

RFQ E23-1: TRENDS IN AIR QUALITY & COMMUNITY EXPOSURES ASSOCIATED WITH OIL AND GAS DEVELOPMENT

SUMMARY

The Health Effects Institute Energy (HEI Energy) seeks to fund a qualified research team to assess trends in air quality and community exposures associated with unconventional oil and gas development (UOGD) in one or more U.S. regions.

BACKGROUND AND RATIONALE

[HEI Energy](#) is an independent nonprofit organization jointly funded by the U.S. Environmental Protection Agency (EPA) and the oil and gas industry to investigate community exposures and health effects associated with UOGD. UOGD refers to the development and production of oil and natural gas as practiced starting around the beginning of the 21st century through multistage hydraulic fracturing in horizontal wells. UOGD processes occur on and off the well pad and include:

- field development: exploration, site preparation, vertical and horizontal drilling, well completion (casing and cementing, perforating, acidizing, hydraulic fracturing, flowback, and well testing) in preparation for production, and management¹ of wastes;
- production operations: extraction, gathering, processing, and field compression of gas; extraction and processing of oil and natural gas condensates; management of produced water² and wastes; and construction and operation of field production facilities; and
- post-production: well closure and land reclamation.

UOGD and Air Quality

Emissions from UOGD can affect local air quality in nearby communities, regional air quality, and the overall climate with its greenhouse gas emissions. UOGD operations emit a complex suite of air pollutants, including air toxics (e.g., benzene, toluene, ethylbenzene, xylenes, hydrogen sulfide, and formaldehyde) and criteria air pollutants (e.g., NO₂, PM_{2.5}). Ozone is formed in the atmosphere from reactions of NO_x and volatile organic compounds (VOCs) in the presence of sunlight. Oil and natural gas operations also directly emit PM_{2.5} and precursor gases (NO_x and some VOCs) that can react to form particulate matter (PM) in the atmosphere.

Atmospheric concentrations of these pollutants depend on emission rates, dispersion patterns and atmospheric transformations, all of which can be highly variable based on site-specific conditions. This variability complicates exposure assessments, especially exposures from intermittent sources or specific meteorological conditions. Concentrations that persist for a relatively brief period of

¹ Management of wastes and produced water refers to their handling from creation to disposal, including collection, storage, transport, treatment, reuse, recycling, and disposal.

² Produced water is naturally occurring water that comes out of the ground along with oil and gas. (Adapted from: American Geosciences Institute 2019). The characteristics of produced water vary and use of the term often implies an inexact or unknown composition. (Adapted from: Schlumberger 2019)

hours to weeks (i.e., short-term) or for months to years (long-term) can both be problematic, depending on the toxicity and concentration of the pollutant and the extent of human exposure. The highest concentrations generally occur on or immediately downwind of UOGD operations, but the spatial extent of their effect on air quality and how exposures vary among various subpopulations are not always well understood.

HEI Energy-Funded Community Exposure Research

In August 2020, HEI Energy issued [RFA E20-1](#), seeking [studies](#) to improve characterization of potential human exposures originating directly from onshore development of oil and natural gas from shale and other unconventional, or low permeability, resources in the United States (UOGD).

The Program's [first five studies](#) are underway to better understand community exposures to UOGD air emissions, noise, and releases to surface water and groundwater. The three studies funded under RFA E20-1 comprise the collaboration, "TRACKing Community Exposures and Releases (TRACER) from UOGD." Collectively the studies will (1) monitor air quality and noise over multiple seasons to assess acute and chronic exposures in three major oil and gas-producing regions, and (2) develop a model that synthesizes current understanding of UOGD emission sources, predicts their impact on local and regional air quality, and can be updated as UOGD operations change over time. The model builds on the Methane Emission Estimation Tool (MEET) model (Allen et al. 2022) by adding preproduction operations and chemicals of concern for human health.

The overarching goal of the program of research and associated community engagement is to inform policy decisions by endeavoring to identify links between specific oil and gas processes and community exposures. This knowledge helps to understand how exposure varies among subpopulations (e.g., historically disadvantaged communities), define science-based setback distances, understand how to mitigate any exposures that pose a health concern, and assess the efficacy of specific emission reduction approaches. The research can feed directly into a cumulative assessment of exposure to chemicals, radiation, and noise; and it can help in assessing biological plausibility of findings from the oil and gas epidemiology literature.

OBJECTIVE OF THIS RFQ

The objective of this RFQ is to seek well-qualified research teams to comprehensively analyze air quality and other data for one or more regions to assess trends in air quality and air pollutant emissions (including but not limited to UOGD) since the early 2000s and the corresponding influence on community exposures in various subpopulations, including historically disadvantaged communities. To the extent feasible, the Committee is interested in analyzing the contribution of UOGD emissions to the observed trends in air quality and exposure and the effectiveness of evolving policy and industry practice intended to reduce exposures to UOGD emissions.

Rationale for the RFQ

Much has changed in the oil and gas sector since the shale boom began in the early 2000s. Federal, state, and local regulation and policy have evolved alongside industry practice. Many of these changes have been designed to address concerns about emissions to air and determining whether and why they succeeded is at the core of HEI Energy's mission. During this same period, alongside research funded by HEI Energy, a great deal of research has been conducted to understand human

exposures and health effects (e.g., [HEI Energy 2021](#)), while routine monitoring has continued (e.g., EPA's Photochemical Assessment Monitoring Stations Network) and remote sensing has emerged as an increasingly important tool to understand human exposure.

After years of data collection, some researchers have begun to review air quality data for specific regions (e.g., McMullin et al. 2018, Garcia-Gonzales et al. 2019, Lim et al. 2019, Long et al. 2019, Lyu et al. 2020, and Lange et al. 2023) and assess trends in air quality (Lange et al. 2023). The HEI Energy Research Committee (the "Committee") recognizes that sufficient data might now be available to analyze trends in air quality and community exposure since the early 2000s in one or more U.S. regions and, where feasible depending on the extent and quality of emissions information and available air quality models, use that data to link concentrations to source emissions. The Committee is interested in learning how air quality may have changed and the corresponding influence on community exposures in various subpopulations, including historically disadvantaged communities. To the extent feasible, the Committee is interested in analyzing the effectiveness of evolving policy and industry practice intended to reduce exposures.

The Committee recognizes that air quality in UOGD locations can be affected by emissions from conventional oil and gas development and other local and regional sources such as industrial activities, non-UOGD traffic, as well as naturally occurring chemicals. They briefly summarized scientific literature in which investigators endeavored to distinguish between UOGD's influence on air quality from other sources. (See, for example, Section 4.2.2.3 in [HEI Energy Research Committee, 2020](#)). Applications should acknowledge this challenge and describe the extent to which data available for their selected study location can be used to separate air quality changes associated with UOGD from other local and regional sources.

Identification of Study Region

Target one or more important regions for oil and gas production with sufficient data to assess trends in emissions from all local and regional sources, air quality, and exposure. The Committee is interested in detailed analyses of single regions to provide a comprehensive understanding of trends in emissions, air quality and exposure, at least to the extent that existing data permit. The Committee expects that the location and size of regions selected for study will, in large part, be driven by the availability of data. The selected region might need to be limited to a relatively small area to assess the effect of evolving UOGD policies and practices. At the same time, the Committee recognizes that, in some cases, less detailed analyses of multiple regions might be more useful for understanding trends than a detailed analysis of a single region, but they would likely be less useful in linking trends to specific UOGD sources, practices, or policies.

Data Sources

Provide information on the type of data available for use in the research, including the period, location, and frequency of measurements, and quality assurance. Useful data outside the public domain might be acceptable for use if their quality and utility for trend analyses can be independently assessed. Consider and account for any lack of comparability of data collected over time for different purposes.

Air Quality Data. The data are expected to include air quality monitoring data collected with ground-based stationary, mobile, and passive monitoring and with remote sensing (e.g., satellites).

The data might have been collected to understand how UOGD or oil and gas operations more generally might have affected air quality (e.g., numerous studies published in the peer-reviewed literature and public efforts to understand air quality effects of oil and gas, such as the [Broomfield Air Quality Monitoring Program](#)) or as part of other air quality monitoring programs that overlap UOGD regions, such as EPA's routine monitoring programs (e.g., PAMs network and other [networks](#)), and more specific initiatives (e.g., [ARP Enhanced Air Quality Monitoring](#) and state-required monitoring networks).

Other Types of Data. Operational data for UOGD and other local and regional sources that emit the same chemicals emitted by UOGD are important for distinguishing air quality changes attributable to UOGD. Noise data also might be helpful in understanding UOGD's impact on air quality if noise is correlated with any UOGD emissions. Other types of data (e.g., indoor air data and human biomonitoring data) also might be helpful in understanding factors that influence trends in air quality and community exposure.

Data Analyses

Describe analyses that will be conducted to understand trends in air quality and community exposure and variables that might explain any observed trends. Trend analyses must recognize and accommodate a number of factors that can contribute to the spatial and temporal variability in observed air quality. These factors include but are not limited to:

- UOGD operational variability and trends. Individual wells and associated facilities have their own unique character, stemming from their location, design, and stochastic nature of facility operations with variation in emissions over the life cycle of each well. In addition, UOGD is subject to operational trends as a function of technological innovation, changing regulations, market conditions, and efforts to protect public health and the environment, trends which can be consequential for potential human exposures. Two examples involve leak detection and repair (e.g., Pacsi et al. 2019) and gas flaring (e.g., Dix et al. 2019).
- Regulatory trends. In the last 10-15 years, many U.S. states have modified their governance of UOGD to protect public health and the environment.
- Presence of other sources. Many of the chemicals emitted by UOGD operations have other anthropogenic sources (e.g., conventional oil and gas development, orphaned and abandoned wells, active coal mines or abandoned mines, landfills, power plants, vehicle emissions, and long-range transport) and natural sources (e.g., methane from biological sources or from depth by way of migration along natural fractures).
- Environmental conditions. The type, location, and extent of UOGD vary as a result of factors such as geology, hydrology, and meteorology. This variability, in turn, influences the potential emissions to air.

Data Management, Preservation, and Access

Providing access to data is an important element in ensuring scientific credibility and is particularly valuable when studies are of regulatory interest. It is the policy of HEI to ensure access is provided expeditiously to data for studies that it has funded and to provide those data in a manner that facilitates review and verification of the work while protecting confidentiality and self-determination of any participants or communities involved in the study and respecting the

intellectual interests of contributors to the original work. Please refer [here](#) for the HEI Policy on the Provision of Access to Data Underlying HEI-Funded Studies.

Successful applicants will be expected to prepare a data management plan with an explicit description of how data are owned and shared and, where data are provided by a third party, a process for other investigators to obtain and work with the data.

Quality Assurance/Quality Control

To ensure research of the highest quality, all work will be subject to Research Committee oversight and peer review by the HEI Energy Research Committee. However, quality assurance depends primarily on the investigator's own quality assurance plan throughout all phases of research. Before commencing research, investigators must prepare and obtain approval of a Quality Assurance Project Plan (QAPP) prepared in accordance with U.S. EPA guidance (see <http://www.epa.gov/quality>).

RESEARCH TEAM

The research team should possess the full range of expertise to conduct the proposed research. The Principal Investigator (PI) should be affiliated with an established research organization and be a widely recognized expert in their area(s) of expertise with a reputation for producing high-quality and objective research. The PI should be extensively published in the peer-reviewed scientific literature and have demonstrated experience successfully leading multidisciplinary teams of scientists. The full team can include the PI, their immediate team (other faculty, research scientists, post docs, students, and technicians), co-investigators, or collaborator(s) at other institutions, community members, and consultants.

HEI strongly encourages applicants to diversify their research teams by including individuals from groups that are underrepresented in environmental exposure and health research and, to the extent appropriate given the study locations, be attuned to and knowledgeable about the communities in which the studies are taking place. For this purpose, HEI has adopted the National Institutes of Health (NIH) definition of underrepresented populations in the U.S. Biomedical, Clinical, Behavioral and Social Sciences Research Enterprise.³

STUDY DURATION AND BUDGET GUIDELINES

Between \$1-2M will be available for this RFQ to fund up to three studies (maximum study budget \$1M). Studies are estimated to begin in January 2024 and be completed within one year (i.e., by January 2025).

³ NIH's definition of underrepresented populations includes individuals from racial and ethnic groups underrepresented in health-related sciences on a national basis, individuals with disabilities who are defined as those with a physical or mental impairment that substantially limits one or more major life activities, and individuals from disadvantaged backgrounds, recognizing that women from these three backgrounds face particular challenges at the graduate level and beyond in scientific fields (Source: <https://grants.nih.gov/grants/guide/notice-files/NOT-OD-20-031.html>).

APPLICATION COMPONENTS

The application should consist of the following components:

1. Cover page ([Form F-1](#))
2. Statement of Qualifications (6-page maximum; *no specific form required*) consisting of:
 - a. Rationale for the selected region(s).
 - b. Description of the anticipated study location, data to be analyzed, including their quality and accessibility, and how you plan to secure the data. If the study requires access to a physical site or data managed by other groups, the team should demonstrate access, for example, by including letters of support from site owners or data managers in the proposal. The study team should have access to or be able to purchase or rent facilities, equipment, instrumentation, or cloud computing services needed to support the proposed research and have prior experience with preparing and implementing quality assurance plans.
 - c. Brief narrative of the types of analyses that will be conducted, along with associated quality assurance/quality control procedures, to understand trends in air quality, exposures across various human subpopulations, including historically disadvantaged communities, and the impact of specific UOGD sources, if feasible, to identify the effectiveness of interventions in reducing community exposures.
 - d. Organizational chart that clearly identifies each team member, their affiliation and role in the research, and lines of communication among team members and how they lead to the PI who oversees the research and coordinates its successful completion. Note any potential conflicts of interest.
 - e. Milestone chart depicting the timeline for completing the research.
3. Description of the facilities, including data security procedures, available at the applicant institution. ([Form F-9](#)).
4. A budget justification for the study. The assumed start date should be January 31, 2024. Budget forms ([Forms F4a and F5a - and 4b and 5b if applicable](#)) should be used. Time and travel expenses should be budgeted for the likelihood of one in-person meeting with the Committee during the study.
5. Biographical sketches of the key personnel involved ([Form F-10](#)).

HOW TO APPLY

The application should be submitted in electronic form by email in PDF format by **November 14, 2023**, to Janet McGovern at jmcgovern@healtheffects.org. Applications should not exceed a file size of 20 MB. Once the application has been submitted, please send a second email to jmcgovern@healtheffects.org without any attachments to notify HEI Energy that your application has been submitted. HEI Energy will acknowledge receipt of the application.

The required application forms [are compiled here](#). No specific form is required for the Statement of Qualifications. For questions about the RFQ please contact Dr. Donna Vorhees (dvorhees@healtheffects.org).

For details about HEI Energy research and applying for funding, please consult the [HEI Energy Policies and Guidelines](#) page, and documents on the HEI Energy [Research and Review Process](#) and [Investigator Commitments](#).

REVIEW OF APPLICATIONS

The HEI Research Committee will review the applications based on the quality of the narrative; relevance to the objectives of the RFQ; experience, competence, and diversity of the research team; adequacy of facilities, including access to relevant data sets; and reasonableness of the proposed costs. A response to all applicants is anticipated by **December 22, 2023**.

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