Marcellus Shale Multi-State Academic Research Conference

Event Collaborators: Cornell University, Penn State University, West Virginia University, Northeast Regional Center for Rural Development and Ben Franklin Technology Central and Northern Pennsylvania

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Development of the Marcellus Shale has created many opportunities for researchers to examine the social, economic and environmental impacts of large-scale natural gas development for the Mid-Atlantic region and beyond. Researchers are in a unique position to examine positive, negative and benign impacts, and help policy makers, communities, industry, citizens, and others understand and maximize benefits while mitigating negatives associated with rapid, large-scale natural gas activity. Large-scale natural gas development and the technologies used to explore unconventional energy resources are new to the Marcellus Shale region, and more research is needed to chronicle the evolution of this development.

Individuals from academic, research and environmental institutions responding to the many facets of development through research and outreach activities were provided an opportunity to meet, share their ideas, and establish collaborative relationships through the Marcellus Shale Multi-State Academic Applied Research Conference. The conference was unique in that it provided an opportunity for individuals of various fields of expertise to share ideas, develop professional networks, and relay their work's progress. The conference provided a structured format, but also allowed individuals ample time to mingle and discuss Marcellus related topics. In this light, the conference brought together researchers and those responsible for applying and sharing knowledge through outreach. The total number of attendees was 92, spanning 19 institutions, and 7 states. Attendees represented states and regions with various levels of experience with natural gas development, and attendees also represented a range of experience with Marcellus related issues, from little to decades of experience.

The conference began on May 10th and continued through May 11th 2011. It was made possible through collaborations among Cornell University, Penn State University, West Virginia University, Northeast Regional Center for Rural Development, and Ben Franklin Technology/Central and Northern Pennsylvania. Over the two day event, researchers from across the Mid-Atlantic region worked together to 1) identify research needs related to the impacts from Marcellus Shale development; 2) identify on-going research activities; 3) build multi-institutional academic partnerships; 4) endeavor to develop a broad applied research agenda that includes natural resource, wildlife, social, community and economic implications as well as research on production methods/technologies and; 5) help inform outreach and education.

To tackle the complex issues facing numerous stakeholders, the conference accepted abstracts which were organized into five breakout sessions: Economic Implications, Geological/Technical/Environmental Issues, Water Resource Management, Local Government/ Public Policy/ Health, Social Implications. In each session, presenters were limited to 5 to 7 minute presentations, with 2 minutes reserved for questions. The bulk of the session time was then dedicated to discussion of the topics and identification of research synergies and gaps.

Marcellus Shale Academic Applied Research Conference

May 10, 2011

Rod Howe of Cornell University welcomed attendees to the first conference dedicated to interdisciplinary, applied research focused on the Marcellus Shale development. Following this address, moderators from each of the five break-out sessions presented a 15-minute overview of current research on Economic Implications (David Kay, Cornell University), Local Government/Public Policy/Health (Rod Howe, Cornell University), Water Resource Management (David Yoxtheimer, Penn State), Geology/Technical/Environmental (Doug Patchen, West Virginia), and Social Implications (Kathy Brasier, Penn State). The subsequent sections document some of the key points made by moderators during the overview and each presentation from the breakout sessions. Additionally, the research gaps needing further attention are outlined.

I. Economic Implications—Presentations

- Impact of Marcellus Shale Development in Pennsylvania on Downtowns and Downtown Businesses (Andrews and Kelsey)
- Marcellus Shale and Property Rights: An Institutional Economic Analysis (Alter and Kelsey)
- Fiscal Impacts of Gas Development on Local Governments in Pennsylvania (Jacobson)
- Local business impacts of Marcellus Shale development: the experience in Bradford and Washington counties (Ward and Kelsey)

These presentations highlight the economic advantages and disadvantages from Marcellus development. On the positive side, downtown businesses are receiving a boost from development. Additionally, some businesses, foundations and charities are receiving

funds via industry donations and grants. And though many municipalities were initially concerned about road destruction and maintenance, Jacobson reports that municipalities are generally pleased with the gas industry's compensation for road damage. Further, tourism was a major economic driver in Marcellus communities before development, and Ward and Kelsey are finding that in Bradford and Washington counties, tourism activity is steady despite drilling. However, development of natural gas resources raises issues of equity, such as: who is benefitting, and who is bearing the costs? It becomes critical to carefully assess the economic implications, the populations associated with these trends, and issues of equity. Another equity issue is access to critical resources such as legal representation, especially because landowners who sought legal advice reported (statistically) significant higher leasing and royalty rates than landowners who did not seek legal advice.

Kelsey believes researchers studying the economic implications of development have an easier time identifying and studying the positives, rather than the negatives, because sometimes the negatives are not immediately apparent or because impacts are both positive and negative. Other economic impacts, such as those felt from leasing bonuses and royalty income, are difficult to assess because the economic boost landowners experience from leasing bonuses and royalty dollars are not all kept local. Out-of-state residents with landholdings and seasonal residences receive a portion of these funds. The estimated scope of the Marcellus multiplier effect is vast, making it difficult to access data documenting many implications, including the economic implications outside the Marcellus region.

Some of the negative implications created by Marcellus development are benefits to other sectors, i.e. populations primed to capitalize on them. The increased activity that contributes to downtown shops also causes traffic congestion during certain times and deters people from patronizing some downtown businesses. The expanding population not only increases business sales but also drives commercial rents higher than typical in rural communities. The increasing rents mean a surge of money for property owners, but low-income residents are having trouble affording the inflated costs of living in a Marcellus county (Andrews and Kelsey).

Research Gaps:

- Wealth (leasing) vs. income (royalty) flows; what landowners do with their money; what influences monetary decisions
- Costs of increasing human service needs. Costs incurred by human services agencies/organizations responding to increasing demands for services?
- Survey fatigue

II. Geology/Technical/Environmental Issues—Presentations

- Landscape Change Associated with Marcellus Shale Exploration and Development—Research and Outreach Efforts (Brittingham et al.)

- Prediction of spatial variability of Marcellus Formation geochemical and geomechanical parameters through improved understanding of sedimentological variability and stratigraphic architecture in central New York State (Jordan and Karaca)
- The Pennsylvania State Seismic Network (Nyblade)
- A laboratory experiment on the fate of pollutants in brines applied to roads (Sang et al.)

The gas industry, landowners, community planners, regulatory agencies, and other stakeholders stand to benefit from detailed information on the geological properties of the Marcellus and the variability of the shale's composition across the formation (Jordan and Karaca). By understanding the Marcellus' properties and its variability, researchers can determine whether, or the extent to which, toxic metals are transferred from the Marcellus into frac water. Armed with this knowledge, wastewater planning and risk assessment are better able to mitigate potential dangers. Jordan and Karaca are characterizing the Marcellus in Seneca Stone Quarry (Seneca County, NY). They believe variability can be measured over distances of 10s to 100s meters (10s to 1000s feet). And though one of Seneca's quarry-based sections may provide a basis for regional extrapolation, Jordan and Karaca intend to incrementally add detailed studies from other quarries, to refine the accuracy of their predictions, therefore increasing the validity of their findings for stakeholders.

The hydraulic fracturing process is followed by the removal and transport of flowback water. Often this solution is transported to treatment facilities for disposal or recycling purposes. If spills occur on-site, chemicals and heavy metals may leach into the soil. Recent studies have shown that colloid deposition/release within the soil is related to ionic strength (Sang). If these bonds are altered, for instance, by the application of salts or brines, it may accelerate or impede leaching. Though previous research has shown that increasing ionic strength resulted in increased colloid retention, Sang's results from experiments using hydrofracturing water differ—most applied metals leached through the sand.

Though hydraulic fracturing dominates much of the environmental discourse, other factors such as the ecological implications of surface disruptions from pad, road and pipeline construction are equally important. Brittingham's GIS study of Pennsylvania landscapes reveals that areas with little fragmentation are of significant concern because restoration efforts are rare and focus primarily on establishing grassy cover. As a result, Marcellus Shale development could have long-term or permanent damage to areas experiencing development, especially as extensive pipeline infrastructure is set up and connected. Brittingham and her colleagues are establishing an online field guide to provide up-to-date information on how Marcellus Shale exploration, development and restoration efforts are impacting natural ecosystems and wildlife. Brittingham's research is ongoing, and during the summer of 2011, her field work will quantify the local landscape effects of Marcellus development on terrestrial ecosystems.

Beneath the Earth's surface, Nyblade and the Pennsylvania Bureau of Topographic and Geological Survey (BTGS) are tracking naturally occurring and drilling/reservoir induced seismicity. To date, little seismic activity of magnitude is attributable to induced seismicity (Nyblade). However, the use of hydraulic fracturing and particularly the large quantities of water injected underground to fracture the Marcellus formation may create induced seismicity. Over the last three years, a broadband seismic network comprised of ten stations was constructed across the Commonwealth. The data from these stations is available to the public by the Incorporated Research Institutions for Seismology (IRIS) data management center. For more information please visit: http://www.iris.edu/mda/_PENN.

Research Gaps:

- Landscape restoration: timing sequence, policy implications
- Comparisons between environmental issues within the Marcellus and other plays (e.g. Haynesville Shale and Barnett Shale)
- Radioisotopes
- Need for baseline data

III. Debriefing (May 10, 2011)

The first set of concurrent sessions were followed by a period of debriefing where all attendees gathered to discuss the key themes, research gaps, targeted audiences, implications for extension and outreach, collaboration opportunities, and funding opportunities. Questions were encouraged, which often generated large group discussions on the hydraulic fracturing and drilling process and procedures, economic advantages and disadvantages, and landscape disturbance (size of drilling pads).

IV. Reception & Poster Session

A reception in the main foyer followed the debriefing session. During this period refreshments were served and posters were on display for attendees. This was one of the many opportunities made available to discuss ideas, potential collaborations, on-going research, and the posters on display. Many attendees formed dinner parties and continued their discussions after day one was officially complete.

—Day Two—

On May 11, 2011, day two began at 8:30 a.m. with three concurrent sessions. Researchers presented their work on: Water Resource Management, Social Implications, and Local Government/Public Policy/Health. Again, presentations lasted 5 to7 minutes followed by a moderated question/discussion period to resolve questions, identify opportunities for collaboration, and discuss research gaps and how to address them.

V. Water Resource Management—Presentations

- Water Resource Impacts of Shale Gas Drilling (Riha et al.)
- Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies (Swistock et al.)
- Water-quality monitoring in the Marcellus gas-drilling area in the Beech Creek Watershed (Khalequzzaman et al.)
- Characterization of Organics in Marcellus Frac-back Waters (Wolford et al.)
- Significance of Uncertainty in the Approval of Water Withdrawals for Hydraulic Fracturing in the Marcellus Shale (Mitchell)

Discussion of hydraulic fracturing fluids dominated the Water Resource Management session. Researchers in this section are assessing private water wells in close proximity to Marcellus wells—pre and post drilling (Swistock et al.), geospatial data across shale plays (Riha et al.), organic materials in frac flowback water (Wolford et al.), water quality in Pennsylvania's Beech Creek Watershed (Khalequzzaman et al.) and water quantity in streams permitted for water withdrawal (Mitchell). The work on flowback fluids is ongoing, and results at this time are limited. The studies by Riha et al., Swistock et al. and Khalequzzaman are important for assessing the quality of water in aquifers, when drilling is present and not present. Wolford's work emphasizes the need for more research on the concentration density of organic matter in flowback and also the need to explore multiple analytical procedures. This fracing process requires a large quantity of water, and Mitchell argues that water withdrawals in streams without gauges pose detrimental effects and be gauged individually rather than relying on nearby gauges on other streams.

Research Gaps:

- More effective monitoring plans for recording data (tracers)
- Monitoring: what to monitor for/consistent techniques
- Concentration of organic matter in frac flowback water
- Need for baseline data

VI. Local Government/Public Policy/Health

- Multi-State Water Management Commissions in the Northeast: What do we know about these institutions and how they are influencing Marcellus Shale development (Abdalla et al.)
- Natural gas landowner coalitions in New York State: Emerging benefits of collective natural resource management (Jacquet and Stedman)
- Using local legislation to mitigate negative impacts of Shale Gas development (Kinne)
- Perceptions of the Natural Environment and Health among Residents in Marcellus and non-Marcellus Communities (Sliwinski)
- Spatial drivers and water policies as determinants of the location of Marcellus Shale gas development in Pennsylvania (Klaiber and Abdalla)

Citizens and local governments are reacting to development through a number of collective responses. Water remains a key topic, and Abdalla et al. are assessing how entities are responding to water quantity and/or quality impacts, public policy challenges facing state agencies in multiple states, and institutional actions to overcome these challenges. Complementing this work, Klaiber and Abdalla are collecting data on natural gas firm characteristics, on the economic climate in developing areas, and on water sources and wastewater disposal. More broadly, Kinne is exploring the approaches local governments in New York are taking to assess and mitigate the negative environmental, economic and social impacts of gas shale development; the extent that governments are acting on or defending these home rule provisions; the greatest challenges faced by local governments in their endeavors to prepare for increased activity by the oil and gas industry; and the extent local governments draw on experiences from other jurisdictions in their legislative development processes.

Additionally, the flurry of early leasing activity in Pennsylvania, West Virginia and New York resulted in collective actions among landowners who joined landowner groups or coalitions to collectively bargain for higher lease and royalty rates and stricter environmental reclamation procedures after development. Jacquet and Stedman are assessing the benefits of collective natural resource management in New York. The rise in leasing and development may alter the health of residents. Sliwinski et al. are chronicling environment-health relationships that can guide effective approaches to both land-use planning and community health strategies. These scholars intend to promote well-being and disease prevention.

Research gaps:

- Political activism of various groups, landowner coalitions
- Forced pooling in PA/compulsory integration in NYS
- Local government control (looking across state lines)
- Health issues, perceived and real (need for baseline data)
- Long-term cost-benefit analysis for communities

VII. Social Implications

- Investigating the role of identities and opinion leadership on risk information seeking and sharing about proposed natural gas drilling in New York's Marcellus Shale (Clarke)
- Pennsylvania and New York Residents' Views of Natural Gas Development in the Marcellus Shale Region (Stedman et al.)
- Effects of Marcellus Shale Development on Families with Children: An Exploratory Study (McLaughlin et al.)
- Public perceptions of Marcellus Shale knowledge gaps: Preliminary findings and new questions (Kinchy et al.)
- Marcellus Shale gas development in Pennsylvania and the perceptions of opportunities and challenge among Pennsylvania educators (Schafft et al.)

As development proceeds, community leaders began organizing groups and collectively raising awareness of development. Clarke identifies a major problem with community leadership, especially in Pennsylvania: local leaders have no real authority or power. Clarke's presentation also highlighted how collective action increases knowledge in Marcellus topics. However, Stedman et al. show that of a random sample of 6,000 households in the Marcellus Shale area of New York and Pennsylvania, most respondents reported low knowledge levels about the impacts of natural gas drilling and the drilling procedures—perhaps a sign many Pennsylvania and New York residents are not actively participating in Marcellus related groups. This survey revealed Pennsylvanians were more likely to trust the natural gas industry and less likely than New York residents to trust environmental groups. Considering these findings, more work on the individual and collective responses and actions of residents needs to be done. Kinchy et al. are pursuing one vein on the utility of volunteer water monitoring—watershed groups, water quality groups—to proactively or reactively address water quality issues. These findings will

contribute to how people respond to perceived threats, generate knowledge on water use, and people's perspectives on water—use and misuse.

The potential for social change in a number of Pennsylvania's social institutions has prompted researchers to track current and future perceptions of community change. Schafft et al. are exploring how educators and educational administrators across Pennsylvania understand the opportunities, contradictions and dilemmas associated with Marcellus Shale activity that are facing rural secondary schools and Career and Technology Centers (CTCs). This work has multiple implications for workforce and economic development, community development and the well-being of residents. Researchers are tracking other institutions as well. McLaughlin et al. are assessing community well-being and cohesiveness among families with various resources—social and economic capital—to assess how they perceive development affecting families, community, and the natural environment.

Research Gaps:

- Gendered implications of development—e.g. economic, social, environmental
- Antecedents of social disruption
- Longitudinal analyses: changes to knowledge, trust and perceptions over time
- Risk perceptions

VIII. Rapid Ad Hoc Sessions

After the breakout sessions, attendees were asked what ad hoc sessions they would like to attend. After a group discussion, a list was created and consolidated to:

- Researchers and Outreach
- Funding Opportunities
- Marcellus Literacy
- Role of Researchers

These sessions represented the range of interests and experience levels among attendees. Participants with research and outreach responsibilities in areas with rapid development sought to develop collaborative efforts to implement research findings and theory into practical knowledge and educational tolls and programs. Other researchers were interested in developing a firmer grasp on funding opportunities available to individual researchers and interdisciplinary research teams for projects spanning multiple institutions. Being an applied research conference, some researchers were interested in discussing their role as researchers, their contributions to scholarly and practical knowledge and where information should be dispersed. Finally, some attendees who were new to Marcellus Shale topics met to outline a series of fact sheets of foundational knowledge related to Marcellus Shale development (e.g. drilling, fracing, water usage, community impacts, leasing).

IX. Closing Remarks & Evaluations

The closing remarks were delivered by Rod Howe. Again, the floor was opened and a group discussion turned toward the future: research, Extension, collaboration, funding opportunities, and the future of the Marcellus Academic Applied Research Conference. Attendees were encouraged to fill out their evaluation forms to provide feedback on how well the conference format accomplished several goals. Sponsors were grateful for the comments and suggestions. Presented here is a summary of evaluations:

- ✓ The first goal assessed was how well the conference brought together researchers from across the Mid-Atlantic region to help identify the research needs related to the impacts of the Marcellus Shale development. Overall, attendees were pleased with the conference's ability to bring together scholars from across the Mid-Atlantic. Thirty-one of 43 respondents agreed, 11 strongly agreed and 1 felt it was hard to say. One attendee believed there was "good representation from Penn State and Cornell. It would have been good to have presentations from other institutions." Many attendees expressed satisfaction with the mix of professionals: "Well done integrating research and extension folks."

- ✓ Responses were also overwhelmingly positive on the conference's ability to identify on-going research activities related to Marcellus Shale although 1 person commented: "There is certainly more being done than was represented here. Maybe a website where people could post abstracts of ongoing research might be useful to promote ongoing awareness and collaboration." Overall, 38 respondents either agreed or strongly agreed, while 5 reported it was hard to say whether this objective was met. However, many attendees were concerned with the short presentations, one attendee commented: "I would have preferred being able to attend more of the 5 substantive sessions. I don't get much out of report-out session; recommend cutting those and offer chance to hear more substance directly from researchers."

- ✓ Another objective outlined by conference organizers was to build multi-institutional academic partnerships focused on Marcellus Shale topics. Twenty-three respondents agreed or strongly agreed, while 1 disagreed. This objective requires time, and 19 believed that at the end of the conference it was hard to say. One attendee felt: "These likely will develop over time. It was hard to find time to talk with folks in other states."

- ✓ The conference accepted presentation abstracts on a broad applied research agenda that includes natural resource, wildlife, social, community and economic implications as well as research on production methods/technologies. The goal was to include applied, interdisciplinary research. Twenty-five respondents agreed or strongly agreed, while 3 disagreed. Fifteen believed it was hard to say. From the comments, attendees believed work on "wildlife or human health effects," "production technologies," "legal and political issues" needed attention.

- ✓ The final objective of the Marcellus Academic Applied Research Conference was to help inform outreach and education through research. Thirty-one respondents agreed or strongly agreed, while 2 disagreed. Ten respondents felt it was hard to say whether outreach and education would benefit from the event. Comments on the conference's ability to benefit outreach and education were mixed, but those who were dissatisfied are best represented in this statement "I don't feel that I gained a lot of new knowledge as an educator that I can take home and deliver to the public."

X. Next Steps

The Marcellus Academic Applied Research Conference marked the first conference dedicated to Marcellus research, outreach and education. Overall, attendees expressed satisfaction with the event, and feedback indicating areas of the event as less than satisfactory will be used for future planning. Yes, some attendees are suggesting an annual event. One attendee commented: "I think we got the beginnings of this initiated. A forum to continue sharing our progress will be critical. Perhaps this conference is done annually?" Others believed creating a listserv would best initiate further applied research and education collaborations and advances. That listserv (multistate-natural-gas-researchers-l@lists.psu.edu) has been created—to be added, please contact Margaret Hopkins at mhopkins@psu.edu.

At this time there are murmurs of another event during 2012; however, a planning committee has yet to be developed. Further discussion will ensue on the listserv.

For additional information on the Marcellus, please visit:

www.naturalgas.psu.edu
www.marcellus.psu.edu
www.msetc.org
http://Naturalgas.cce.cornell.edu
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