Environmental Risk Assessment for Shale Gas Development

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Research work begun in the 1970's by the U.S. Department of Energy on the resource potential of Appalachian Basin black shales helped lead to the development of these resources decades later. Gas production from shales like the Marcellus suggests that the ultimate recoverable reserves in these rocks may be enormous, possibly exceeding all earlier estimates. Shale gas could free the United States from a decades-long dependence on imported oil, and it is abundant enough to replace nearly all coal combustion. Development of shale gas is not without environmental consequences, however. Two techniques employed to recover the gas in economic quantities are horizontal drilling and staged hydraulic fracturing, which create significant amounts of solid and liquid waste, and need relatively large work areas and robust infrastructure, potentially affecting ecosystems, landscapes, air, and water. Rigorous scientific data on the environmental effects of shale gas development are sparse, resulting in a great deal of uncertainty in probabilistic risk assessment models. This lack of information has contributed to a contentious public debate, and resulted in uneven regulations that are minimal in some locations and draconian in others. The U.S. Department of Energy, in cooperation with other federal and state agencies, universities, and industry is seeking a better understanding of the engineering risks of shale gas production. As such, the National Energy Technology Laboratory has been performing a triad of field, laboratory, and modeling-based research to collect detailed scientific data on the possible effects of drilling and hydraulic fracturing on water resources, air quality, landscapes and ecosystems, and assessing the potential for induced seismicity. Fieldwork includes the collection of baseline data near planned drill sites from air, surface streams and groundwater, and then monitoring changes in environmental parameters throughout the drilling and production process. Laboratory investigations consist of evaluating the threshold sensitivity and response of electronic water quality instrumentation to drilling fluids and frac chemicals, measuring natural attenuation pathways and rates in laboratory sand column experiments, and determining the chemistry of possible leachate from shale drill cuttings. A two-phase flow model is being used to calculate scenarios for methane gas migration in aquifers, and a reactive transport model is assessing the fate and transport of drilling and frac fluid contaminants to the accessible environment. Scientific documentation of the environmental impacts from shale gas production is expected to help the gas industry improve drilling management practices, identify sensitive environmental indicators for more focused regulatory monitoring, and provide accurate and unbiased risk information to citizens.

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Dan Soeder is a research scientist in geology and hydrology with the U.S. Department of Energy at the National Energy Technology Laboratory in Morgantown, West Virginia, where his interests include energy and environmental issues related to unconventional fossil energy resources. Prior to joining DOE in 2009, Mr. Soeder was a hydrologist with the U.S. Geological Survey in the mid-Atlantic region, after spending eight years on the Yucca Mountain Project in Nevada. His career before joining the USGS in 1991 included a decade of research at the Gas Technology Institute in Chicago on unconventional natural gas resources, including shale gas, and several years characterizing drill cores on the DOE Eastern Gas Shales Project. Mr. Soeder received a BS degree in geology from Cleveland State University in 1976, and an MS in geology from Bowling Green State University (Ohio) in 1978.

Unconventional Resource Development – A Look Forward

Michael Parker, P.E., Parker Environmental and Consulting, LLC, Huffman, TX

This presentation will examine trends and technology developments that are anticipated to have a substantive impact on operational, environmental, and public engagement activities associated with unconventional oil and gas development. Key areas that will be addressed include workplace safety and industrial health, water use and consumption, wastewater treatment reuse and disposal, chemical development and use, air emissions (combustion and vented), waste management practices, surface impacts, and public engagement and interactions. Where possible, external factors and influences will be identified and discussed.

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Michael E. Parker is currently Principal of Parker Environmental and Consulting, LLC, which provides environmental and regulatory policy development, technical, and advocacy support on a range of issues, focusing on nonconventional oil and gas development including hydraulic fracturing, produced water management, water resource management, onshore and offshore environmental management issues, and carbon capture and storage issues. Prior to establishing his consulting practice, Mr. Parker worked for ExxonMobil Production Company for over 35 years in a variety of engineering and technical assignments. At retirement, Mr. Parker was a Technical Advisor in ExxonMobil's Upstream Safety, Health, and Environment organization. Mr. Parker provided technical support and guidance to ExxonMobil affiliates world-wide on a range of issues including drilling and production discharges, underground injection control, spill prevention and control, facility decommissioning, artificial reef programs, marine environmental issues, carbon capture and storage, hydraulic fracturing and general issue management coordination. Mr. Parker has served as Chair of the American Petroleum Institute's Upstream Environmental Subcommittee, the Hydraulic Fracturing Workgroup, the Carbon Capture and Storage Work Group and the Water Issues Group and is currently involved in the revisions to API's HF Guidance Documents and Recommended Practices. Mr. Parker is a graduate of the University of Texas and Texas A&M University and is a registered Professional Engineer in Texas and Louisiana.

Social Impacts of Unconventional Oil and Gas Development

Jeffrey B. Jacquet, Ph.D., Assistant Professor of Sociology and Rural Studies, South Dakota State University, Brookings, SD

Intensive shale energy development can provide an array of positive and negative changes to host communities. Numerous economic stimuli can provide wealth and employment opportunities, as well as increased cost of living, shortages for housing and municipal services, disrupted identities and ways of life, and perceived or actual environmental degradation. The actual and perceived allocation of these costs and benefits are not distributed evenly, and are often stratified across factors such as landownership, age, employment status, environmental attitudes, and proximity to development. Increasingly, shale energy host communities exhibit contentious debates over the regulation and location of development activities. Research in shale energy and other types of large-scale development have shown social-psychological disruptions, perceptions of risk, and community conflict can lead to stress and culminate in physical and mental health concerns.

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Since 2005, Dr. Jacquet has performed research and published widely on the social and economic impacts of hydraulic fracturing in sites across the US Recent endeavors have examined municipal-level planning, regulation, and ownership of energy facilities and social-psychological disruption in energy impacted communities. He is currently an assistant professor of Sociology and Rural Studies at South Dakota State University.