National Academy of Sciences holds workshop on legacy issues, induced seismicity, and risk management in the oil and gas industry

On Thursday and Friday, December 1-2, the National Academies' Roundtable on Unconventional Hydrocarbons held a workshop on *Unconventional Hydrocarbon Development: Legacy Issues, Induced Seismicity, and Innovations in Managing Risk*. The meeting brought together experts from industry, academia, state and federal agencies, and environmental organizations to assess recent and potential future developments in understanding, monitoring, and mitigating the risks associated with oil and gas production.
Click “Read More” for a summary of some key takeaways.

- Regulation of oil and gas production varies from state to state. This is even more true today – the technology behind the recent oil and gas boom has advanced so rapidly that the inherently slow regulatory process has had difficulty keeping up. Although states have been able to learn from each other, regulations that work in one state may not work well in another; the complexity of drilling for oil and gas requires different rules and regulations in different places. Many participants in the workshop from a variety of backgrounds said that regulations need the flexibility to respond to continual change in the industry.
- Better risk management requires better data collection, particularly on well integrity, gas leaks, surface emissions, pipeline integrity, and the chemistry and toxicity of wastewater. More and better data will also require improved data storage, analysis, and communication.
- Technologies exist to mitigate many of the environmental risks in the oil and gas industry; the problem is incentivizing the industry to use them. Some risk-mitigation methods include: better cement chemistry or cement alternatives; fiber-optics for monitoring well integrity; surface emission monitors; drilling multiple wells from a single well pad; GIS-based tools to promote better siting of well pads; recycling of produced and flowback waters; reduced injection rates for wastewater disposal; more rigorous (but expensive) well decommissioning procedures; and long-term data collection to help identify deviations from normal conditions.
- Many wells are left inactive for long periods of time instead of being decommissioned, increasing the risk of gas leaks. Some states (e.g., Texas) have implemented regulations that require well operators to account for and justify their inactive wells. However, decommissioned wells can leak, too. Exactly how many decommissioned wells may be leaking is poorly known; with 3.5 million oil and gas wells in the United States (only 800,000 of which are active), finding out is expensive.
- Industry consortia can be an effective means of sharing best practices. Two examples that have proven successful are the DeepStar project (for deep-water drilling) and the Center for Responsible Shale Development (for shale gas producers).
- Financial uncertainty for both states and companies makes effective reclamation efforts much more difficult. States require oil and gas companies to obtain bonds to ensure that their wells are properly plugged and decommissioned at the end of

their usable life. Because drilling a well carries an inherent financial risk (the well might not produce anything), bonding requirements must be sufficiently low that oil and gas companies are able to take that risk. On the other hand, bonding requirements must be sufficiently high to cover the decommissioning costs in case the well owner goes bankrupt and the responsibility for decommissioning the well is left to the state. In many states, the average cost of decommissioning a well is greater than the bond requirement, which puts financial pressure on the state. Both bonding requirements and regulations vary greatly from state to state, and the costs of decommissioning a well are highly variable, making this an extremely complicated issue in need of close attention.

- Legacy issues aren't just environmental. The socioeconomic impacts of oil and gas development can be positive during periods of intense activity, but local communities often struggle when the activity dies down. When oil production drops, so do state revenues, providing less money for reclamation efforts and the maintenance of communities that previously relied on income and employment from the industry. A recurring theme during the workshop was the need to ensure that oil and gas revenues are used in a way that benefits communities both during and after production. For example, North Dakota puts 30% of its oil and gas revenues into a legacy fund to provide long-term funding for the state, and earmarks a portion of the revenue for reclamation of environmentally damaged sites.
- Very few of the earthquakes induced by oil and gas activity are due to hydraulic fracturing ("fracking"). The vast majority are due to high-volume wastewater disposal by deep underground injection, which can effectively reduce friction on faults, allowing them to slip and cause earthquakes. In Oklahoma and Kansas, there are well-documented correlations between wastewater injection volumes and the number and size of earthquakes. In the past few years, many states have developed procedures for responding to and decreasing the number of induced earthquakes. In Oklahoma and Kansas, where induced earthquakes have been the most problematic, these procedures and the downturn in the industry have made damaging earthquakes less frequent.
- Huge improvements in monitoring tiny earthquakes (thousands of times too small to feel) have made it easier to determine the impacts of hydraulic fracturing on surrounding rocks. In the few instances where hydraulic fracturing has triggered larger earthquakes (up to magnitude 4.6 in Western Canada), careful monitoring has made it possible to determine how the hydraulic fracturing process interacted with existing faults to trigger an earthquake. This has helped regulators and operators to develop procedures to avoid fracking in at-risk areas.
- The largest uncertainty in managing the risk of induced earthquakes is the location of faults. The Kansas and Oklahoma geological surveys are both working to locate previously unknown faults in high-risk areas. At the same time, geoscientists are constantly improving their ability to model the response of these faults to wastewater injection, thus informing the development of smarter regulation and better operating practices.
- Many states have significantly expanded their seismic monitoring capabilities, allowing them to better detect and respond to earthquakes induced by oil and gas activity.
- Despite the recent downturn in the industry, unconventional oil and gas production is going to remain an important part of the U.S. energy economy for many years to come. Improvements made in procedures now will reduce legacy issues in the future. This will require investment and innovations in both the building of new infrastructure and the monitoring and maintenance of old infrastructure.

A video recording of the workshop will be made available at the Roundtable’s website, and a report summarizing the meeting will be published in 2017. If you are interested in more information about induced seismicity and the oil and gas industry, check out last year’s AGI webinar, *Induced Seismicity in the Midcontinent*.

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