

PUBLIC HEALTH DIMENSIONS OF OIL AND GAS DEVELOPMENT



Symposium

January 21-22, 2016

Tools
Strategies
Collaboration

Co-sponsored by:



coming **clean**

1976 ♦ COMMONWEAL ♦ 2016

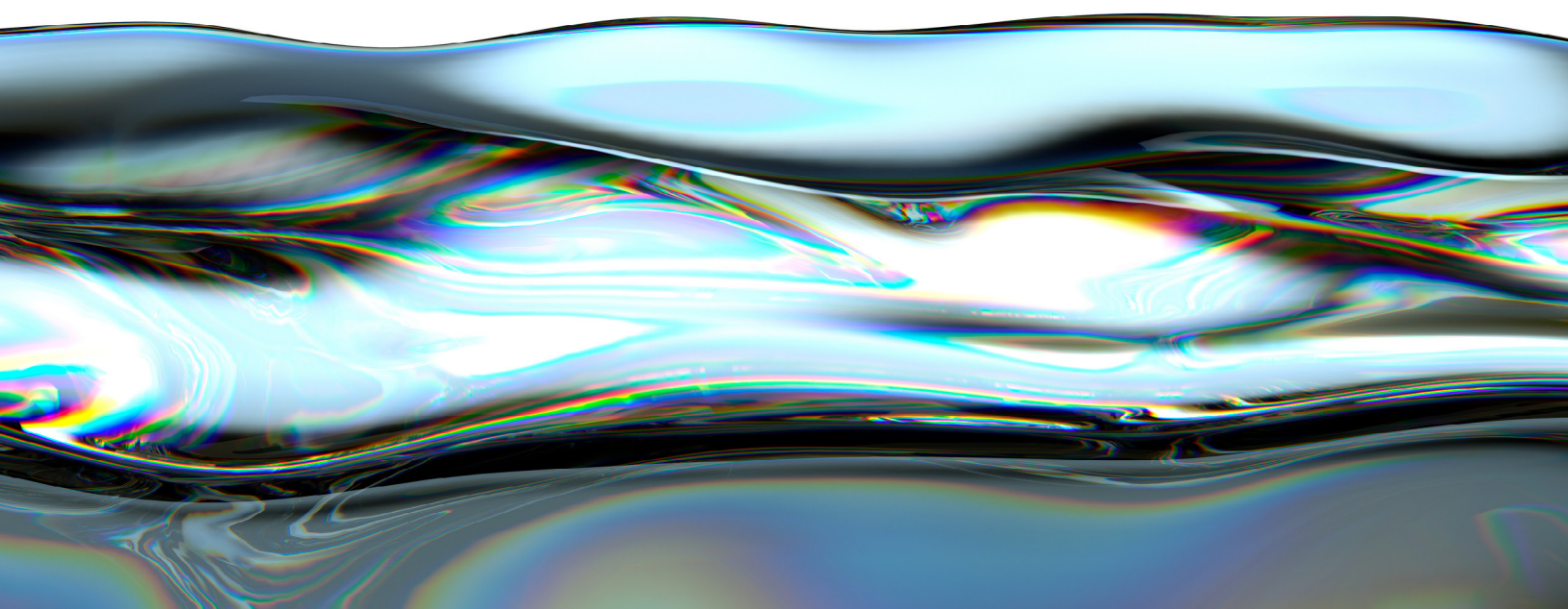


TABLE OF CONTENTS

2	Symposium Overview
3	Policy Recommendations & Future Research Needs
5	Presentations
28	Breakout Sessions & Discussion
31	Appendix A. Presenter Profiles
34	Appendix B. Participant List
37	Appendix C. Agenda

SYMPOSIUM OVERVIEW

On January 21-22, 2016, a group of 40 community advocates, scientists and public health practitioners from across the country convened for a symposium with a collective set of goals. This symposium aimed to discuss the role of monitoring in identifying and communicating the potential health risks of unconventional oil and gas development (UOGD), while also creating space to discuss community monitoring experiences, share expertise to add value to engagements, and finally, to provide an opportunity to connect public health departments and relevant stakeholders.

This symposium was organized as the follow up to the first “Fracking and Health” symposium convened by CEH and other groups in Washington, D.C. in 2014. Attending the 2014 Symposium were scientists, health professionals, nonprofit researchers, community advocates and others working on energy issues with a focus on unconventional oil and gas development. This gathering was significant in that it brought these groups together for the first time to focus specifically on community monitoring.

The 2016 symposium was organized for frontline communities, community scientists, researchers, as well as health professionals looking at environmental and social determinants of health, with the intention of creating effective engagement and collaboration amongst those working on upstream oil and gas activities.

This symposium was co-sponsored by the Center for Environmental Health, Alliance of Nurses for Healthy Environments, California Environmental Health Tracking Program, Coming Clean Collaborative, Commonweal, PSE Healthy Energy, Physicians for Social Responsibility - Los Angeles, and Urban & Environmental Policy Institute, Occidental College.

The attendees first met to hear a series of presentations. They then moved into breakout groups to have in-depth discussions of monitoring practices, challenges facing the community, and challenges of collecting research data. Each breakout group considered different topics. To learn more about these sessions, see Breakout Session and Discussion.

For a full list of speakers and attendees, see Appendices A. & B.

Policy Recommendations & Future Research Needs

The following were key policy recommendations that emerged from the presentations and break-out discussions with the goal being to help mitigate potential health risks from oil and gas development:

Increased Regulation & Accountability:

- Enforcing stricter regulations for emissions, disposal, etc.
- Ensuring the safe disposal of byproducts (e.g. UOG wastewater)
- Addressing unrestricted well stimulation chemical use
- Increasing regulation of percolation (disposal) pits
- Ensuring proper containment of UOGD wastewater

Improve Transparency and Reporting:

- Improving chemical data reporting standards (e.g. transparency)

Setbacks:

- Developing and enforcing science-based surface setbacks from sensitive receptors to limit exposures

Community & Political Engagement:

- Providing education, community power and collective voice/collective community action through:
 - civic engagement
 - demonstrations
 - advocacy
- Sharing information through support groups
- Supporting and partnering with local groups to effectively engage in community-level organizing
- Seeking opportunities for political engagement
- Supporting capacity building at the local level
- Partnering with tax and fiscal policymaking officials to establish programs to nurture new leadership in affected communities

Fostering Collaboration:

- Improving collaboration among different environmental health organizations to develop

solutions for reducing pollution resulting from unconventional oil and gas development

- Creating a shared vision among all partners to integrate climate, health, and equity
- Bringing together health researchers, community organizers, and physicians to advocate against community drilling

Air Quality Control:

- Requiring application of air pollutant emission control technologies for all oil and gas infrastructure
- Bringing industry representatives and community leaders together to improve air quality and protect the public's health
- Increasing the role of government in enacting policies to reduce emissions from UOGD facilities

The following were key research needs and considerations that emerged from presentations and break-out discussions:

Data Quality & Monitoring Considerations:

- Developing models
- Conducting air monitoring using real-time information from monitors
- Improving specificity of inventories to allow better understanding of oil and gas air pollutant emissions sources
- Measuring pollutants/leaks both temporally and spatially to more effectively compare data
- Using data quality assessments to compare monitoring information
- Investigating the use of low-cost monitoring tools to develop high quality data

Air Quality Research:

- Furthering research on health effects associated with UOGD
- Assessing air quality at different locations/air

pollution exposures as a function of distance - at facilities, directly outside, and on the fence line

- Framing research in a way that allows the results to be compared, and to use the comparisons to develop models for monitoring
- Conducting research to highlight exposure pathways

Research Needs:

- Conducting research to determine three important factors: the identity of the chemicals, the impact/toxicity of the chemicals, and the quantity/frequency of use of the chemicals
- Researching population density and cumulative impacts of UOGD pollution are important considerations
- Conducting human health risk assessment
- Conducting data analysis (pre and post UOGD conditions)
- Conducting long-term health studies are needed
- More health-related testing on UOGD chemicals
- Eliminating the gap between research that is available at the regulatory level and research that community needs to be informed about air quality that impacts their health
- Improving strategies for data dissemination
- Collecting field data and ensuring public health commitment and infrastructure
- Research should be encouraged to address health needs, but also designed in a way that will have policy outcomes. This latter goal is often overlooked. Strategic partnering in this case could include private foundations that might fund research and state agencies like departments of health that would be interested in results.

Community & Partnership Considerations:

- Considering cultural sensitivity, neighborhood history, and challenges the residents face
- Seeking assistance from the science/research community, universities, and national labs
- Supporting the need for community-based participatory research to be able to promote sustainability

PRESENTATIONS

Welcome & Introduction

Ansje Miller, Director of Policy & Partnerships, Center for Environmental Health
Michael Green, CEO, Center for Environmental Health

Michael Green, founder and CEO of CEH, opened the symposium describing CEH's work to protect individuals and communities from toxic chemicals. Mr. Green discussed how the chemical industry fails to adequately test chemicals for their potential to harm the environment and human health, referring to this practice as a "science experiment" on the public. He also outlined how chemicals that are eventually found to be harmful are often replaced by new, untested substances that are often just as hazardous. He introduced the related topic of unconventional oil and gas development (UOGD), discussing the high health costs associated with UOGD in residential neighborhoods and the concerns that children in these communities are exposed to disproportionately high rates of toxic air pollution.

Mr. Green suggested that we begin mediating this issue by sharing data and techniques, providing an overview of the different types of oil & gas extraction and associated health risks, and then using this information to create a shared understanding about what health threats communities collectively face. By doing so, he stated, we will learn from communities and be able to come together to talk about health monitoring and health studies and ways to bring health information about risks to decision-makers. Together, these practices will enable us to engage health departments to implement new strategies and practical applications.

Public Health Dimensions of Oil & Gas Development in California

Martha Dina Arguello, Executive Director, Physicians for Social Responsibility, Los Angeles

Ms. Argüello provided an overview of the work she has carried out as Executive Director for PSR-LA. Physicians for Social Responsibility works in support of communities that are disproportionately affected by oil and gas extraction by highlighting the lack of science on urban oil drilling. The work of PSR focuses on both indoor and outdoor air quality issues and it is in this context that they are working with the STAND –LA coalition to develop policies that will protect urban residents from toxic exposures. Ms. Argüello described her work with local elected representatives, community members, and health professionals to find and advocate for strategies to reduce urban asthma rates and to explore ways to integrate the medical voice into environmental policy. She stated that PSR works to bring together the powerful voice of communities with the credible voice of the medical community to create policy and systems changes. She noted that the emerging scientific evidence showing that the best way to address climate change is to ensure that fossil fuels stay in the ground. Further, Ms. Argüello made the case for focusing on the issues of urban oil drilling in Los Angeles, given the city's long history of oil drilling and unequal protection for low-income communities.

Types of Oil and Gas Development, Health Risks, and Approaches to Reduce These Risks

Seth B.C. Shonkoff, PhD, MPH, PSE Healthy Energy, University of California, Berkeley

PSE Healthy Energy is an energy research and policy institute working to bring scientific transparency to energy policy issues by generating, translating, and disseminating scientific resources. The ultimate purpose of PSE is to ensure responsible decision-making in energy policy. Citing a study commissioned by the California Natural Resources Agency under Senate Bill 4 and conducted by the California Council on Science and Technology, Dr. Shonkoff provided an overview of what is known and unknown concerning the public health dimensions of oil and gas extraction, specifically in the state of California.

Oil and Gas Extraction Techniques

In an in-depth explanation of the sources of oil and gas and the techniques of extraction, Dr. Shonkoff highlighted how UOGD in California varies from techniques used in other states. He began by describing the differences between source rock and migrated oil development. Outside of California, oil is generated in shale rock and the extraction process involves vertical drilling of a well. Through this process, water, sand, and chemicals are pumped through the source rock to increase pressure, which then cracks open the source rock and releases the pockets of oil and gas. When pressure of the wellhead is released, the oil and gas flow upward (on their own) to be collected. However, this process is not used in California. In California, the majority of oil and gas production is from migrated oil pools. In this process, oil and gas migrates upward towards the surface along fissures and cracks until it hits a cap rock and collects in oil fields. Most often, a vertical well is drilled into these oil and gas zones for production. If the oil is in a "tight" formation (low porosity), hydraulic fracturing is often used (e.g., in the diatomite formations in the North and South Belridge oil fields in the San Joaquin Valley). This is important because the health hazards and risks of oil and gas development, especially in California, are not always attributable to hydraulic fracturing and well stimulation but to the oil and gas development process as a whole.

As of July 2014, there were 51,694 active oil wells in California, 125-175 of which were hydraulically fractured each month. Approximately 90% of the hydraulically fractured wells in CA were located in the San Joaquin Valley, and in 2012-2013, over 85% of hydraulic fracturing operations occurred in 4 fields on the west side of this region, specifically South Belridge, North Belridge, Elk Hills, and Lost Hills. Approximately 20% of oil and gas produced in the State of California in 2014 was attributable to hydraulic fracturing and the remaining 80% is attributable to other forms of oil and gas development techniques, such as enhanced oil recovery (EOR).

EOR is one of the most commonly used suite of techniques of oil and gas development used in California. One type of EOR is steam injection, which involves the injection of steam into oil and gas wells in order to heat up heavy, tar-like oil, enabling it to more easily be produced. Studies have found that the air pollution and waste products are not dissimilar to oil production from hydraulic fracturing. A primary difference between oil and gas produced by EOR versus hydraulic fracturing is that the latter has a lower carbon intensity level (GCO₂ emitted per unit energy delivered to the consumer). The California Air Resources Board carbon intensity score for steam injection-enabled oil production is much higher than the global average. In addition, there are little data to suggest that EOR-enabled oil and gas development emits less methane and associated air toxics than hydraulic fracturing.

Public Health Concerns

Subsequent to explaining the techniques by which oil and gas are extracted, Dr. Shonkoff described how oil and gas development can lead to toxic exposures and health problems. There are pollution concerns across all stages of the unconventional oil and gas lifecycle, including pad construction, drill set-up, drilling, hydraulic fracturing, oil or gas extraction, well decommissioning, and land restoration. Dr. Shonkoff discussed the chemicals used both during hydraulic fracturing as well as during other types of oil well stimulation techniques such as EOR. He discussed the use of produced water—water produced as a byproduct of oil and gas development or water that comes out of oil and gas fields as a result of production—and the risks of reuse of this produced water that can lead to contamination of drinking water and crops.

Below is a list of the primary public health risk factors specifically associated with the oil and gas development in California:

1. Elevated toxic air contaminant concentrations near human populations
2. Use of large numbers of chemicals and lack of information about their effects on human health and the environment
3. Use of produced water for irrigation of crops without appropriate testing and treatment
4. Disposal of produced water with chemicals into unlined pits (percolation pits), especially near water aquifers (this is an exposure pathway if the water is used for human consumption or agriculture/crop irrigation)
5. Shallow hydraulic fracturing near protected aquifers that are or could be used for human consumption
6. Disposal of produced water into aquifers that are or could be used for human consumption
7. Elevated VOC and silica exposures in occupational settings

Studies have found that air quality is consistently worse in regions where oil and gas are produced. Various chemicals, including benzene, formaldehyde, hexane, hydrogen sulfide and others can be released into the air from oil and gas operations and are associated with health problems. Moreover, in particular in the San Joaquin Valley of California, this oil and gas development co-occurs with what is already some of the worst air quality in the United States. This region is also one of the poorest and home to disproportionately low-income people and communities of color. The combination of poor air quality, other environmental exposures, poverty, and low socioeconomic status contribute to a cumulative environmental burden on communities living near oil and gas development.

In addition to air quality concerns, Dr. Shonkoff discussed how geographic proximity to oil and gas development activities are associated with risks to public health. The closer an individual resides to a UOGD site, he stated, the more likely that individual is to be exposed to air toxics emitted from oil and gas development activities. One study found that there is a significant positive correlation between density of and distance from oil and gas wells and the rate of hospitalizations for cardiologic, neurological, oncological, dermatological, and urological issues.

Dr. Shonkoff also described the associations between birth defects and UOGD observed in studies in the peer-reviewed literature. A number of studies suggest that as the density of oil and gas development activity increases, so does the risk of adverse birth outcomes and some birth defects, specifically neural tube defects (NTDs) and congenital heart disease. He explained that a study in Colorado found evidence that babies born to mothers that live in the highest density of oil and gas development were twice as likely to give birth to a baby with a NTD than mothers who gave birth in areas with no oil and gas development within 10 square miles. Other studies out of Pennsylvania suggest a statistically significant association between UOGD density and the risk of premature births.

The negative health impacts of UOGD are especially salient in California for several reasons. As Dr. Shonkoff discussed, the fact that drilling activity occurs in high population density areas (for example, the Inglewood Oil Field in Los Angeles) means that more individuals are at higher risk of being exposed to health-damaging air pollution associated with oil and gas development.

Future Research Needs and Policy Recommendations

Dr. Shonkoff noted that a lack of data transparency is a significant problem and that the lack of accessibility to relevant data poses a major challenge to carrying out exposure studies related to oil and gas development. In order to better understand the health risks of UOGD, more research and more comprehensive policies are required. Dr. Shonkoff provided an overview of research, action, and policy recommendations from a state-funded report conducted by the California Council on Science and Technology and Lawrence Berkeley National Laboratory (CCST report), of which he was the lead author on the public health research. This report calls for the initiation of studies in California to assess air pollutant exposures as a function of distance for all types of oil and gas development, not just stimulated wells.

Dr. Shonkoff highlighted a need to develop science-based surface setbacks to limit exposures, to require the application of air pollutant emission control technologies for all relevant oil and gas infrastructure, and to improve specificity of inventories to allow better understanding of oil and gas air pollutant emissions sources. Policies must also address the public health hazards of unrestricted chemical use in well stimulation. Currently, oil and gas operators have few restrictions on the types of chemicals they use for hydraulic fracturing and acid treatments. Even under SB 4's mandated disclosure, chemicals can be reported as "trade secrets." The large number of chemicals used and the limited information on many of them makes it difficult to judge the public health risks posed by releases of stimulation fluids. Chemical disclosure policies should, at minimum, address three important factors: the identity of the chemicals, the impact/toxicity of the chemicals, and the quantity/frequency of use of the chemicals.

According to the CCST report, public policy must also address the use of potentially contaminated water for food crop irrigation, as is seen in the Cawelo Water District of California. Due to the frequency of droughts in California, there is a need to reuse water. However, reused water must not pose risks to human health and the environment. The potential exposure pathways from the uptake of chemicals into the food supply through irrigation make regulation and research imperative. The CCST report recommends that UOGD-produced water should not be used for irrigation or groundwater re-charge until or unless appropriate testing shows non-hazardous chemical concentrations, or that required water treatment reduces chemical concentrations to non-hazardous levels.

Lastly, the CCST report calls for policies that ensure the safe disposal of oil and gas wastewater. In preliminary results from an analysis of chemicals used in routine oil and gas activities (e.g. drilling, well maintenance, etc.) in the Los Angeles Basin, more than 10 chemical additives found are on the Proposition 65 List; multiple chemical additives are on the list of U.S. EPA National Primary Drinking Water Standard and Health Advisory Chemicals; more than 20 are categorized as "category 1 & 2" in the Globally Harmonized System (GHS) for mammalian toxicity; and more than 100 are categorized as "category 1 & 2" (most toxic) in the Globally Harmonized System (GHS) for ecotoxicity. Therefore, it is necessary that percolation (disposal) pits be highly regulated to contain UOGD wastewater with appropriate testing and treatment or altogether phase out this practice.

Race, Health Disparities, and Community Engaged Research: Case Study of Los Angeles

Bhavna Shamasunder, PhD, Assistant Professor, Urban and Environmental Policy, Occidental College

Dr. Shamasunder discussed issues of race and class in relation to oil and gas development. According to her research, the industry has worked to hide oil and gas development from public view since the 1940's. Historically, individuals from lower socioeconomic backgrounds have faced a disproportionate burden of risk from unconventional oil and gas development. She noted that we must focus on factors such as population density, cumulative impacts, regulatory failure, and power/access when addressing oil and gas development. As Los Angeles contains more than 1,000 active oil wells and high population density, its residents are especially at risk from UOGD.

Dr. Shamasunder specifically focused on the question of how we think about UOGD in relation to issues of environmental justice. How, for example, do we measure the vulnerability of a neighborhood, or count the number of existing environmental harms in that area that might contribute to cumulative and aggregate risks? How do we address the exposures of children and elderly in areas with oil production facilities? Dr. Shamasunder highlighted the lack of monitoring data in neighborhoods and the need for further research. She pointed to CalEnviroScreen 2.0 as an example of a measurement tool that addresses questions of environmental justice. The screen is a method developed by the Office of Environmental Health Hazard Assessment of CalEPA to map exposures in order to identify the most vulnerable communities and determine overlap between these communities and proximity to oil fields. CalEnviroScreen 2.0 has allowed researchers to recognize an overlap between the most vulnerable populations, such as children and elderly, and the presence of oil fields.

Lastly, Dr. Shamasunder pointed out the lack of regulations concerning UOGD in Los Angeles. At the state and local levels, there is an ineffective process for monitoring oil and gas facilities and the affected communities lack power to address their concerns. There is no plan in place to address the cleanup problems associated with closing oil and gas facilities. The California Department of Conservation houses the Department of Geothermal and Gas Resources, the regulatory agency with primary oversight of UOGD. But the Department of Conservation does not participate in the state environmental justice framework, so UOGD is not included in regulatory work involving vulnerable populations. Dr. Shamasunder called for greater regulatory attention to issues of neighborhood oil drilling in Los Angeles given that exposures are both ubiquitous and disparate.

The Strength of Community: Organizing for Environmental Justice, Health, Housing, and Safety

Rabeya Sen, Director of Policy, Esperanza Community Housing Corporation

Ms. Sen presented a case study highlighting the strengths of community organizing and advocacy in holding both industry and government accountable for public health. She explained the issues of race and class in an environmental justice framework. Describing Esperanza Community Housing Corporation, Ms. Sen recounted how one community came together through the organization and found power in collective voice, achieving an exemplary level of justice. Esperanza Community Housing Corporation provides community housing for those threatened by displacement and homelessness. The group insures that community voices are part of the civic process, are heard and not ignored, and are one of the driving forces in the local government's response to upholding health and safe housing as basic human rights.

In explaining the purpose of Esperanza Community Housing Corporation, Ms. Sen emphasized the disparate treatment of marginalized communities in regards to oil and gas infrastructure and development. Providing an example of community organizing, Ms. Sen described the AllenCo drilling site in the University Park area of South Central Los Angeles, which operates on land they lease from the LA Archdiocese. It is a neighborhood consisting of schools and residences that are highly impacted by industry. In 2009, community residents reported foul odors emanating from AllenCo, along with health symptoms including loss of smell, chronic fatigue, nausea, headaches, blurred vision, confusion, stomach ailments, increased head pressure, pediatric and adult-onset of asthma, respiratory distress, sensitivity and pain in eyes and throat, and spontaneous nosebleeds.

In 2010, the community established an initiative called People Not Pozos. They developed monitoring and tracking systems, held community meetings, recorded community members' symptoms, and tracked reports to and responses from the local regulatory agency, SCAQMD (South Coast Air Quality Management District). In addition, they began conducting a health assessment survey in households to document the community's health and track it in the upcoming years. They also reached out to other communities and the press to publicize their efforts. In 2013, officers from the EPA investigated the AllenCo drilling site. During their tour, the EPA officials fell sick, suffering from sore throats, coughing and severe headaches that lingered for hours.

Shortly after the EPA visit, residents were told monitoring would continue in the area. In the months following, AllenCo announced it would close down the site to make repairs.

Community efforts in LA have led to the formation of Stand Together Against Neighborhood Drilling Los Angeles (STAND LA), a coalition working to address the health and safety issues around the area's oil and gas facilities. STAND LA has called for human health and safety buffer zones that would prohibit all oil and natural gas extraction in residential neighborhoods. In addition, youth from the affected communities in South Central LA and Wilmington have sued the city of LA, accusing it of "rubber stamping" oil-drilling plans, alleging that the city has disproportionately exposed residents to health and safety risks and engaged in unlawful racial discrimination and violation of environmental justice.

In closing, Ms. Sen emphasized the importance of community organizing and power in highlighting health risks and disparate impacts in communities near oil and gas drilling sites, especially in communities of color and low-income communities of color. She emphasized that neighborhood drilling is fundamentally incompatible with human health, and is inextricably tied to issues of racial and economic justice. Marginalized communities face great danger from the oil and gas industry, and collective community action goes a long way in enacting change. Ms. Sen stressed the importance of community power and collective voice to improve regulatory standards for the oil and gas industry. She also emphasized the need for expanding to larger issues around policies and planning (such as racial and economic justice) and called on health researchers, community organizers, and physicians to join in the fight against neighborhood drilling.

Citizen Science and Monitoring – Case Study of Susquehanna County, PA

Rebecca Roter, Founder and Chair of Breathe Easy Susquehanna County (BESC)

Ms. Roter founded Breathe Easy Susquehanna County “to protect air quality and health of communities across Pennsylvania’s Marcellus Shale region from potentially harmful air emissions released through the processes of shale gas extraction, production and transport.” In this presentation, she discussed the incidence of an explosion of a natural gas compressor station in Susquehanna County, Pennsylvania. Subsequent to the explosion, the community united under the common goal of limiting chemical exposure from oil and natural gas infrastructure and making air quality a mainstream concern. Ms. Roter stressed the need for scientific-based data in advocating for these common goals, which will increase the organization’s credibility and public presence. She briefly explained the importance of bringing industry representatives and community leaders together to work together towards protecting air quality and the health of the public. Additionally, their strategy to “co-opt” industry and foster respectful fact-based dialogue was to manage public opinion to make concern about air quality and public health mainstream in a community where environmentalist is synonymous with tree hugger. They had no illusions they would really convince operators to change their ways; nonetheless, they adjusted their public relations as needed.

Presentation: Community Engaged Air Pollution Monitoring – Case Study of Lost Hills, CA

Rosanna Esparza, PhD, Clean Water Action, California

Ms. Esparza is an environmental organizer, advocate, and resident of Kern County, California who facilitates the environmental literacy, justice, and engagement of Lost Hills residents. The community is facing the health and safety challenges of living near oil and gas production. She noted in her presentation that issues of air quality are of great concern in Kern County, CA because of the high number of oil extraction facilities and the number of chemicals typically known to cause cancer (420 chemicals) detected in blood, urine, hair, and other human samples. In Lost Hills, Ms. Esparza learned that community members are concerned about air and water quality of their neighborhood because of oil and gas development. She and her colleagues have reached out to local residents and invited individuals to participate in collecting Odor and Health logs to document what they smell and their symptoms associated with the odors.

She shared the results of this tracking. Along with area residents and her colleagues, she used these logs to gain insight into air pollution levels and community health outcomes. They used Dylos air quality monitors to track the days and times of higher levels of volatile organic compounds (VOCs) in the air and linked this data with information from the Odor and Health logs. She also interviewed residents and learned that many children were missing about 60% of the school year because of bloody noses, headaches, and gastrointestinal issues. In addition to health effects, community members expressed concern over the adverse environmental impacts of UOGD due to air pollution from the oil extraction sites, gas operations, drilling, flaring, compressors and pits.

By measuring emissions from the facilities with low-cost air monitoring tools and obtaining data from residents, they were able to bring solid data to legislators. Ultimately, the goal is to shut down the plants in residential areas to reduce air pollution and the associated adverse health effects. Ms. Esparza emphasized the importance of considering community input in gathering data and enacting change. She ended her presentation by advocating for collective community advocacy in acting to protect neighborhoods from air and water pollution.

Value of Community Perspective in Research and Monitoring Development

Niki Wong, MPH, Lead Community Organizer at Redeemer Community Partnership

Ms. Wong spoke from a public health perspective about her experiences in working with communities in South Los Angeles that have been affected by oil and natural gas development. She cautioned that affected communities have little trust in regulatory agencies or the research community, due in part to a lack of transparency. Ms. Wong further noted that the promise of bottled drinking water provided by the industry and the threat of cessation of provision have been used to inhibit residential complaints or health reports when water wells are contaminated. In order to work with communities, she stated that researchers need to collaborate with on-the-ground groups, like Redeemer Community Partnership, that have earned community trust.

Ms. Wong went on to discuss quality of life issues associated with natural gas development on Jefferson Boulevard in South LA and the major concerns of community members including fumes and odors, noise, and health problems. Chemicals of high concern in South LA include silica sand, a known carcinogen; methanol, an air toxin known to cause developmental toxicity; 2-Butoxyethanol, an air toxin and endocrine-disruptor; nonylphenol ethoxylate, an endocrine-disrupting chemical; and hydrochloric acid and hydrofluoric acid, highly toxic and corrosive compounds. Ms. Wong described community outreach efforts used to increase awareness about these chemicals and the health effects associated with long-term exposures. Efforts include providing education and mobilizing the community through civic engagement, demonstrations, and other advocacy forms.

Ms. Wong explained how community organizing informs research development. The methods she highlighted included relationship building with community members and policymakers; adding to the research community perspective, including consideration of cultural sensitivity, neighborhood history, and challenges the residents face; and increasing empowerment among community members experiencing disproportionate health effects from oil drilling by giving them a voice and participation opportunities in research efforts.

Frontline Community Organizing to Protect Health

Ashley Hernandez, Youth Organizer, Communities for a Better Environment, Los Angeles, CA

Ashley Hernandez works with local youth in Los Angeles to help them become active community leaders fighting for changes in the oil industry. Much of her work is done in Wilmington, the LA neighborhood that is home to the largest oil field in California. The Wilmington field produces 1/3 of the state's oil, contains 5 refineries, and is also home to 54,000 predominantly Latino residents. Many of the area schools are funded by the oil industry, creating a school-to-industry pipeline as the oil companies provide students with internships, scholarships, and jobs. This gives schools of Wilmington an incentive to ignore the harmful effects from living in close proximity to oil development.

Through her work with the community, Ms. Hernandez has found that pollution often stems from diesel trucks, auto dismantlers, brownfields, refineries, and oil drilling sites. In response to the increasing pollution due to oil development, Ms. Hernandez is helping the youth of LA sue the city for violating their civil rights.

Air Monitoring for Emissions from Oil and Gas Development Operations

Detlev Helmig, PhD, Associate Research Professor of INSTAAR, University of Colorado

Detlev Helmig assesses air quality impacts of oil and gas development, specifically in association with hydraulic fracturing, wells, loading, storage, distribution, pipelines, and flaring processes. Chemicals released from these processes form new chemical compounds in reactive processes with the atmosphere. This can result in the production of secondary particulate matter from PAH oxidation and ozone from nitrogen oxide and volatile organic compounds.

Dr. Helmig highlighted the various challenges with air monitoring of emissions from oil and gas development operations: a large variety of compounds are used, emissions can originate from numerous point sources, and air pollution is found in different concentrations. In assessing health risks, it is important to differentiate between primary emissions and secondary pollutants that may form in the atmosphere. The main pollutants of concern in the atmosphere are direct emissions from a specific source, such as benzene, which can be directly traced to elevated concentrations in the atmosphere. Secondary pollutants are produced by chemical reactions in the atmosphere, such as ozone and nitrated polycyclic aromatic hydrocarbons. Their production depends on the photochemical state of the atmosphere, which constantly changes. Therefore, during certain conditions secondary pollutants may be very high or low, even though the emission rates may remain constant. In addition, secondary pollutants are mainly of concern on a wider regional scale, rather than directly near a source. It is important to understand variability in atmospheric concentrations of emissions, which differ based on time of day, height from the ground, and spatial variations. Necessary considerations in monitoring emissions include cost, chemical type, sensitivity, precision, accuracy of monitoring tools and the skills and training required to use the tools. In order to improve air monitoring for emissions, Dr. Helmig proposed seeking assistance from the science/research community, universities, and national labs.

Mobile Monitoring, Data Broadcasting, and Source Attribution in Real-Time

Eduardo (Jay) Olaguer, PhD, Program Director at Air Quality Science, Houston Advanced Research Center

Dr. Olaguer gave an overview of various air monitoring techniques that can be used to test the air quality near unconventional oil and gas operations, discussed emissions of concern in relation to UOGD, and explained how public health assessments can be used to detect the effects of emissions.

One example of an air monitoring technique is the combination of an HARC 3-D micro-scale air quality model with a fast chemical ionization instrument for mobile monitoring, data broadcasting, and real-time source attribution. This combination enables measuring emissions at high temporal and horizontal resolution and attributing concentration spikes to emission events from specific emission points, as opposed to total emissions from a facility.

The Houston Advanced Research Center aims to compile more data than has ever been collected for human health risk assessment, combine social media and real time approaches to change the current mindset regarding air pollution, and empower community members to become involved in efforts to reduce air emissions from oil and gas facilities.

The Benefits and Limitations of Low-Cost Monitoring

Michael P. Hannigan, PhD, Associate Professor Mechanical Engineering Department, University of Colorado

Dr. Hannigan's research for the AirWaterGas Study focused on natural gas infrastructure, water quality and quantity, and the potential health effects from exposure to chemicals associated with oil and gas production. The work also included socio-economic impacts associated with policies and regulations, and the development of tools to improve air quality monitoring in the future. Oil and gas production data from Colorado demonstrates the convergence of new wells and increasing residential development. From these wells, there are various sources of pollution, including storage tanks, glycol dehydrators, drill rig engines, and diesel generators. Leaking storage tanks are a particularly major concern because they can emit hazardous chemicals into the air that are difficult to identify. In terms of air quality monitoring, he explained the importance of considering the origins of carbon dioxide, methane, VOCs, and other pollutants during oil and gas production. Each of these chemical species has impacts in the air, but at different spatial scales. Hannigan uses the multiple species to aid in determination of which specific activity is affecting the air quality. He notes that industry and regulators are working on improved measurement techniques to identify leaking equipment.

Low cost monitoring techniques have both benefits and limitations. In general, the new low cost sensors struggle with accurate quantification. To overcome this limitation, users can and should use thoughtful experimental design when exploring an air pollutant of concern. He noted that it is important to frame research in a way that allows the results to be compared, and to use the comparisons to develop a measurement plan and understand the results. Dr. Hannigan further pointed out the importance of acknowledging the limitations of monitoring and of being aware of the appropriate situations in which to apply each monitoring tool.

With their research, Dr. Hannigan and his colleagues hope to prove that high quality data can come from low-cost monitoring tools when they are used appropriately. The next steps in their research involve collaborations with community groups in regions where oil and natural gas development are occurring, emphasizing open source databases and analysis tools that include data quality assessment for the purpose of comparing monitoring information. To conduct this research, they are using Y-Pod air quality monitors, databases such as OpenAQ, homemade analysis tools, and educational materials.

Measuring Distance Decay Gradients Around Oil and Natural Gas Developments

Diane Garcia Gonzales, PhD Student, UC Berkeley Division of Environmental Health Sciences

Ms. Gonzales is a PhD student in Dr. Michael Jerrett's lab at UC Berkeley, where researchers have been exploring the key questions and challenges arising from oil and gas development as well as current practices for addressing some of these issues. She highlighted the importance of being aware of the origin of emissions and referred to a graphic of the natural gas production life cycle, which illustrated the multiple points at which leaks and emissions can occur and the various emissions compounds. Furthermore, she highlighted the importance of measuring human health impact zones around oil and natural gas development sites, to characterize the spatial variability in emissions and potential impact to human and environmental health.

Key challenges in air quality monitoring include temporal and spatial variability between sites, measuring and identifying all emission compounds from oil and natural gas sites, understanding the impacts of single and multiple exposures, and accurately attributing these emissions to their source. Bearing in mind both the potential environmental benefits and detriments from the displacement of coal, Ms. Gonzales suggested that solutions could be found through a combination of adequate monitoring and transparent reporting. In light of the anticipated increase in oil and natural gas development and the emergence of issues seen by communities near natural gas storage facilities, she urged that challenges be faced sooner rather than later.

Ms. Gonzales's research aims include investigating the human health impact zone around oil and gas operations in the Colorado Front Range and Southern California, comparing Colorado and California production phase results, interpreting potential human health outcomes resulting from these activities, and performing health analyses of infants born to mothers living inside the impact zone of oil and natural gas sites in California.

Air Sampling Through Speck Monitors

Raina Rippel, Director of Southwest Pennsylvania Environmental Health Project

The Southwest Pennsylvania Environmental Health Project (EHP) addresses the health effects of unconventional oil and gas development in Southwest Pennsylvania, New York, Ohio and West Virginia. EHP's mission is to respond to individuals' and communities' need for access to accurate, timely and trusted public health information and health services associated with natural gas extraction.

The organization conducts on the ground research by placing Speck air quality monitors as well as SUMMA canisters, which are used to collect VOCs, inside and outside of homes near unconventional oil and gas development sites. Ms. Rippel identified the difficulties in gathering accurate measurements from these devices. Residents collected air samples using the Speck monitors, completed home exposure assessments, and answered individual health assessments conducted by partner organizations.

Ms. Rippel explained the importance of testing Speck monitors for their usefulness as public health tools to improve emissions data. For example, the monitors can help determine when spikes in emissions occur. She additionally discussed how Speck monitor research can highlight the fact that pollution has more than one origin.

Data analysis is one of the most important tools EHP brings to the community. By explaining to the community what the collected data means for their health, residents are better able to adjust their behaviors to avoid pathways of exposure to the extent possible. Ms. Rippel highlighted the need for a comprehensive movement but also acknowledged the importance of actions individuals can take to improve the air quality in their own homes. She stressed the importance of collaboration among different environmental health organizations in finding a solution to reduce pollution resulting from unconventional oil and gas development.

Since January of 2016, EHP has refined the way Speck results are reported to individuals by developing a tool that allows EHP to collectively examine all monitoring results, compared to each other in a single database. Using this tool paired with home exposure assessments, numerical values (0-10 scale) can be assigned to each home, indicating the level of exposure compared to other homes in a similar environment.

In previous years, EHP had looked at Speck data relative to the 24-hour standard set by the Environmental Protection Agency's (EPA) National Ambient Air Quality Standards (NAAQS) for Criteria Air Pollutants. After much work and expanding upon their analysis tool, EHP can now examine each Speck data set on a 15-minute time interval for several key parameters such as 1) peaks per day, 2) duration of peaks, 3) time between peaks, 4) total accumulation of particles and 5) the baseline for each home.

To date, EHP has collected more than two hundred air quality (PM2.5) data samples. Due to the requirements that are essential to complete their analysis, their sample size was 107 indoor samples and 101 outdoor samples. While EHP was able to examine the statistics of their monitoring results and draw conclusions of exposures, it is often very difficult to compare a single home to the entire data set, as circumstances for each home vary.

For example, while looking at the entire data set (N=107 indoors and N=101 outdoors), EHP found that the mean duration of peaks occurring indoors was 31.5 minutes per peak, which is longer than the mean duration of outdoor peaks of 26.1 minutes per peak. Also, the mean duration of time between peaks indoors is 7.2 hours, which was less than the mean outdoor duration between peaks of 9.1 hours. In sum, as a mean, EHP's dataset showed that peaks of PM2.5 last longer and occur more often indoors than outdoors.

If you were to draw one random home from the data set, the information may be very different. For example, after randomly selecting a home, the duration of peaks occurring indoors was 23.4 minutes per peak, which was shorter than the duration of outdoor peaks of 30.1 minutes per peak. Also, the duration of time between peaks indoors was 7.5 hours, which was more than the duration between peaks outdoors of 5.4 hours.

One house experienced longer lasting and more frequent peaks of PM2.5 outdoors than indoors. After a closer examination of this home, EHP found that their monitoring occurred during the initial well pad development for fracking, as well as the digging stage for a proposed impoundment pond.

In conclusion, it is difficult, if possible at all, to compare a single home to an entire data set as each home experiences its own sources of exposure and also acts as its own control. However, EHP is able to pull specific homes that are experiencing the same exposure from similar sources and compare them to one another.

For more information on EHP's monitoring protocols or method/procedure of data analysis, please refer to their technical reports found on their website, www.environmentalhealthproject.org.

Air Monitoring and Community Health in 3 States

Bruce Baizel, BA, MA, JD, Energy Program Director at Earthworks, Durango, CO

Mr. Baizel provided an overview of community health in areas across the United States, including affected regions of Pennsylvania and California. He specifically discussed Earthworks' air monitoring strategies. Earthworks is a non-profit organization dedicated to protecting communities and the environment from the impacts of unconventional energy development and seeking sustainable solutions. Community-based air monitoring and participatory research is key in the organization's efforts.

Earthworks' Oil and Gas Accountability Project seeks to use scientific data to enact social change through building community partnerships and advocating for better industry practices. Their work in Pennsylvania focused on finding patterns of symptoms in different locations and identifying links between health problems, nearby gas facilities, and agency oversight. Data was collected from 108 health symptom surveys and 34 air and water tests in 14 counties. The framework included health surveys, odor and symptom logs, and SUMMA canister testing.

Through this study, Earthworks found an association between proximity to oil and gas facilities and health problems in the community. For example, people living closer than 1500 feet to gas facilities reported higher rates of sinus and respiratory symptoms than those who lived further away. The top symptoms reported among residents in all counties included sinus and respiratory problems, mood/energy changes, neurological issues, and muscle/joint pain.

Earthworks' studies provide impacted residents with information that responds to their health concerns and reveals the necessity of greater transparency from oil and gas facilities about chemicals used, more health-related testing on these chemicals, and increased access to data. Mr. Baizel noted several central issues with air monitoring, including intermittency of exposures (acute vs. chronic), detection variability, access to data, lack of regulatory standards, and gaps in health service provider training relating to symptom recognition and treatment.

Community-Based Participatory Air Sampling

Kim Schultz, Oil and Gas Program Coordinator, The Endocrine Disruption Exchange (TEDX)

As Oil and Gas Program Coordinator for TEDX, Ms. Schultz focuses on the potential health effects from exposure to chemicals associated with oil and gas production. She described a baseline air sampling project designed to identify chemicals in the air in a region of western Colorado where future natural gas development has been proposed. This sampling project was a collaborative effort between a community organization and the researchers at TEDX. Community volunteers wore backpacks equipped with air monitoring tools to measure pollution levels they were exposed to on their properties. The devices in the backpacks included a small SUMMA canister to measure methane and non-methane hydrocarbons, and a pump used to test for polycyclic aromatic hydrocarbons by drawing air through filters. Lab analysis was conducted for a total of 74 chemicals.

This project was designed to detect chemicals present in the breathing zone of residents living near oil and gas operations. While the backpack sampling method showed individuals were exposed to multiple chemicals, identifying the source of the chemicals proved challenging. The results document baseline air quality in a community threatened by expanding natural gas development. Establishing a baseline for air quality levels and chemicals in the air can promote industry accountability, and participation by residents impacted by oil and gas development can encourage community engagement efforts.

Costs and Benefits of Community Based Monitoring in the Rural West

Deb Thomas, Director at Shale Test

Ms. Thomas became involved with community organizing 16 years ago when tight sands gas development contaminated groundwater aquifers and drinking water wells in her community. She is currently a director with Shale Test, an organization that tests air quality near oil and gas development sites. In collaboration with community members, academics, and other nonprofit organizations, Shale Test uses visualization techniques such as FLIR imagery and real-time monitors, including RAE and Jerome meters, and collects air samples using methods including SUMMA canisters and tedlar bags. Shale Test also helps conduct research programs to identify new methods of environmental testing that are user friendly for community members and residents impacted by oil and gas extraction and development.

During studies of air quality in Wyoming, Shale Test collaborated with other organizations to test the air for VOCs, sulfides, methane, and formaldehyde at various sampling locations. The results showed dangerous levels of toxic emissions, which is especially alarming given the close proximity of the development sites to areas where people live and work. The emissions originated from separation equipment, compressor stations, produced water impoundments, and discharge canals. The results are limited, but there are clear indicators that more testing is needed to protect human health and the environment.

Approaches to Community Biomonitoring—Challenges and Successes

Robert Harrison, MD, MPH, Clinical Professor of Medicine, University of California

Dr. Harrison discussed the occupational hazards of unconventional oil and gas development and the challenges and successes of collecting data on occupational health. In North Dakota and other Western states there have been 9 cases of worker deaths due to high levels of VOCs emitted from production tanks. In one such case, an OSHA investigation found high levels of VOCs in an employee's blood during an autopsy, but because his H2S monitor had not gone off, the incident was recorded as a non-occupational death. On this issue, Dr. Harrison emphasized the importance of collecting field data and ensuring public health commitment and infrastructure, which is currently lacking. Dr. Harrison discussed how, in order to prevent occupational deaths related to UOGD, industrial hygienists, environmental health professionals, and occupational health professions must all collaborate.

Health Effects of Endocrine Disrupting Chemicals in Oil and Gas Development

Susan C. Nagel, PhD, Associate Professor of Obstetrics Gynecology and Women's Health, University of Missouri

Dr. Nagel discussed her current research involving hormones, endocrine disruptors, and unconventional oil and gas development. She specifically studies how chemicals used in natural gas extraction can be associated with endocrine disruption using human cancer cells in the laboratory. In this presentation, Dr. Nagel provided a broad scientific overview of the functioning of estrogen, androgen, glucocorticoid, progesterone, and thyroid hormones. These hormones are involved in processes of development, sexual differentiation, appetite, weight, energy, immune function, fertility and pregnancy, puberty, secondary sex characteristics, organ development and maintenance, brain development, cell proliferation, and muscle and bone development. An endocrine disrupting chemical (EDC), which the Endocrine Society defines as "a chemical, or mixture of chemicals, that interferes with any aspect of hormone action," works by altering the "lock and key" association of hormones and their receptors, or by changing the amount of the hormone itself. It is important to understand that hormones and EDCs can act at low concentrations, that there are various paths of possible human exposure, and that exposure during human development can alter adult health.

Dr. Nagel described findings from research projects on EDCs found in surface and ground water in Garfield County, Colorado and from the surface water above and below an oil and gas wastewater injection disposal facility in West Virginia. Using a solid phase extraction process where chemicals are separated from a liquid mixture, the researchers found that many of the EDCs from the wastewater could inhibit estrogen, androgen, progesterone, glucocorticoid, and thyroid receptors. Using a developmental programming model, where pregnant mice were given a mixture of 23 UOGD chemicals in their drinking water, offspring that were developmentally exposed were examined in early life and in adulthood. The researchers found that fetal exposure to UOGD wastewater chemicals was associated with adult health issues, including altered development of oocytes in females, reduced sperm counts in males, and altered pituitary hormones necessary for reproduction in both males and females in adulthood. Testing the effects of the chemicals on mice, researchers determined that the EDCs altered body and organ weights as well as enlarged testes and increased testosterone levels in developmentally exposed male mice. They also found enlarged cardiomyocytes and collagen deposition in the hearts of adult mice (suggesting heart defects relating to maternal exposure). Lastly, they found that 40% of the embryos of exposed mice had defects, demonstrating the dangers of the chemicals associated with UOGD.

SWPA EHP Processes to Build Community Understanding of UOGD Emissions

Jill Kriesky, PhD, Associate Director, Southwest Pennsylvania Environmental Health Project

Dr. Jill Kriesky of the Southwest Pennsylvania Environmental Health Project (EHP) provided an overview of the organization's current collaborative emissions monitoring protocol and related projects." EHP responds to individuals' and communities' needs for access to accurate, timely and trusted public health information and health services associated with UOGD. Dr. Kriesky specifically discussed the role of collaborators, the importance of reporting information back to community members, and the next steps for data dissemination.

In an effort to involve community members in data collection and increase their knowledge of air quality related to oil and gas development, EHP provides residents of UOGD regions with speck monitors. The protocol for placing speck monitors in communities involves choosing a community leader who acts as a point person for the distribution and collection of monitors and who can be available to meet with residents as needed. The monitors are distributed to houses within 3 miles of a UOGD site, with priority in southwest Pennsylvania, northeast Pennsylvania, New York, West Virginia, and Ohio.

Dr. Kriesky described various community projects involving air monitoring. In the Penn-Trafford district of Pennsylvania, for example, EHP distributed both speck monitors and SUMMA canisters to 6 houses. Dr. Kriesky additionally mentioned the NY State Compressor Project, which involved private funders, SUNY Albany, county health departments, and community organizers. The purpose of the project was to conduct health assessments and monitor air quality using speck monitors, SUMMA canisters, and formaldehyde badges. Five New York counties participated: community organizers educated residents on UOGD concerns and identified residents to participate in monitoring; SUNY Albany and other academic institutions analyzed the data; and the county health departments provided monitoring devices, gathered health data, analyzed data, and funded the project.

An important aspect of community participatory research is reporting interpretation of the data to the community. After data has been collected, EHP works to generate a report on the findings and distribute this information to the community in a timely manner. The report includes a description of PM2.5 and its risks, a summary of the air monitoring results with graphs and explanations, general information on avoiding contaminated air exposures, the role of weather in influencing exposure, the use of air filters, air quality references, and the importance of recording changes in air and health. EHP also holds community meetings to explain the summary results to participating residents.

EHP also seeks to analyze peer-reviewed publications that look at New York data on air quality conditions from before and after the onset of oil and gas development. EHP is planning to create web-based reports for the purpose of making information easily accessible by broad audiences, produce a web-based map of exposure and health impact data, and lastly, use information from research to advance the public health discussion of UOGD.

Government and Communities: Working Together?

Linda Rudolph, MD, MPH, Director of the Climate Change and Public Health Project, Center for Climate Change & Health, Berkeley, California

Dr. Rudolph is the Director of the Climate Change and Public Health Project in the Public Health Institute's Center for Climate Change and Public Health. She previously held positions as the director of the Center for Chronic Disease Prevention and Public Health at the California Department of Public Health, as well as public health officer for Berkeley, California. In her presentation as a facilitator of the symposium, she discussed how the field of public health serves to protect and promote community well-being by preventing disease and injury, in addition to influencing social, economic, and environmental factors that cause disease. In recent decades, public health agencies have often focused on downstream risk behaviors and interventions for assuring access to healthcare for individuals who are already sick. More recently, however, there has been a movement to emphasize upstream public health; that is, looking at the fundamental determinants of health in communities and reasons for the existence of these factors.

Social determinants of health may include educational attainment, poverty, inequality, levels of social support, the built environment, housing conditions, transportation, and access to healthy foods and green spaces. Dr. Rudolph discussed how these determinants account for the majority of adverse health outcomes and how communities of low socio-economic status as well as communities of color are disproportionately affected by health inequalities. Most decisions that shape the environments that determine health outcomes are made by non-health agencies. Local health departments face many challenges, including lack of capacity, funding, and resources. In addition, there are competing priorities within departments, a lack of leadership, conflicting roles, frequent changeovers among elected officials, and a culture of risk aversion. Many health department employees have limited exposure to environmental health issues and no training in community engagement, and issues that appear more urgent (such as gun violence or homelessness) may take precedence over environmental health issues. It is the government's role to consider different perspectives and determine an appropriate balance in terms of policy implementation. But the focus must be on health, which requires shifting the focus on proving safety of industry practices/chemicals rather than reducing harm after the fact.

Dr. Rudolph shared several lessons from her work to integrate considerations of health and equity across government sectors, such as the importance of creating a shared vision among all partners to integrate climate, health, and equity, and articulating the possibility of working together to achieve healthy communities. Community voices and community organizations play critical roles in identifying concerns, assets, and solutions. But as long as powerful industries are allowed to have more impact on government policy than the people whose health is impacted by those policies, issues of environmental health will be difficult to resolve. Environmental health advocates will need to partner with the many others who are working for policy change in areas as diverse as tax, campaign-finance, and food and transportation policy. And, they need to work together to establish programs with the purpose of building new leaders to place into positions of power within their communities.

Using Community-Based Research to Monitor Air Quality in Neighborhoods

Paul English, PhD, MPH, Principal Investigator, Public Health Institute

Dr. English provided an overview of the importance of using community-based research to monitor air quality in neighborhoods. He pointed out that there is a significant disparity between the research that is currently available on air quality at the regulatory level and the research that communities require in order to know about their local air quality. Eliminating this gap is imperative to improve community health and requires improved strategies for data dissemination. Community-based research, in which community members participate in the collection of air quality data, would promote sustainability and allow data to be used efficiently towards reducing exposure.

Dr. English described the concept of community-based research citing a study funded by the National Institute of Environmental Health Sciences (NIEHS) that he and colleagues conducted in the Imperial Valley of Southern California. In this study, Dr. English and researchers trained 45 community members in mapping hazards, conducting analyses on air quality data, sharing the data locally, and engaging individuals in public health action. The participants collected data over a one-week period by logging hazards using a mapping tool installed on their cell phones. Hazards included pesticides, air pollution, water quality, and noise from wind turbines. The researchers' main goals were to establish a community-based monitoring network using 40 low-cost particulate matter monitors and using the data to develop community monitoring and action strategies. Another goal was to use the data to reduce air pollution levels in the Imperial Valley.

Dr. English and his colleagues sought to address several questions in their research. They explored whether real-time monitoring could enable identification of air pollution hotspots and facilitate development of public health actions, whether hazard recognition and asset mapping could result in increased awareness of environmental health issues that could lead to environmental health advocacy and action, and whether mobile technologies could serve as tools for the community to access health data. Using spatial analysis to identify hotspots, the researchers were able to test the visualization of data with the committee and begin the program evaluation phase.

As Dr. English explained, this research demonstrates the importance of community engagement, such as involving the community in hazard/asset mapping and the siting of the low-cost monitors, and how engagement can accommodate both the needs of the scientific and general communities. Involving the community in data collection enhanced their capacity to take environmental health action in other areas of concern such as water quality and agricultural burning, and increased their knowledge about air quality.

Correlating Monitoring Results with Population Health & Community Disease

Rebecca O. Johnson, End of Life Care Program, Graduate & Professional Studies, Sarah Lawrence College

Ms. Johnson discussed both air monitoring and biomonitoring in the context of oil refining and chemical processing in Mossville, Louisiana. After Hurricanes Katrina and Rita, she worked with the Environmental Support Center to assess recovery needs of environmental justice organizations in the fenceline communities and sacrificial neighborhoods. One of these organizations was Mossville Environmental Action Now (MEAN). Documentation of their struggles to protect the health of Mossville can be found in *Industrial Sources of Dioxin Poisoning in Mossville, Louisiana: A Report Based on the Government's Own Data*, by Wilma Subra, MEAN, and Advocates for Environmental Human Rights. The report includes results from the Agency for Toxic Substances and Disease Registry (ATSDR) sampling of blood, soil, breast milk, fish, and foodstuffs. In one alarming result, the report showed

that blood samples from Mossville residents contained dioxin, a known carcinogen, at levels three times above the national average.

Through the Environmental Support Center, Ms. Johnson worked with MEAN and the Louisiana Bucket Brigade to build community capacity. In 2010, Ms. Johnson and her students in the Sarah Lawrence College Graduate Health Advocacy Program partnered with MEAN to document health conditions suffered by community members. MEAN obtained the informed consent of both individual participants and the community as a whole to move forward with the participatory action research project. MEAN members had leadership participation in the IRB process. SLC-HAP created a protocol for community ownership of data and control of publication rights, community participation in data analysis, and community control of strategic decision-making based on data analysis. Furthermore, MEAN sought to create a free health clinic, protect children riding school buses through the Conoco Plant, engage Conoco in finding a solution, participate in a refinery neighbors campaign pushing for more effective remediation by the state, and maintain a more effective web presence.

In order to assess the health of Mossville residents, Ms. Johnson and MEAN used the 2009 National Health Interview Survey and adapted it to assess the needs of residents. They found that approximately 60 percent of the adult population had high blood pressure, as well as high rates of diabetes, angina, cancer, COPD, asthma, thyroid disease, reproductive problems, and decreased bone density. Additionally, 40 percent of residents had no physician follow-up.

The researchers found that there were many benefits as well as various issues with community monitoring methods. The community was energized and their efforts gained attention from the EPA, ATSDR, and the local clinic. However, data analysis with the community proved difficult and participation required constant focus and training.

Ms. Johnson lauded the ongoing and decades long struggle by MEAN to protect their community and seek remediation or a fair and just relocation. But the political commitment to and economic dependence of the state of Louisiana on the oil and chemical industries outweighs any documented harm to its citizens. Ultimately, in 2013, Louisiana Governor Bobby Jindal gave \$115 million to Sasol, the apartheid era South African oil company to buy out Mossville residents through a coercive Voluntary Property Purchase Program (VPPP). The program was "voluntary" on the part of Sasol- it provides none of the protections of a community-negotiated relocation. Sasol intends to build the first fracked gas to liquid fuels processing plant on the land where one of the oldest African-American communities in the US was founded. MEAN continues to seek a just buyout that leaves folks debt-free and whole, without residual homelessness that the VPPP has caused.

Public Health Evaluation of Communities Burdened by Proximity to Multiple Sources of Pollution

Cyrus Rangan, MD, Director, Toxic Epidemiology Program, LA County Department of Public Health

Dr. Rangan discussed toxicology and public health in relation to oil and natural gas development. When it comes to issues such as environmental toxicology, public health departments require data and opportunities for surveillance. There is a need in the public health field for additional studies and training, both in terms of acute cases (for example, the immediate health impacts of gas leaks) and chronic issues (such as the health of communities living in close proximity to a pollution source).

Dr. Rangan specifically used the AllenCo oil field and Aliso Canyon Natural Gas Storage Facility as examples of UOGD areas in which communities are disproportionately impacted by multiple sources of pollution. The AllenCo oil field near the University of Southern California is a 1-2 acre oil extraction facility within close proximity to a community. On October 23, 2015, a gas leak began at Aliso Canyon, near Porter Ranch and continues to release methane and mercaptans today. Dr. Rangan explained that mercaptans are of most concern in this gas leak. They are heavy compounds that sink into the ground and give off a pungent odor that causes physiological symptoms among residents living in close proximity to the site. Due to the duration of the leak, it is also important to monitor benzene, metal, and hydrocarbon levels in the air. Daily monitoring and 12-hour integrative sampling is important to assess the risks from this natural gas leak.

Dr. Rangan explained that industry compliance with air quality standards is not necessarily an indicator of being a good neighbor. Air quality standards are designed to protect regional air; not the air directly around the facilities, and that leaves communities dealing with both acute and chronic cases of UOGD-related pollution behind.

Health Impacts on the Community from Porter Ranch (LA) Gas Leak

Alexandra Nagy, Southern California Organizer, Food and Water Watch, Los Angeles

Ms. Nagy is the Southern California Organizer at Food and Water Watch (FWW) in Los Angeles. In response to the Aliso Canyon Natural Gas Storage Facility gas leak, FWW created a fact sheet, educated residents about the health risks of methane and mercaptans, and partnered with other organizations to implement more comprehensive air monitoring. FWW seeks to shut down the natural gas storage facility indefinitely, and is pushing for California to enact a statewide ban on fracking. Ms. Nagy explained the need to look at natural gas infrastructure in California and start discussions around the problems associated with natural gas and their potential solutions. "What [they] see as an asset, we see as a toxic poisoning in our community," she said.

She went on to pose the question, "How do we ensure that the air quality study and health data come together to give people a sense of what they have been exposed to and the potential long-term impacts of these chemicals?" She ended by highlighting the need to expose corruption in California in order to protect the people from harmful industry practices.

Analyzing Institution and Analytical Methods

Michael Jerrett, PhD, Professor and Chair of the Department of Environmental Health Sciences, UCLA Fielding School of Public Health

Dr. Jerrett discussed the need for long-term health studies on benzene exposure. He described analytical methods for benzene and hydrogen sulfide, and the limitations to each. There is a gap between occupational exposures and chronic exposures due to lack of research on sub-chronic levels of exposure.

He described the analytical methods for benzene and for hydrogen sulfide. For benzene, SUMMA canister samplers, flame ionization detection, gas chromatography/mass spectrometry, and modified EDA-18 are used. For hydrogen sulfide, analytical methods include Teflon bag samples, method SCAQMD 307.91, and gas chromatography with a Hall electrolytic conductivity detector operated in oxidative sulfur mode. Problems with these methods include overloading labs, difficulties in compiling data, and the tendency of control sample concentrations to be higher in labs than at field sites.

Dr. Jerrett stressed the need for a longer term health study that includes real-time information from monitors placed in people's backyards living near UOGD sites and facilities.

Description of Workshops:

Building Partnerships and Exchanging Information

This workshop is designed to encourage discussion on common ground and challenges in partnership dynamics, to present a framework for meaningful partnerships, to understand the similarities and differences of concerns in the different oil and gas communities, and to foster trust and solidarity among groups from different areas. Through shared stories and dialogue among these groups, we will exchange information and identify and form productive partnerships in order to effect better health protections in oil and gas development communities.

Strategizing for Effective Engagement

In this workshop, participants will discuss and strategize how to engage public health department officials (both state and local) with organizations involved in monitoring and other health data collection efforts to highlight threats to public health. Panelists will discuss strategies that can lead towards enhanced public participation in decisions related to public health.

Facilitators:

Ansje Miller, Eastern States Director, Center for Environment Health

Elizabeth Crowe, Co-Director, Coming Clean

Larysa Dyrszka, MD, Sullivan Area Citizens for Responsible Energy Development, PSR-NY, and Concerned Health Professionals of NY

Jill Johnston, Ph.D., Assistant Professor, Department of Preventive Medicine, University of Southern California

Paul English, Ph.D., M.P.H, Senior Branch Science Advisor, Environmental Health Investigations Branch, CA Department of Public Health

Emily Harris, MPH, LMT, NCTMB, Program Manager, Arkansas Fracking

WORKSHOP: BREAKOUT SESSIONS & DISCUSSIONS

Questions Raised for Group Break-out Discussions:

- How can community engagement be encouraged?
- What types of monitoring equipment are best?
- What are pressing research needs?

At the end of Day 1, participants were divided into small groups to discuss the following topics:

- How to create partnerships to get funding for projects
- How to use the most recent research to ensure that there is a process and outcome in mind to facilitate effective data generation
- How to cultivate meaningful partnerships among diverse and “non-conventional” constituencies
- How to create partnerships to tackle major systemic challenges with government health agencies (e.g. industry influence, regulatory authority, human resources)

Breakout groups discussed their ideas regarding effective methods for obtaining project funding and creating partnerships. They emphasized that it is not the funding alone that ensures the success of a project, but the work of community organizers and partner organizations that bring a project to completion.

The participants additionally came up with several ideas for improving community organizing, including:

- Generating a list of scientists who would be able to make themselves available to the community for questions
- Taking into consideration numbers and strategies when creating academic and community partnerships
- Focusing on equitable leadership
- Using crowd-sourcing as a potential way to obtain fundraising for research
- Using academic professionals to provide their expertise on academic review boards and to support community-based research and community organizing agendas
- Implementing a ‘Research to Action Program’ to collect research and take public health action.

Groups also focused on ways to cultivate meaningful partnerships among diverse and non-conventional constituencies. They highlighted the kinds of partnerships that are important for tackling the systemic challenges of government health agencies. They also explained the utility of community-based participatory research versus participatory action research, specifically in terms of ownership. Community-based participatory research is a research approach that ensures equitable involvement of all stakeholders, including community members, researchers, and organization representatives. Participatory action research emphasizes the importance of collective action and participation in order to make change. They pushed for participatory action research because of the way in which it leads to the investment of community members and gives them a sense of ownership, which helps sustain partnerships. Groups additionally discussed the importance of building a sense of power and identity prior to engaging with industry or regulatory agencies. They cited an example of New York medical professionals developing partnerships to leverage legislative action. They suggested that in religious communities, leveraging faith-based organizations would perhaps be an effective strategy.

At the end of Day 2, participants were divided into small groups to discuss and strategize about how to engage public health department officials (both state and local) with organizations involved in monitoring and other health data collection efforts to highlight threats to public health.

The groups subsequently suggested how to effectively engage public health and government agencies and noted the barriers to these efforts, including industry influence, regulatory authority, issues with human resources, and a flawed system of regulatory agency decision-making processes (for example, challenges regarding risk assessments and the adoption of the latest science and methods in conducting research). Moreover, regulatory agencies often shift the burden of proof of harm to the communities most exposed. Additional challenges involve the absence of health and human services departments, an antiquated perspective on toxicology and risk assessment from the EPA, the discretion of the states and local municipalities in making risk assessment decisions, and government agencies that focus on the cheap flow of energy.

In terms of a solution, group participants proposed that analysts help navigate bureaucracy within public health departments, and meet with department staff to determine what data should be looked for and where to find it. Existing barriers include infrastructure problems in the legislative system, difficulties of groups in navigating through the system, a legacy of distrust, a lack of transparency, unclear expectations, language barriers, gaps in access to technology, and intimidation tactics used by the oil and gas industry.

Next, solutions were proposed for mitigating these problems, including making connections with public health staff before meetings, developing informal relationships, creating a citizens directory on environmental issues, making public health more customer service oriented, approaching public health officials with community health concerns, improving education for decision-makers, closing workforce gaps in health departments, developing collaborative relationships, updating safety standards, and increasing the role of the ATSDR.

During the group break-out sessions, the participants brainstormed potential solutions for key issues discussed during the symposium. In order to make research collaborative, academic researchers and communities need to partner with the IT industry to apply 'Big Data' strategies. The policy triangle is the standard applied to determine environmental justice communities and eligibility. The group went on to provide potential solutions for questions around the assumptions governing where money and research occurs and who has access.

The following were proposed solutions to the question, "how do we provide recognition to community scientists?"

- By emphasizing efforts to see and make citizen research as valid
- By assessing the needs of both communities and scientists and by investing time in exploratory discussions between the 2 groups (to meet needs for both)
- By exploring how we can partner to marry policy and regulation practices in how they apply standards, or how we can push towards dismantling barriers and other next steps

The following were some of the responses to the question, "Can government dollars be allocated for citizen science, and if so, how?"

- Possibly, but we should recognize the need for funding grassroots organizing and to develop community capacity to do this work. We also must address the concern that much community organizing does not support citizen science
- Yes, by investing in youth (for example, by teaching environmental education in schools)
- Possibly, but we must keep in mind some barriers/concerns, including differing state policies on what states recognize and are willing to fund
- Yes, and we can encourage students & provide tools for them to research & focus on issues in their communities
- Yes, the CDC has money for community-based public health research
- Yes, if we find legislative champions for budget
- No, but we can pursue private funding and work with those private sponsors to develop funding streams
- Yes, if we understand and take advantage of the utility of mixed methods (quantitative & qualitative)
- Yes, if we are creative with laws/funding (e.g. Affordable Care Act)

The following were proposed responses to the question, "Can collaborative responsibility projects be supported through health department dollars?"

- Yes, if we share experiences and knowledge gained from this symposium with others
- Possibly, but we must keep in mind that participants in citizen science are impacted citizens and therefore, their perspective is different (and a critical need)
- Possibly, but we must find the opportunities in a community to study this (e.g. money for hospitals to do annual community benefit reports)
- Yes, if we learn how to use/adapt strategies (such as the CBPR process) to slowly push forward.

In closing, participants highlighted the importance of dynamic cross-professional collaboration. There is a huge benefit when community members, academia, and government workers all collaborate to find solutions, as well as when research is used to build coalition capacity in terms of community-based participatory research. Lastly, by identifying the issues, getting the science community to conduct research and present data, and by the community advocating for change and working together, legislation will follow. We have to be patient because change happens gradually—not overnight.

APPENDIX A: PRESENTER PROFILES

Argüello, Martha Dina / Executive Director, Physicians for Social Responsibility - Los Angeles

For the past 32 years, Martha has served in the nonprofit sector as an advocate, community organizer, and coalition builder. Martha joined PSR-LA in 1998 to launch the environmental health program, and became Executive Director in November 2007. Martha is committed to making the credible voice of physicians a powerful instrument for transforming California and our planet into a more peaceful and healthy place.

Baizel, Bruce, B.A., M.A., J.D. / Director, Energy Program, Earthworks

Bruce received his B.A. in Biology from Earlham College and his M.A. in International Relations and J.D. from the University of Denver. Based in Durango, Colorado, Bruce has worked on oil and gas issues throughout North America, at local, state, national and international levels. He has testified before Congress, drafted federal, state and county legislation and ordinances related to oil and gas and advised numerous local governments on regulation of natural gas. He most recently served on the STRONGER review team, which evaluated the state of Louisiana's hydraulic fracturing regulations. Prior to joining Earthworks and the Oil & Gas Accountability Project in 2003, Bruce practiced law in Colorado, was a co-founder of Round River Conservation Studies and was legal counsel for Diné CARE, on the Navajo Nation.

Crowe, Elizabeth / Co-Director, Coming Clean

Elizabeth is the Co-Director of Coming Clean, a national environmental health and justice collaborative working on chemical and fossil fuel industry reforms. Elizabeth has worked as a community and network organizer since 1992, primarily in Kentucky, on issues including chemical weapons, incineration, coal and chemical reform. She lives in Boulder County, Colorado.

Dyrszka, Larisa, M.D. / Sullivan Area Citizens for Responsible Energy Development, PSR-NY, and Concerned Health Professionals of NY

Dr. Dyrszka is an advocate for health on the issue of natural gas exploration and production. She is a founding member of Sullivan Area Citizens for Responsible Energy Development, vice-chair of the CME curriculum committee for Physicians, Scientists and Engineers for Healthy Energy and on the board of Physicians for Social Responsibility – New York. Together with fellow NY medical colleagues, she founded Concerned Health Professionals of New York. Dr. Dyrszka is a graduate of Washington University School of Medicine in St. Louis. She is a United Nations representative to ECOSOC with the World Federation of Ukrainian Women's Organizations.

English, Paul, Ph.D., M.P.H. / Senior Branch Science Advisor, Public Health Institute

Dr. Paul English is currently Senior Science Advisor for the Environmental Health Investigations Branch at the California Department of Public Health. Dr. English is Principal Investigator of the California Environmental Public Health Tracking Symposium on the Public Health Dimensions of Oil and Gas Development 13 Program and has directed multiple research grants from the CDC, U.S. EPA, and NIH. Dr. English received his Master's in Public Health and doctorate degree in Epidemiology from the University of California, Berkeley. Dr. English has 20 years of experience working in environmental public health for the California Department of Public Health and has published extensively in the peer-reviewed literature.

Esparza, Rosanna, Ph.D. / Program Organizer, Clean Water Fund

A Program Organizer with Clean Water Action, Rosanna holds graduate degrees in Gerontology and Public Policy from the University of Southern California. For more than 15 years, Rosanna has fed the flames of social justice by joining forces with marginalized and disenfranchised people living in communities from East Los Angeles to Kern County as an agent of change. Rosanna is focused on ensuring the longevity and strength of her connections and conviction to environmental issues.

Garcia-Gonzales, Diane / Ph.D. Student, UC Berkeley

Diane Garcia-Gonzales is a doctoral candidate at the Division of Environmental Health Sciences in the School of Public Health, UC Berkeley and a Systems Approach to Green Energy Fellow. Ms. Garcia-Gonzales is interested in the effects of air pollutants on adverse birth outcomes. Her dissertation research focuses on air quality around oil and natural gas development in Colorado and Southern California.

Green, Michael, M.S., M.P.P. / CEO, Center for Environmental Health

Michael Green is CEO of the Center for Environmental Health (CEH) which he founded in 1996. As CEO of CEH (www.ceh.org), he has been a leader in national efforts to protect children and families from lead and other toxic chemicals in consumer products, and from illnesses related to pollution in our air, water and food. CEH is a leading advocate for comprehensive chemical policy, and has been hired by both corporations and government agencies to design policies that will protect the public from exposure to toxic chemicals.

Hannigan, Michael P., Ph.D., M.S. / Assistant Professor, Mechanical Engineering Department, University of Colorado

Dr. Michael Hannigan is an Assistant Professor at the Mechanical Engineering Department of the University of Colorado in Boulder, and has been teaching in Environmental Science series, Air Pollution Control, Sustainable Energy, Environmental Toxicology, Fluid Mechanics, Solid Mechanics, and Experimental Design & Data Analysis. Dr. Hannigan's research has focused on characterizing particulate air pollutants at urban and remote locations. In addition to the focus on particulate air pollution, Dr. Hannigan's research interests have branched out to include air pollution sampler development, and making sense of the current energy use patterns and trends.

Harris, Emily, M.P.H., L.M.T., N.C.T.M.B. / Program Manager, Arkansas Fracking

Emily Harris is a Public Health Educator and Trauma Recovery Specialist. She facilitates her neighborhood Arkansas Department of Health Hometown Health Improvement Coalition, Faulkner County Citizens Advisory Group by connecting community members with the governmental agencies and elected officials that represent them. Mrs. Harris has fulfilled a variety of professional roles with multiple state agencies, including senior epidemiologist in air quality analysis and as a planning staff specialist. She served as the Arkansas State Contact for the County Health Rankings while program manager for a CDC funded cooperative agreement for the Arkansas Department of Health known as the Arkansas Assessment Initiative (AR-AI). Mrs. Harris was honored with an "Arkansan of the Year" award in 2013 for her work with the Mayflower community following the Pegasus pipeline rupture.

Harrison, Robert, M.D., M.P.H. / Clinical Professor of Medicine, University of California, San Francisco

Dr. Robert Harrison founded and has directed UCSF Occupational Health Services for more than 15 years, and now is a senior attending physician. Dr. Harrison has diagnosed and treated over 10,000 patients with work- and environmental-induced diseases and injuries. Dr. Harrison also directs the worker tracking investigation program for the California Department of Public Health. Dr. Harrison received his B.A. from the University of Rochester and his M.D. from the Albert Einstein College of Medicine. He is board certified in both internal medicine and occupational medicine. Dr. Harrison has served on the California Occupational Safety and Health Administration (Cal/OSHA) Standards Board, and authored numerous publications in the area of occupational medicine. He is a clinical professor of medicine at UCSF.

APPENDIX B: Participant List

Hays, Jake / Director, PSE Healthy Energy

Jake Hays has worked as a program director for PSE Healthy Energy and a research associate at Weill Cornell Medical College since 2011. His principle focus has been on the environmental and public health aspects of unconventional oil and gas development. He has a B.A. in philosophy from Connecticut College and an M.A. in environmental ethics from the University of Montana. He is also currently pursuing a J.D. at Fordham University School of Law in New York City, where he serves as a board member of the Environmental Law Advocates and a staff member of the Environmental Law Review.

Helmig, Detlev, Ph.D. / Associate Research Professor, INSTAAR, University of Colorado

Dr. Detlev Helmig is an Associate Research Professor at the Institute of Arctic Research at the University of Colorado. After receiving his university education and Ph.D. degree in Germany, Dr. Helmig held appointments at the Statewide Air Pollution Center, University of California, Riverside, and the National Center of Atmospheric Research in Boulder, Colorado. Dr. Helmig's research focuses on development of atmospheric research instrumentation that is then applied to 15 studies of atmospheric composition, transport, and chemistry. Particular focus areas are volatile organic compounds, biogenic emissions, and polar chemistry. Dr. Helmig has published more than 150 peer-reviewed publications in the field of Atmospheric Science and is Editor in Chief of the Atmospheric Science Domain of the open access and non-profit journal Elementa.

Hernandez, Ashley / Youth Organizer, Communities for a Better Environment, Los Angeles

A Youth Organizer with Communities for a Better Environment, Ashley was immersed in the world of social justice as a high school junior. Now, in the shoes of past organizers, she is a full time organizer and student at Long Beach City College, working with her own frontline community. She has had to face the difficult truth of industry support while organizing in a community she has known her entire life, but continues to work, seeing leadership training and development as a catalyst for changing the culture in the heart of the harbor.

Johnston, Jill, Ph.D. / Assistant Professor, Department of Preventive Medicine, University of Southern California

Jill Johnston, PhD is an Assistant Professor and Director of Community Engagement in the Division of Environmental Health at the University of Southern California. Dr. Johnston received her PhD in environmental sciences and engineering from the University of North Carolina at Chapel Hill, where she studied hazardous waste sites and industrial animal production. Broadly, her research focuses on addressing unequal exposures to harmful contaminants that affect the health of the working poor and communities of color, including impacts of oil and gas development. Most recently, she has investigated impacts of wastewater from fracking in communities in the Eagle Ford Shale.

Kriesky, Jill, Ph.D. / Associate Director, Southwest Pennsylvania Environmental Health Project

Dr. Jill Kriesky has been the associate director of the Southwest Pennsylvania Environmental Health project since February 2013. Previously, Dr. Kriesky worked on community-based issues in shale gas development at the Center for Healthy Environments and Communities in the University of Pittsburgh's Graduate School of Public Health and at the Appalachian Institute at Wheeling Jesuit University in West Virginia.

Limón, Gladys, J.D. / Staff Attorney, Communities for a Better Environment

Gladys Limón is a Staff Attorney at Communities for a Better Environment, representing community members in all stages of litigation and administrative proceedings. Her work currently includes an unprecedented lawsuit against the City of LA alleging unlawful and racially discriminatory approval of oil drilling in neighborhoods; a legal challenge to a major refinery project that plaintiffs allege will result in the transport of heavy, dirty crude tar sands by rail; and opposing a proposal to build a fourth gas power plant on the City of Oxnard's beaches before the PUC. Ms. Limon received her J.D. from Stanford Law School in 2003.

Aguirre Jr., Gustavo / Project Coordinator, Central California Environmental Justice Network
Website: <http://Kernreport.org>

Argüello, Martha Dina / Executive Director, Physicians for Social Responsibility - Los Angeles
Website: <http://www.psr-la.org>

Baizel, Bruce, B.A., M.A., J.D. / Director, Energy Program, Earthworks
Website: <https://www.earthworksaction.org>

Bellomo, Angelo J. / Chief, Los Angeles County Department of Public Health
Website: <http://publichealth.lacounty.gov>

Chiang, Sue / Pollution Prevention Co-Director, Center for Environmental Health
Website: <http://www.ceh.org>

Collier, Ashley / Graduate Research Assistant, University of Colorado, Boulder
Website: <http://ashleymonika.wordpress.com>

Corlett, Susan / Director of Development, Center for Environmental Health
Website: <http://www.ceh.org>

Cox, Caroline / Research Director, Center for Environmental Health
Website: <http://www.ceh.org>

Crowe, Elizabeth / Co-Director, Coming Clean
Website: <http://www.comingcleaninc.org>

Dewing, Aimee / Director, RALLY
Website: <http://wearerally.com/>

Dyrszka, Larysa, M.D. / Sullivan Area Citizens for Responsible Energy Development, PSR-NY, and Concerned Health Professionals of NY

English, Paul, Ph.D., M.P.H. / Senior Branch Science Advisor, Public Health Institute
Website: <http://www.phi.org>

Esparza, Rosanna, Ph.D. / Program Organizer, Clean Water Fund
Website: <http://www.cleanwateraction.org>

Flores, Juan / Community Organizer, Center on Race, Poverty and the Environment
Website: <http://www.crpe-ej.org>

Garcia-Gonzales, Diane / Ph.D. Student, UC Berkeley
Website: <http://ehs.sph.berkeley.edu/garcia-l>

Gozdiskowski, Audrey / Chairperson, Air Coalition of Tunkhannock
Website: <http://wcexaminer.com>

Green, Michael / Executive Director, Center for Environmental Health
Website: <http://www.ceh.org>

Hannigan, Michael P., Ph.D., M.S. / Assistant Professor, Mechanical Engineering Department University of Colorado
Website: <http://spot.colorado.edu>

Harris, Emily, M.P.H., L.M.T., N.C.T.M.B. / Program Manager, Arkansas Fracking
Website: <http://www.arkansasfracking.org>

Harrison, Robert, M.D., M.P.H. / Clinical Professor of Medicine, University of California, San Francisco
Website: <http://coeh.berkeley.edu>

Hays, Jake / Director, PSE Healthy Energy
Website: <http://www.psehealthyenergy.org>

Villanova University
Website: <https://www.l.villanova.edu>

Website: <https://www.facebook.com/BreatheEasySusq/?-fref=nf>

Helmig, Detlev, Ph.D. / Associate Research Professor, IN-STAAR, University of Colorado
Website: <https://instaar.colorado.edu>

Miller, Ansje / Eastern States Director, Center for Environmental Health
Website: <http://www.ceh.org>

Rotkin-Ellman, Miriam, M.P.H. / Staff Scientist, Natural Resources Defense Council
Website: <http://www.nrdc.org>

VanDyke, Mike, Ph.D. C.I.H. / Chief, Colorado Department of Public Health and Environment
Website: <https://www.colorado.gov/cdphe>

Hernandez, Ashley / Youth Organizer, Communities for a Better Environment, Los Angeles
Website: <http://www.cbecal.org/>

Morgan, Jake / Program Coordinator, 11th Hour Project
Website: <http://www.11thhourproject.org/>

Rudolph, Linda, M.D., M.P.H. / Director, Climate Change and Health, Public Health Institute
Website: <http://www.phi.org>
Sattler, Barbara, R.N., Dr.P.H., F.A.A.N., / Professor, Public Health Program, University of San Francisco
Website: <https://www.usfca.edu>

Webb, Ellen / Health Energy Sciences and Advocacy Manager, Center for Environmental Health
Website: <http://www.ceh.org>

Huffling, Katie, R.N., C.N.M. / Director of Programs, Alliance of Nurses for Healthy Environments
Website: <http://enviRN.org>

Nagel, Susan, Ph.D. / Associate Professor, Obstetrics Gynecology and Women's Health, University of Missouri
Website: <http://medicine.missouri.edu/obgyn/susan-nagel-phd.html>

Schultz, Kim / Program Coordinator, TEDX
Website: <http://endocrinedisruption.org>

Williams, Terri / Acting Director, DPH Environmental Health
Website: <https://www.cdph.ca.gov/Pages/DEFAULT.aspx>

Johnston, Jill, Ph.D. / Assistant Professor, Department of Preventive Medicine, University of Southern California
Website: <https://pm.usc.edu>

Nagy, Alexandra / Southern California Organizer, Food and Water Watch, Los Angeles
Website: <http://www.foodandwaterwatch.org>
O. Johnson, Rebecca / End of Life Care Program, Sarah Lawrence College
Website: <https://www.sarahlawrence.edu>

Sen, Rabeya / Director, Policy, Esperanza Community Housing Corp
Website: <http://www.esperanzacommunityhousing.org>

Wong, Niki / Lead Community Organizer, Redeemer Community Partnership
Website: <http://www.redeemercp.org>

Kim, Jennifer / Air Quality and Health Associate, Physicians for Social Responsibility - Los Angeles
Website: <http://www.psr-la.org>

Olague, Eduardo, Ph.D. / Program Director, Air Quality Science, Houston Advanced Research Center
Website: <http://www.harc.edu>

Shamasunder, Bhavna, Ph.D. / Assistant Professor, Occidental College, Urban and Environmental Policy Department
Website: <http://www.oxy.edu>

Kriesky, Jill, Ph.D. / Associate Director, Southwest Pennsylvania Environmental Health Project
Website: <http://www.chec.pitt.edu>
Lane, Emily G. / Director, Arkansas Fracking
Website: <http://www.arkansasfracking.org>

Patton, Sharyle / Director, Commonweal
Website: <http://www.commonweal.org>

Sherani, Avais / Healthy Energy Choices Campaign Associate, Center for Environment Health
Website: www.ceh.org

Levin, Robert, M.D. / Medical Director, Ventura County Public Health
Website: <https://www.ventura.org>

Pomeroy, Jackie / Senior Account Associate, RALLY
Website: <http://wearerally.com>

Shonkoff, Seth B.C., Ph.D., M.P.H. / Executive Director, PSE Healthy Energy
Website: <http://www.psehealthyenergy.org>

Limón, Gladys, J.D. / Staff Attorney, Communities for a Better Environment
Website: <http://www.cbecal.org/>

Rangan, Cyrus, M.D., F.A.A.P., F.A.C.M.T. / Director, Toxic Epidemiology Program, LA County Department of Public Health
Website: <http://www.chla.org>

Stano, Madeline / Staff Attorney, Center on Race, Poverty & the Environment
Website: <http://www.crpe-ej.org>

Madrigal, Daniel S. / Health Educator, California Environmental Health Tracking Program
Website: <http://sph.berkeley.edu>

Rippel, Raina / Director, SWPA Environmental Health Project
Website: <http://www.environmentalhealthproject.org>

Szabados, Laura / Development Associate, Center for Environmental Health
Website: <http://www.ceh.org>

McDermott-Levy, Ruth, Ph.D., R.N. / Assistant Professor,

Roter, Rebecca / Chairperson, Breathe Easy Susquehanna County

Thomas, Deborah K. / Director, Shale Test
Website: <http://www.shaletest.org>

APPENDIX C: Agenda

Day One: Thursday, January 21, 2016

7:30 a.m. – 8:00 a.m.	Registration & Light Breakfast
8:00 a.m. – 8:15 a.m.	Welcome & Introduction Ansj Miller Eastern States Director, Center for Environmental Health Michael Green Executive Director, Center for Environment Health
8:15 a.m. – 9:30 a.m.	Public Health Dimensions of Oil & Gas Development in California
Facilitator	Martha Dina Argüello Executive Director, Physicians for Social Responsibility, Los Angeles
Presenter	Seth B.C. Shonkoff, Ph.D., M.P.H. Executive Director, Physicians Scientists & Engineers for Healthy Energy
Topic	Types of Oil and Gas Development, Health Risks, and Approaches to Reduce These Risks
Presenter	Bhavna Shamasunder, Ph.D. Assistant Professor, Urban and Environmental Policy, Occidental College
Topic	Race, Health Disparities, and Community Engaged Research: Case Study of Los Angeles
9:30 a.m. – 10:45 a.m.	The Power of Health Risk Communication: Community Organizing and Participatory Research
	This panel will focus on the role of communicating about public health risks of oil and gas development. Panelists will present different perspectives on community organizing and community participatory research with the goal of trying to empower and educate the public using data collected in the field. Speakers will share their experiences participating in citizen science, community participatory research, and community organizing. Speakers will share how they have used environmental monitoring data and public health data to highlight potential health risks of oil and gas development and empower local community members so that they can become catalysts of change.

Facilitator	Sharyle Patton Director, Commonweal Biomonitoring Resource Center
Panelist	Rabeya Sen Director, Policy, Esperanza Community Housing, Los Angeles
Topic	The Strength of Community: Organizing for Environmental Justice, Health, Housing, and Safety
Panelist	Rebecca Roter Chairperson, Breathe Easy Susquehanna County (BESC) Citizen Science and Monitoring - Case Study of Susquehanna County, PA
Panelist	Rosanna Esparza, Ph.D. Program Organizer, Clean Water Action
Topic	Community Engaged Air Pollution Monitoring – Case Study of Lost Hills, CA
Panelist	Niki Wong, MPH Lead Community Organizer, Redeemer Community Partnership
Topic	Value of Community Perspective in Research and Monitoring Development
Panelist	Ashley Hernandez Youth Organizer, Communities for a Better Environment, Los Angeles
Topic	Frontline Community Organizing to Protect Health
10:45 a.m. – 11:00 a.m.	Break with Light Refreshments
11:00 a.m. – 12:30 p.m.	Air Monitoring Part - I: Atmospheric Air Sampling: Research Approaches
	The discussion for this panel will focus on some of the various tools and techniques being used by the academic research community measuring emissions data and assessing air quality and atmospheric pollution in urban and remote areas. Researchers will focus on the most successful atmospheric research instrumentation and methodologies being applied to studies of atmospheric composition, transport, and chemistry. Speakers will also discuss some of the strengths and limitations associated with different methods and instrumentation, as well as strategies that can be employed to overcome air monitoring challenges.
Facilitator	Seth B.C. Shonkoff, Ph.D., MPH Executive Director, Physicians Scientists & Engineers for Healthy Energy
Panelist	Detlev Helmig, Ph.D. Associate Research Professor of INSTAAR, University of Colorado
Topic	Air Monitoring for Emissions from Oil and Gas Development Operations

Panelist Eduardo (Jay) Olaguer, Ph.D.
Program Director, Air Quality Science, Houston Advanced Research Center

Topic Mobile Monitoring, Data Broadcasting, and Source Attribution in Real-Time

Panelist Michael P. Hannigan, Ph.D., M.S.
Assistant Professor Mechanical Engineering Department University of Colorado

Topic The benefits and limitations of low-cost monitoring technologies

Panelist Diane Garcia-Gonzales
Ph.D. Student, UC Berkeley

Topic Measuring Distance Decay Gradients around Oil and Natural Gas Developments

Panelist Raina Rippel
Director, Southwest Pennsylvania Environmental Health Project

Topic Air Sampling through Speck Monitors

12:30 p.m. – 12:45 p.m. Box Lunch (to go) – Swan Dumke Patio
Meet the Corporate Coach Tour Bus on the Alumni Drive (slightly west of Swan Dumke). Bus leaves at 12:45 p.m. Sharp

12:45 p.m. – 2:45 p.m. Field Tour of South Los Angeles Oil Extraction Sites with Nancy Halpern Ibrahim, MPH, Executive Director of Esperanza Community Housing Corporation

Physicians for Social Responsibility Los Angeles Chapter (PSR – LA) has arranged for a field trip to three oil drilling sites that are located within residential communities or other sensitive land uses of South Los Angeles: The AllenCo, Murphy, and Jefferson Drill Sites. The field trip will be led by a representative from one of the community based organizations, Esperanza Community Housing Corporation, and will help the participants to see a glimpse of the exposures these communities face every day. The participants will also be briefed on the health impacts the residents are facing and their experiences with regulatory agencies like the South Coast Air Quality Management District.

3:00 p.m. – 4:00 p.m. Air Monitoring Part - 2: Community Based Participatory Air Sampling

This panel will focus on community based monitoring and the various tools and techniques being used for analyzing the impacts on air. Community advocates and scientists will share the costs and benefits of community based participatory air sampling as well as how they have used citizen science techniques to educate the public on the risks associated with unconventional oil and gas development.

Facilitator Elizabeth Crowe
Co-Director, Coming Clean

Panelist Bruce Baizel, B.A., M.A., J.D.
Director, Energy Program, Earthworks

Topic Air Monitoring and Community Health in 3 States

Panelist Kim Schultz
Oil and Gas Program Coordinator, The Endocrine Disruption Exchange (TEDX)

Topic Community Based Participatory Air Sampling

Panelist Deb Thomas
Director, Shale Test

Topic Costs and Benefits of Community Based Monitoring in the Rural West

4:00 p.m. – 4:15 p.m. Break with Light Refreshments

4:15 p.m. – 5:15 p.m. Best Practices in Community Monitoring: Understanding the Emission Profiles at Oil and Gas Sites

The goal of this session is to share different tools, approaches and techniques being used to measure and monitor other environmental media (i.e. soil, water, noise, and biota) near oil and gas sites. We will hear from experts as they discuss approaches taken in their community monitoring work to measure and characterize emission profiles and some of the challenges and successes associated with these approaches. Panelists will share ideas for monitoring protocol development and how study results have been successfully used to support intended goals such as advancing regulations, building community cohesion, connecting with the science community, and promoting awareness through public education and community advocacy.

Facilitator Jake Hays
Director of the Environmental Health Program, PSE Healthy Energy

Panelist Jill Kriesky Ph.D.
Associate Director, Southwest Pennsylvania Environmental Health Project (EHP)

Topic SWPA EHP Processes to Build Community Understanding of UOGD Emissions

Panelist Robert Harrison, M.D., M.P.H.
Clinical Professor of Medicine, University of California
Topic Approaches to Community Biomonitoring - Challenges and Successes

Panelist Susan Nagel Ph.D.
Associate Professor, Obstetrics Gynecology and Women's Health, University of Missouri
Topic Health effects of Endocrine Disrupting Chemicals in Oil and Gas Development

5:15 p.m. – 6:30 p.m. Workshop: Building Partnerships and Exchanging Information
This workshop is designed to encourage discussion on common ground and challenges in partnership dynamics, to present a framework for meaningful partnerships, understand the similarities and differences of concerns in the different oil and gas communities, and to foster trust and solidarity among groups from different areas. Through shared stories and dialogue among these groups, we will exchange information, and identify and form productive partnerships in order to effect better health protections in oil and gas development communities.

Facilitators Ansje Miller
Eastern States Director, Center for Environment Health

Elizabeth Crowe
Co-Director, Coming Clean

Larysa Dyrszka, MD
Sullivan Area Citizens for Responsible Energy Development, PSR-NY, and Concerned Health Professionals of NY

Jill Johnston, Ph.D.
Assistant Professor, Department of Preventive Medicine, University of Southern California

6:30 p.m. – 7:30 p.m. Reception (Swan Dumke West)

Day Two: Friday, January 22, 2016

7:30 a.m. – 8:00 a.m. Registration & Light Breakfast
8:00 a.m. – 8:15 a.m. Recap and Day Two Introduction
8:15 a.m. – 9:30 a.m. Working Effectively with Government Public Health Agencies

Presenter Linda Rudolph, M.D., M.P.H.
Director, Center for Climate Change and Health, Public Health Institute

Local and state government public health agencies are charged with protecting and promoting the health of all people in their jurisdictions. Dr. Rudolph will explore how community-based organizations and community residents can work more effectively with these agencies to share information and knowledge to address pressing health needs.

9:15 a.m. – 10:45 a.m. Asking the Right Questions: Data and Decision Making

In this session we will hear from health department officials and environmental justice advocates as they discuss the gaps between regulatory decision-making and public health safety information. The panel will explore which tools are helpful in protecting public from UOG, such as the pros and cons of risk assessment vs. Environmental Impact Assessments vs. Health Impact Assessments, and how public health officials and advocates can and should work with government officials in creating policy on oil and gas operations in communities.

Facilitator Linda Rudolph, M.D., M.P.H.
Director, Center for Climate Change and Health, Public Health Institute

Panelist Paul English, Ph.D., M.P.H.
Senior Branch Science Advisor, Environmental Health Investigations Branch, CA Department of Public Health
Topic Using Community-Based Research to Monitor Air Quality in Neighborhoods

Panelist Rebecca Johnson
End of Life Care Program, Graduate and Professional Studies, Sarah Lawrence College
Topic Correlating Monitoring Results with Population Health & Community Disease Experience

Panelist Gladys Limón, J.D.
Staff Attorney at Communities for a Better Environment
Topic Formulating Policies & Regulations: Data & Participation Challenges

Panelist Cyrus Rangan, M.D. FAAP FACMT
Director, Toxic Epidemiology Program, LA County Department of Public Health
Topic Public Health Evaluation of Communities Burdened by Proximity to Multiple Sources of Pollution

Panelist Alexandra Nagy
Southern California Organizer, Food and Water Watch, Los Angeles
Topic Health Impacts on the Community from Porter Ranch (LA) Gas Leak.

10:45 a.m. – 11:00 a.m. Break with Light Refreshments

11:00 a.m. – 12:30 p.m. Workshop: Strategizing for Effective Engagement
In these two workshops, participants will discuss and strategize about how to engage public health department officials (both state and local) with organizations involved in monitoring and other health data collection efforts to highlight the threats to public health. Panelists will discuss strategies that can lead towards enhanced public participation in decisions related to public health.

Workshop 1: Swan Dumke West Managing public health through public participation impediments and solutions

Facilitator Paul English, Ph.D., M.P.H.
Senior Branch Science Advisor, Environmental Health Investigations Branch, CA
Department of Public Health

Workshop 2: Promoting and disseminating health research from collaboration UEPI Seminar between health departments, community groups, and academics

Facilitator Emily Harris, MPH, LMT, NCTMB
Program Manager, Arkansas Fracking

12:30 p.m. – 1:30 p.m. Luncheon (Lower Herrick)

1:30 p.m. – 2:30 p.m. Workshop Results (Swan Dumke West)
The Workshop groups will share the discussion results/draft strategies/collaboration mechanism, followed by Q&A.

2:30 p.m. – 2:45 p.m. Symposium Closing

Swan Dumke West
Occidental College
1600 Campus Road, Los Angeles 90041

Co-sponsors:
Center for Environmental Health (CEH)

Alliance of Nurses for Healthy Environments (ANHE)

California Environmental Health Tracking Program

Coming Clean Collaborative

PSE Healthy Energy

Physicians for Social Responsibility-Los Angeles (PSR-LA)

Urban & Environmental Policy Institute, Occidental College