains committed to its mission and approach to providing high-quality, impartial science. Through the research priorities identified in this strategic plan, we are poised to advance a complementary and coordinated research program that produces results and insights that are greater than the sum of its parts. By funding rigorous research, synthesizing scientific evidence, convening a broad range of interested communities, and supporting effective communication and collaboration, we will leverage HEI's strengths and expertise to meet tomorrow's challenges.

ACRONYMS AND ABBREVIATIONS

CAPHER-India	Collaborative on Air Pollution and Health Effects Research
EPA	U.S. Environmental Protection Agency
GBD	Global Burden of Disease
HEI	Health Effects Institute
LMIC	low- and middle-income country
NAAQS	National Ambient Air Quality Standards
PM _{2.5}	fine particulate matter
RFA	request for application
SoGA	State of Global Air
TRACER	TRACKing Community Exposures and Releases, a study supported by the HEI Energy and Health program
TRAP	traffic-related air pollution
UOGD	unconventional oil and natural gas development

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