Exhibit 5

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The Economic Consequences of Marcellus Shale Gas Extraction: Key Issues

A Research Project sponsored by the Cornell University Department of City & Regional Planning

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A Research Project sponsored by the Cornell University Department of City & Regional Planning

by Susan Christopherson, Professor, Department of City & Regional Planning, Cornell University

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Introduction

New York and Pennsylvania have a long history of natural gas extraction, including in the Marcellus Shale. Drilling is occurring currently in both states. Recent public concerns about shale gas drilling have revolved primarily around a specific technology -- high volume hydraulic fracturing (HVHF or "fracking"). Hydro-fracking uses millions of gallons of water infused with chemicals in a drilling process that fractures shale along bores drilled horizontally as well as vertically to extract gas from formations deep underground. The concerns with this technology have focused particularly on its potential effects on water supplies and quality. This is the central issue addressed in the Supplemental Generic Environmental Impact Statement (SGEIS) being developed by the New York State Department of Environmental Conservation. But the draft SGEIS, released in 2009, takes as a given that, while environmental considerations are important, exploitation of this new natural gas asset will produce significant economic benefits for New York's economy, reduce natural gas costs to state residents and industries, and provide for long-term economic development. Media coverage of issues surrounding shale gas development has tended to reinforce this assumption.

Natural resource extraction industries typically play only a small role in state economies; their employment impact is tiny compared to industries such as retail or health services On the other hand, these industries have major impacts on the regions where production takes place. Shale gas drilling brings an economic "boom" to the regions that experience it. As drilling companies move into a community, local expenditures rise on everything from auto parts to pizza and beer. New jobs are created in hotels and retail. Landowners receive royalty payments and have extra spending money in their pockets. This increased economic activity is eagerly anticipated in many parts of Pennsylvania and New York, especially in light of the "great recession". To fully assess the economic effects of shale gas drilling, however, policy makers and citizens need information on a wide range of questions: Who will get the jobs that are created? What about severance taxes? What are the costs of shale gas drilling to the public? How will the costs and benefits be distributed? How will other regional industries be affected? Where will the royalty money be spent? How long will the boom last, and what happens when it ends?

During the past year, a group of researchers centered at Cornell University undertook research to try to answer some of these questions, examining both the short-term (economic impact) and long-term (economic development) consequences of shale gas drilling and production. Our specific goal was to go beyond the narrow models that have been used to predict the economic impact of shale gas drilling, and to look at three issues:

1. How will the pace and scale of shale gas drilling affect the short-term and long-term economic consequences for counties in the Marcellus Shale gas play? What are the implications for job creation, in the short term and in the long term?
2. What costs do communities face in conjunction with shale gas drilling? What are the likely to be the cumulative effects of shale gas drilling and production, not only from the drilling process itself, but also from the industrial infrastructure required to transport and store the gas and to service the wells? How will these costs be affected by the pace and scale of drilling?
3. What evidence is there to tell us about the longer-term consequences of developing an economy dependent on natural resource extraction, and particularly natural gas extraction? What will happen after the boom-bust cycle of drilling ends? How will other key industries be affected?

Our research focused on Pennsylvania, where Marcellus HVHF drilling has already begun, and on New York, which is considering how to regulate HVHF. Many states in the U.S. have shale gas plays where HVHF is being used, however, and we can learn from their experiences about what to expect, both in the short term and in the longer term.

Because our goal was to answer complicated "how" and "why" questions, we used multiple methods including case studies, interviews, and descriptive statistics. Some of the data we gathered prompted us to ask, and enabled us to answer, questions about how the pace and scale of drilling could affect economic impacts. Overall, we wanted our research to inform the discussion of critical policy issues, and to provide citizens and policy makers with a framework for thinking about shale gas drilling and the questions it raises for long-term economic development in the Marcellus regions of Pennsylvania and New York.

This report presents executive summaries of the findings of research conducted in conjunction with the project from May 2010 to August 2011. (For a more in-depth picture on each topic, please download the complete working papers and policy briefs posted at http://www.greenchoices.cornell.edu/development/marcellus/policy.cfm.)

- Susan Christopherson and Ned Rightor lay out the factors that drive the boom-bust cycle characteristic of natural gas drilling, and their implications for the economic consequences of Marcellus shale gas extraction.
- David Kay emphasizes why we need to pay attention to the assumptions that underpin the models that have been used to project jobs and taxes in Pennsylvania and New York.
- Susan Riha and Brian Rahm tackle the water resource regulatory issues attending HVHF; their work makes the critical point that significant environmental dangers will

occur beyond the well site, and will have to be addressed both at the regional and at the state level.

- Andy Rumbach looks at the possible "crowding out" of tourism in drilling regions, and how to ameliorate the impact of drilling to retain a diversified economy.
- Jeffrey Jacquet explores what kind of public efforts will be needed to capture (short-term) drilling and (long-term) gas production jobs for local citizens in the parts of New York and Pennsylvania where natural gas jobs may dominate the local economy.
- Amanda Wilson and Lydia Morken take a look at one important area where regulation and public resources are needed to meet the challenges of shale gas extraction: public health monitoring and services.
- CJ Randall examines another important area of public costs from drilling, that of damage to local roads.
- And finally, Sara Lepori looks at how severance taxes in shale gas producing states have been used to pay for short-term public sector costs during the drilling boom, and protect long-term economic development prospects in drilling regions.

Susan Christopherson, Ph.D
Project Director

Acknowledgements

We are grateful for the financial support and personal guidance of Philip R.S. Johnson, Senior Program Officer for the Environment Program at the Heinz Endowments, and of Park Foundation Executive Director Jon M. Jensen and Program Associate Amy B. Panek, who together made this project possible. We are likewise grateful for the support of the Academic Venture Fund of the Cornell Atkinson Center for a Sustainable Future for our work on monitoring air and water quality in Marcellus Shale drilling regions, and for a grant from the Appalachian Regional Commission to the Southern Tier Central Regional Planning and Development Board that underwrote a companion study on potential impacts of shale gas extraction on the tourism economy of the Southern Tier, ably administered by STCRPDB Executive Director Marcia D. Weber.

More people than we can possibly name here contributed their knowledge and insights to our understanding of this complex and multi-faceted topic, and we would like to thank the many public officials, industry executives, researchers, technical experts, cooperative extension agents, community leaders, advocates, and interested citizens of New York and Pennsylvania who helped us in our efforts.

Those at Cornell University who contributed to both the substance and, crucially, the administration of this project include Katia Balassiano, Brett Chedzoy, Kristen Ford, Tom Frank, George Frantz, Al George, Danielle Hautenemi, Charlie Kruzansky, Susan Reed Lewis, Katie Lopez, Heidi Mouillesseaux-Kunzman, Zoe Nelson, Alexis Saba, Sarah Smith, Mort Sosna, Rich Stedman, Jeff Tester, Paula Willsie, and especially, Rod Howe and Robin Blakely-Armitage at CaRDI.

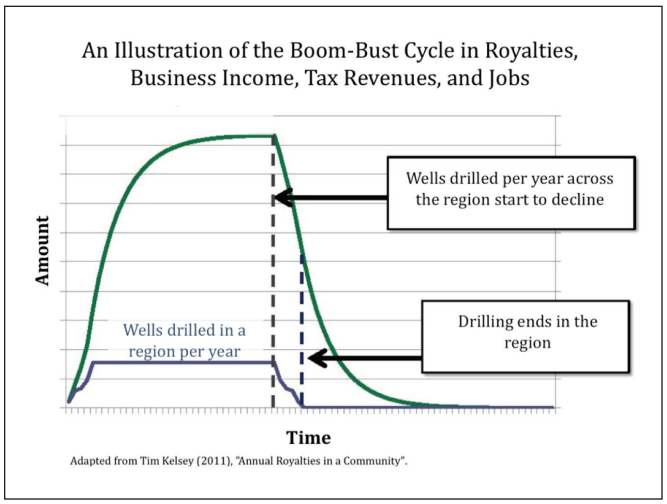
Then there's our intrepid research team. Not only the lead authors mentioned above, but City & Regional Planning Department Chair Kieran Donaghy, Isaac Argentineau, Tom Knipe, Vivien Li, Jack Lowe, Javier Perez Burgos, Sam Scoppettone, David West, and the members of the Spring 2011 CRP Workshop on the Marcellus Shale all contributed mightily to this project.

Finally, we would like to acknowledge in particular the members of the New York State Legislature who shared with us their thoughts and concerns: Aileen Gunther, Member of the Assembly, 98th District; Barbara Lifton, Member of the Assembly, 125th District; Donna Lupardo, Member of the Assembly, 126th District; and William Parment, former Member of the Assembly, 150th District. In New York, the necessary legislative action, authorizations, and appropriations to meet the challenges that we have identified now lies with them and their colleagues.

The Boom-Bust Cycle of Shale Gas Extraction Economies

Susan Christopherson and Ned Rightor

The extraction of non-renewable natural resources such as natural gas is characterized by a "boom-bust" cycle, in which a rapid increase in economic activity is followed by a rapid decrease. The rapid increase occurs when drilling crews and other gas-related businesses move into a region to extract the resource. During this period, the local population grows and jobs in construction, retail and services increase, though because the natural gas extraction industry is capital rather than labor intensive, drilling activity itself will produce relatively few jobs for locals. Costs to communities also rise significantly, for everything from road maintenance and public safety to schools. When drilling ceases because the commercially recoverable resource is depleted, there is an economic "bust" -- population and jobs depart the region, and fewer people are left to support the boomtown infrastructure.



In the case of high volume hydraulic fracturing for Marcellus shale gas, the pace and scale of drilling will determine the duration of the boom period in the cycle. And because the public costs are greater with more rapid boom-bust cycles, communities and states anticipating this kind of economic pattern need to understand what will influence the pace and scale of drilling.

There are two ways to forecast the pace and scale of drilling in a shale gas play. The first is based on what is geologically and technologically possible: an analysis of total potential natural gas reserves and the capacity of existing or anticipated technologies. The other is based on business dynamics in the energy industry, and looks at what are the likely strategies of energy firms in response to their profit opportunities in particular shale plays and overall. An understanding of the choices made by operators and their subcontractors in a shale play requires an analysis of the costs and delivery rates of well operations, margins of commercial profitability, and corporate financial and competitive relationships.

For those living in the Marcellus Shale region, oil and gas industry assessments of the commercial viability of wells and how to best exploit the resource have important consequences. For example, in the Barnett and Haynesville shale plays, high initial production rates dropped off rapidly. What that means for shale gas dependent local economies is that the "bust" may come sooner than they expected, with adverse implications for tax revenues and jobs. Industry investment advisors are cautious about the long-term productivity of all U.S. natural gas plays.

But because the Marcellus Play is large and geologically complex, the play as a whole is likely to have natural gas drilling and production over an extended period of time. While individual counties and municipalities within the region experience short-term booms and busts, the region as a whole will be industrialized to support drilling activity, and the storage and transportation of natural gas, for years to come. Counties where drilling-related revenues were never realized or have ended may still be impacted by this regional industrialization: truck traffic, gas storage facilities, compressor plants, and pipelines. The cumulative effect of these seemingly contradictory impacts -- a series of localized short-term boom-bust cycles coupled with regional long-term industrialization of life and landscape -- needs to be taken into account when anticipating what shale gas extraction will do to communities, their revenues, and the regional labor market, as well as to the environment. Effective planning to moderate the speed at which extraction occurs, and a commitment to invest the short-term infusion of private and tax revenue in longer-term economic development, may mitigate the effects of the boom-bust cycle.

Susan Christopherson *is a Professor in the Department of City and Regional Planning at Cornell University. She is an Economic Geographer, who has led a series of policy research projects to develop, analyze or evaluate strategies for economic development and job creation in New York State.* ***Ned Rightor*** *is President of New Economy Dynamics LLC, a research and consulting firm focused on workforce development and economic development projects throughout the northeast. Their complete report is available for download at http://greenchoices.cornell.edu/development/marcellus/policy.cfm.*

The Economic Impact of Marcellus Shale Gas Drilling: What Have We Learned? What are the Limitations?

David Kay

For several years, the prospects for energy development from gas deposits in tight shale formations have riveted the attention of natural gas industry boosters and detractors across the US. In southern and western shale-rich states, the shift towards shale gas production is definitively underway, if yet in its early stages. In New York in the middle of 2011, unconventional shale gas drilling remains on hold as debates over the pros and cons of a nascent 21st Century gas rush are fiercely engaged. In New York as well as in Pennsylvania, where shale gas drilling has only recently begun, the extensive Marcellus Shale formation is at the center of policy attention. Few natural resource issues have moved from obscurity to center stage in so dramatic a fashion and within such a short time frame.

Extractive natural resource development has frequently been described as transformative to regions that experience it. Many citizens believe that the future of New York's economy, environment, character, and quality of life are at stake because of the geographic breadth of the Marcellus natural gas play and the anticipated scale and pace of its development. Environmental issues, especially those involving water, are currently being intensively scrutinized. However, in this brief we focus our attention on the economy. Our primary goal is to review the existing research into the likely economic implications of shale gas development, and to raise questions about what policy makers need to know.

We highlight four key issues that have not been adequately addressed by existing economic impact models but which are critical to understanding the economic consequences of shale gas drilling.

- First: we examine existing input-output-based studies of the economic impacts of shale gas operations, focusing on those that have been referenced in New York State's still evolving environmental impact assessment documents. Because these studies involve projections based on models, we look carefully at several central assumptions that affect model results.
- Second: we discuss the most critical factor that will affect the regional and local economy – the uncertain pace, scale and geographic pattern of drilling operations, and the associated need to better understand oil and gas company decisions about where, when and how many wells to drill.
- Third: we highlight the need to better understand the economic behavior of landowners who receive a significant fraction of gas company local spending through leasing bonuses and royalties.
- Fourth: we review the long-term economic prospects for regions dependent on natural resource extraction industries. In particular, we consider the relevance of substantial research that points to the possibility of diminished long-term economic prospects for regions or communities that become overly dependent on natural resource extraction industries.

The amount of natural gas expected to be extracted and sold to consumers each year has the most influence on the results of all of the economic impact studies we review. In some studies, this quantity is a calculation based on drilling rates and sales actually observed in the recent past. In others, it is an assumption or projection into the future. However, even in more mature shale gas fields in southern and western states, only the early stages of a full development cycle have been observed. The Marcellus play is in the initial phase of exploration and production. Thus, assumptions or observations supporting the estimates of future drilling rates still involve significant uncertainty, are controversial, and deserve intense scrutiny. At this point, no single perspective can be said to have a lock on the 'right' estimate of the number of wells that will be drilled, the ultimate recovery rates of shale gas, or future gas prices.

The assumptions made about who has claims on the revenue streams generated by gas production are nearly as important as those about the rate of development of the play as a whole. Particularly critical for regional economic impact analyses are:

1. how drilling revenues will be split between people and businesses located inside the region versus outside the region; and
2. for money that does enter the region, the share that will go to landowners versus the share that will go to drilling related businesses.

Current estimates of these proportions are not strongly supported and will, in any event, evolve over time.

We conclude that existing evidence about the Marcellus shale gas operations is inadequate to make confident predictions about the numbers of jobs that will be created, business expansion, or revenue generation.

Gas development is already directing new money into the Marcellus region, and the prospects for substantial short-term economic gain for some local businesses and

property owners are real. Many economic development opportunities will also arise.

On the other hand, mixed economic results are also occurring even in the short run. The rising tide is not likely to lift all boats: there will be losing communities, and individuals who are displaced or left behind. Moreover, the experience of many economies based on extractive industries warns us that short-term gains frequently fail to translate into lasting, community-wide economic development. Most alarmingly, a growing body of credible research evidence in recent decades shows that resource dependent communities can and often do end up worse off than they would have been without exploiting their extractive reserves. When the economic waters recede, the flotsam left behind can look more like the aftermath of a flood than of a rising tide.

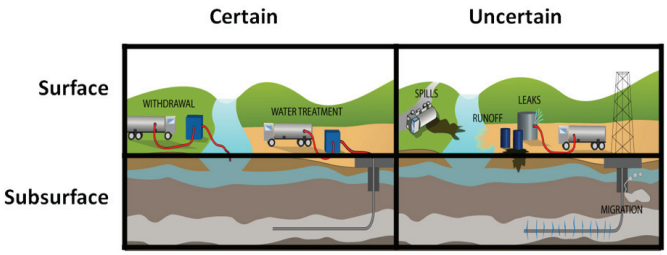
In the end, it seems clear that neither riches nor ruin are inevitable. The academic consensus is that the quality of policy and governance makes an important difference to the realization of an extractive industry's long-term economic development potential. The prospects for positive economic impacts in the short run should not blind policy makers to the potential for long term harm to overall economic development, especially when responsible, proactive policies may reduce and even reverse that risk.

David Kay *is a staff economist and Senior Extension Associate with the Community and Regional Development Institute in the Department of Development Sociology at Cornell University. The complete report is available for download at http://greenchoices.cornell.edu/development/marcellus/policy.cfm.*

A Framework for Assessing Water Resource Impacts from Shale Gas Drilling

Susan Riha & Brian G. Rahm

Recovering natural gas in the Marcellus Shale currently involves withdrawing large volumes of surface water, using large quantities of chemicals in close proximity to surface and ground water, disposing of waste water, and preventing gas and other formation fluids from entering potable groundwater during drilling and hydraulic fracturing. We present a framework for organizing and assessing these impacts on water resources that identifies (1) impacts that are certain, which can be planned for, as well as (2) impacts that are uncertain (accidents), which must be addressed through risk assessment, preventative practices, and reporting and monitoring structures. The Water Resources Institute framework can be used to help stakeholders better understand the wide range of events associated with shale gas drilling that will, or could potentially, impact water resources.



Distinguishing between certain and uncertain events is important from both a public policy and communications perspective:

- Certain events (those that are planned, such as water withdrawal and waste disposal) can be managed and regulated to minimize or avoid impairments to surface and groundwater, and also to control and monitor the scale and pace of development.
- Uncertain events (spills and leaks, contaminant migration) can be minimized by targeted regulation, encouragement of preventative management practices, establishment of timely and accurate reporting guidelines, and emergency response planning.

Distinguishing between surface and subsurface impacts is also useful. Surface impacts, which encompass a wide range of activities occurring at various locations, are more common than subsurface impacts, and are likely to represent a more significant threat to environmental water resources. Subsurface impacts associated with failures in cementing, casing and pressure management have received significant public attention and scrutiny, but are likely to pose relatively few and site-specific threats to water resource quality as compared to surface impacts.

Both surface and subsurface impacts warrant serious attention from all stakeholders. It is important for policy makers and regulators to understand their relative importance and differing causes so that proper measures can be taken to avoid or mitigate negative consequences. Making a distinction between surface and subsurface impacts is also necessary to determine whether or not current and proposed regulations adequately address various gas extraction related activities, and who should have the responsibility for regulating those activities. Identifying clear roles for local, state and federal agencies may help avoid lapses in critical oversight.

More specifically, we make the following suggestions with respect to public policy and shale gas regulation in New York State:

- A water withdrawal permitting system, with data collection and management functionality similar to that employed by the Susquehanna River Basin Commission, should be established state-wide. (NY State legislation on this issue is pending.)
- Use of private industrial treatment facilities (rather than municipal facilities) for highly concentrated and complex waste waters such as flowback and produced water.
- Stringent on-site containment practices to address water resource impacts associated with spills and leaks.
- A fast and transparent reporting system to ensure that unplanned events trigger effective responses from emergency and regulatory personnel.
- Testing of private drinking water wells pre and post gas drilling to establish any link between drinking water quality and drilling related impacts.
- General Stormwater SPDES permit requirements and/or other enforceable requirements for containment, monitoring, and compliance measures that take into account the unique phasing and layout of shale gas operations.

Unfortunately, gas extraction related events that have negative consequences for water resources will occur. New York has an opportunity to plan for mitigation of these impacts now. It also has an obligation to communicate to residents both the inherent risks of gas development and the allocation of responsibility for its regulation. Working together, industry and regulators can manage the range of possible negative impacts on water resources associated with shale gas drilling, and develop transparent monitoring and reporting systems that assure the public that shale gas drilling is occurring in a manner that protects our citizens.

For more information, please visit the New York State Water Resources Institute online at http://wri.eas.cornell.edu/

Susan Riha *is Director of the New York State Water Resources Institute at Cornell University.*
Brian G. Rahm *is a postdoctoral research associate, also with the NYS Water Resources Institute.*
Illustration by ***Laura Buerkle***

Natural Gas Drilling in the Marcellus Shale: Potential Impacts on the Tourism Economy of the Southern Tier

Andrew Rumbach

While much of the debate over gas drilling in the Marcellus Shale focuses on the potential environmental impacts, there is also concern that gas extraction will create a "boom-bust" economic development pattern seen in many resource rich regions and countries. Shale gas drilling in states like Wyoming, Texas, and Pennsylvania has had serious economic consequences for adjacent industries like agriculture and tourism because of the widespread industrial activity that accompanies drilling. This report examines the potential impacts of gas drilling on the tourism industry in the three-county region served by the New York Southern Tier Central Regional Planning and Development Board (STC).[1] Tourism is an important and diverse sector of the economy of the Southern Tier, and understanding the potential impacts of gas drilling on the tourism industry is important for business owners, elected officials, and planners concerned with economic development in the region. This paper addresses three major questions: 1) What is the value of the tourism sector to the economy of the STC region? 2) In what ways might gas drilling in the Marcellus Shale impact the tourism economy, now and into the future? 3) If gas drilling could potentially harm the tourism sector, what policies or strategies might help to mitigate those negative impacts? It is based on published reports, news articles, and studies related to gas drilling, empirical data from federal and state agencies, and interviews with public officials, gas drilling experts, business owners and operators, civic organizations, advocacy groups, and other local stakeholders.

The STC region has a diverse range of tourism assets, both urban and rural in character. The tourism "brand" of the Southern Tier is very much intertwined with agriculture; rolling hills, scenic farmlands, rural vistas, and viticulture all contribute to drawing tourists . Supporting and growing the tourism sector is a key component of economic development strategies for the counties in the STC region over the next several decades. In 2008, visitors spent more than $239 million in the STC region across a diverse range of sectors. The tourism and travel sector accounted for 3,335 direct jobs and nearly $66 million in labor income in the STC region that year. When indirect and induced employment is considered, the tourism sector was responsible for 4,691 jobs and $113.5 million in labor income.[2] In addition, the travel and tourism sector generated nearly $16 million in state taxes and $15 million in local taxes, for a total of almost $31 million in tax revenue -- a tax benefit of $1,181 per household. Though the tourism sector creates a significant number of jobs in the STC region, it is likely that the value of gas drilling, measured simply by jobs created and wages generated, will exceed the value of tourism in the short term. It is also likely that many tourism related businesses, including hotels, restaurants, and shopping venues, would benefit from the influx of gas workers. These observations come with two major caveats, however. First, tourism brings many non-monetary benefits to the STC region and its communities. Second, whereas many tourism related businesses are locally owned and operated and are thus part of a long-term economic development trajectory for the region, the employment "boom" in gas drilling will be relatively short-term and non-local.

One of the central questions confronting the tourism industry is whether drilling will permanently damage the carefully developed "brand" of the region. Individual impacts are unlikely to have serious and long-term consequences, but without mitigation, cumulatively they could do substantial damage to the tourism sector. Examples of such impacts include strains on the available supply and pricing of hotel/motel rooms, shortfalls in the collection of room (occupancy) taxes, visual impacts (including wells, drilling pads, compressor stations, equipment depots, etc.), vastly increased truck and vehicle traffic, potential degradation of waterways, forests and open space, and strains on the labor supply that the tourism sector draws from. All told, the region's ability to attract tourists could be damaged in the long-term if the perception of the region as an industrial landscape outlasts the employment and monetary benefits of gas drilling.

The pace and scale of gas drilling will be a crucial determinant of the overall impact on the tourism economy in the Southern Tier. Nearly every negative impact of drilling listed above could be more or less disruptive depending on the pace and scale of drilling; fewer permits per year mean a lower volume of truck traffic on primary and secondary roads, fewer visual impacts and less chance of multiple rigs in view-sheds, an increased but not overwhelming demand on hotel rooms and short-term accommodations, fewer pressures placed on the local labor supply, and so on.

Municipal and County governments have many tools at their disposal to help mitigate the impacts of gas development. Municipalities can regulate many of the industrial developments associated with gas drilling through comprehensive planning and zoning or during

the site planning process. These regulations might address the location, size, appearance, or operation of gas related infrastructure, buildings and sites, and should be developed and passed with the intention of mitigating the impacts of gas development on tourism and other adjacent industries. The full study makes additional recommendations that local and county governments take a proactive stance towards drilling and its attendant impacts by conducting truck traffic impact studies, making adjustments to the county room tax laws, and taking common-sense steps in site design and operations to reduce the visual impacts of drilling activities.

*Prepared by **Andrew Rumbach** for the Southern Tier Central Regional Planning and Development Board, with support from the Appalachian Regional Commission. Andrew Rumbach is an Assistant Professor in the Department of Urban and Regional Planning at the University of Hawaii. The complete report is available for download at http://www.stcplanning.org/index.asp?pageId=195.*

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[1] STC serves Chemung, Schuyler, and Steuben Counties in upstate New York.

[2] Employment numbers for the tourism and travel industries exclude wine production and vineyards. Wine and wine tourism is an emerging industry in the STC region, however, and employment in the industry is largely driven by tourism dollars. According to the New York State Department of Labor, 18 firms in the STC region were classified as "wineries" in 2010 and employed 275 people. An additional 8 firms were classified as "grape vineyards" and employed 63 people.

Workforce Development Challenges in the Natural Gas Industry

Jeffrey Jacquet

Summary

Thousands of (mostly) short-term and (some) long-term jobs will be created as natural gas extraction takes place in the Marcellus Shale, presenting both employment opportunities and workforce development challenges. These jobs – found primarily on crews needed during the drilling and completion process – are not for everyone; they require a diverse skill set and a rigorous work ethic. In Pennsylvania, the industry has thus far relied on "out-of-town" workers for many of these hard-to-fill roles, but over time will replace a portion of these workers with local employees -- if they are available. A similar pattern is likely to be repeated in New York.

Key Points

- Job creation is primarily dependent on the pace and scale of drilling, which has proven to be very difficult to predict.
- A study by Pennsylvania's Marcellus Shale Education and Training Center (MSETC) found that about 98% of jobs are concerned with developing the gas well, and are not needed after the well has been drilled, while 2% of the jobs are concerned with the long-term production of gas. If production lasts 20-30 years, and if many wells are drilled in a region, those production jobs can still amount to a sizeable workforce.
- The majority of jobs do not require advanced skills or training, but they do require a basic orientation to the industry and its technologies and terminology, as well as experience with the work conditions and schedules required.
- The industry is largely comprised of an array of independent contractors and subcontractors, and lacks a standardized training curriculum.

Development of the Marcellus Shale will be significantly more industrial in nature, technologically advanced, and labor intensive than the shallow natural gas drilling traditionally carried out in New York State and Pennsylvania.

Clearing and constructing a natural gas well site, drilling and casing the well, performing the hydro-fracturing process, and constructing the associated pipeline infrastructure are all considered part of the Drilling Phase. These jobs include the "roughnecks" who work on drilling rigs, excavation crews, CDL (tractor-trailer) drivers, heavy equipment operators, hydro-fracturing equipment operators, and semi-skilled general laborers.

After this work is performed, the number of workers needed to keep producing gas for the remainder of the life of the well -- the Production Phase -- is much smaller. MSETC found that approximately one worker is needed to monitor and maintain 6 wells under production. However, occupations associated with the production phase tend to be less labor intensive, more location specific, less hazardous and more specialized than drilling phase occupations, while still providing excellent wages and benefits. These include well operators (or "well tenders"), instrumentation technicians, pipefitting and welding technicians, production engineers, and office staff (although most office-based occupations are found in regional or corporate headquarters, and are not hired in the communities where drilling takes place).

While comprising less than 5% of the total workforce, jobs associated with the Production Phase will remain local and predictable, and these jobs will be required even if drilling ceases completely. Most of these occupations require either experience or vocational education that makes employees well suited for on-the-job training.

A Complex Workforce Training Opportunity

So, while a number of studies have projected impressive levels of job creation, the actual job picture will be much more complicated. In general, local residents will find relatively fewer opportunities for accessible and stable employment in the short term, although opportunities may grow over time. In Western states, employment statistics have shown natural gas industry employment increasing in local areas despite declining natural gas activity, reflecting jobs that have become more "local" to the area over time.

The complicated chain of contractors and subcontractors upon which the gas industry relies leaves hiring practices and training programs largely uncoordinated. Many companies will provide on-the-job training to their workers – either in- house or via private training firms – but the focus of training remains largely company specific. There is not yet a recognized curriculum standard for either the drilling or production phase jobs in the industry.

If they are realistic about the prospects for drilling phase vs. production phase jobs, local workforce training programs can help to "filter in" local employees that are well-suited to the industry, provide them with a basic orientation to the skills required, and steer these workers towards gas industry occupations that are safe, well-paying, and will keep them in the region for the long term. A concerted effort to match local workers with high quality jobs will first require significant investment in local educational institutions (community colleges, high schools, and other training programs) to provide workforce education, technical, and trade programs to local workers interested in these types of jobs. Examples of such workforce training programs exist in other gas producing regions, including those underway in Pennsylvania, while some smaller initiatives are being investigated in New York State.

The majority of programs are one to two years and offer an array of introductory classes in areas such as welding, electrical work and instrumentation, with the content specifically tailored to gas industry applications. An important component to these programs is typically a "Gas Industry 101" class that introduces students to the culture, terminology and equipment in the drilling industry, and the schedules and working conditions involved, which serves to screen out potential employees who find these unappealing. They provide a basic orientation to the types of jobs available in natural gas drilling and production, and such rudimentary skills as safety practices, welding, and instrumentation. Such an orientation positions local workers as "pre-fitted" for entry-level positions and on-the-job training provided by the gas industry.

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What Happens When Something Goes Wrong?

Dealing with public health issues that come with hydraulic fracturing

Amanda Wilson and Lydia Morken

What is the Issue?

As New York's Department of Environmental Conservation (DEC) works towards the final Supplementary Generic Environmental Impact Statement (SGEIS) for high volume hydraulic fracturing (HVHF) of the Marcellus Shale, counties are anticipating the potential impacts gas drilling will bring. County Health Departments (CHDs) "represent the front line in responding to concerns about public health impacts and nuisance issues" and will be the primary responder and investigator of water well complaints.[1] Will counties and their CHDs be able to fulfill this role once drilling begins? To answer that question, we surveyed CHDs in areas expected to experience drilling. We also spoke with current and former employees of the DEC, New York's Department of Health (DOH), the New York State Association of County Health Officials (NYSACHO), and the Conference of Environmental Health Directors (CEHD) to get their perspectives on the issue.

What is the Role of County Health Departments?

CHDs perform a broad range of functions from lead poisoning prevention to restaurant inspections to private water well support. In the Preliminary Revised Draft SGEIS, DEC "proposes that county health departments retain responsibility for initial response to most water well complaints, referring them to the [DEC] when causes other than those related to drilling have been ruled out."[2] CHDs, the DEC, and the DOH are responsible for water well complaints (see Table 1), but exactly how the agencies will jointly investigate cases remains unclear.[3]

How CHDs are to respond to other HVHF-related public health complaints is also unclear. DMN indicates that: "Investigation of water well complaints … is the only role for CHD's [sic] discussed in the GEIS and SGEIS."[4] While CHDs may or may not have regulatory jurisdiction over other environmental health issues, they are often the "troops on the ground" who first respond to and report those issues, or who provide care for secondary public health impacts. Jurisdiction over any HVHF-related environmental health issue will depend on the level of government at which a relevant regulation is in place (e.g. if a municipal regulation pertains, a municipal agency responds; if a State regulation pertains, a State agency responds), the language in the final SGEIS, the nature of the problem, or the level of threat it poses to health and safety. But at this point, most CHDs have not made provisions for potential environmental issues beyond water well complaints, nor for possible secondary health impacts.

Abbreviations of Agencies Cited

DEC – NY Dept of Environmental Conservation
DMN – DEC's Division of Mineral Resources
DOH – NY Dept of Health
CHD – County Health Dept
EHD – Environmental Health Division
NYSACHO – NYS Association of County Health Officials
CEHD – Conference of Environmental Health Directors

What Do County Health Departments Tell Us?

We interviewed County–level officials that typically handle water well issues in seven Southern Tier counties: Broome, Chemung, Chenango, Sullivan, Tioga, Schuyler, and Tompkins.[5] Counties differ in how they handle these issues; depending on the county, water well issues are investigated by an Environmental Health Division (EHD), a Watershed Protection Agency, a Water Resources Specialist, or a Code Enforcement Officer. We asked the responsible agency how their CHD anticipates handling complaints; whether they have the capacity and expertise to manage drilling-related health complaints; and whether protocols exist for handling various other public health impacts.

Agency	Responsibility
CHDs	• Primary role in initial complaint response; confirm well contamination and determine cause • Secondary role in complaint follow-up
DEC's Division of Mineral Resources (DMN)	• Secondary role in initial complaint response • Primary role in complaint follow-up once CHD finds contamination to be HVHF-related
DOH	• Assist CHDs in investigations of complaints

Most officials said that they lack the staff capacity, and in some cases the expertise, to handle an influx of calls and investigations. Most CHDs have the sense that the issue is out of their hands and are in "wait-and-see" mode. Some said they would like to plan ahead but lack time or resources, and do not know what to expect in terms of complaint volume. Some are looking for answers from the additional socioeconomic sections of the SGEIS to be released.

No additional resources have been identified for CHDs, and it is unclear how they will be able to respond to new public and environmental health concerns. Members of the CEHD have been meeting quarterly with DOH staff to address potential demands. But any support for the counties from the DEC, DOH, or other state-level sources will not be delineated in the final SGEIS, and instead must be brought about through a Memorandum of Understanding (MOU), a grant program, or legislation.

What Could Help County Health Departments Respond More Effectively?

In a letter to the New York State Association of County Health Officers (NYSACHO), the CEHD states: "The impacted counties WILL see a substantial increase in workload, and simply CANNOT handle it without appropriate funding for staff, analytical support, etc."[6] A list of key requests and concerns from CHDs and the CEHD includes:

1. A Statewide MOU.
CEHD advocates "A statewide Memorandum of Understanding (MOU)… between NYSDEC, NYSDOH, and the local health departments" for investigating water well complaints.[7] This MOU would outline the role and activities of all agencies involved, and would replace a 1985 MOU between the DEC and three counties (Allegany, Cattaraugus, and Chautauqua).

2. Response Resources.
CEHD recommends that additional funding for oversight "should be derived from the gas companies via permit fees, with a mechanism to transfer funds from NYSDEC to NYSDOH and [local health departments]".[8] No mechanism currently exists to redistribute permit fees to DOH or CHDs; to do so will require legislation. Article 6 reimbursements from the State for environmental health programs classified as "optional" by NYSDOH were eliminated from the 2011-2012 budget.[9] As CEHD urges, "State Aid funding dedicated to addressing individual water issues needs to be continued and enhanced."[10]

3. Representation and Involvement.
CEHD also requests a role in the gas permitting process led by DMN. Additionally, involved counties urge the appointment of DOH, county, and CHD representatives to DEC's new Hydraulic Fracturing Advisory Panel, formed to develop "recommendations to avoid and mitigate impacts to local governments and communities."[11]

4. Notification.
DEC recommends that "the (drilling) operator, at its own expense, sample and test all residential water wells…" in the vicinity prior to, during, and up to a year after drilling and hydraulic fracturing for natural gas, and that the test results be supplied to the well owner.[12] CEHD recommends that CHDs also receive those results for environmental health monitoring.

Conclusion

County Health Departments (CHDs) are the front line in responding to public and environmental health issues, whether or not the SGEIS designates them as the primary response agency. The requests by CEHD outlined above represent the minimum level of resources and authority they will need to adequately protect public and environmental health when HVHF drilling begins in the state.

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[1] CEHD letter NYSACHO, April 2011, page 2

[2] 2011 Preliminary Revised Draft SGEIS, Page 8-4

[3] See Table 8.1 of 2011 Preliminary Revised Draft SGEIS and Table 15.1 of the 1992 GEIS

[4] Personal communication with DEC's DMN, August 1, 2011

[5] Because Steuben and Delaware Counties do not have an EHD and refer environmental health concerns to a New York Department of Health (DOH) District Office, they were not interviewed.

[6] CEHD letter to NYSACHO, April 2011, page 2 (emphasis in the original)

[7] CEHD letter to DEC, Dec 2009, page 5

[8] CEHD letter to NYSACHO, April 2011, pages 1-2

[9] New York State Association of Counties and the New York State County Executives Association, "Enacted 2011-12 New York State Budget County Impact Summary," May 19, 2011, http://www.nysac.org/legislative-action/documents/11_12State_Budget-UPDATEDSummary.pdf

[10] CEHD letter to NYSACHO, April 2011, page 2

[11] DEC, http://www.dec.ny.gov/press/75416.html

[12] 2011 Preliminary Revised Draft SGEIS, page 7-46

Hammer Down: A Municipal Guide to Protecting Local Roads in New York State

C.J. Randall

What is the Issue?

Dust, noise, and road damage from industry truck travel are major citizen complaints in regions where shale gas is extracted via high-volume, horizontal hydraulic fracturing ("hydrofracking"). A typical Marcellus Shale well requires 5.6 million gallons of water, delivered and removed by truck. The initial drilling phase accounts for half of the estimated 625 to 1148 truckloads of water, additives, and drilling or fracturing equipment required for each well site. Unlike state highways and county primary roads, local roads are generally not built to stringent guidelines, and will not handle that volume of trucks or the weight those trucks typically carry. Local road quality management is imperative, and also provides a way that municipalities can manage the pace and scale of drilling.

Road Impacts and Costs

Road access and maintenance are critical to shale gas exploration. At the same time, drilling communities are seriously affected by the attendant road damage. Local roads have neither the width nor depth to handle sustained pummeling by heavy trucks; sinkholes, 6" to 10" of rutting, and complete road failures are not uncommon. The impact of 1000 extra trucks per year on a county primary road uses up 0.13% of that road's lifespan, but the impact of those same trucks on a town road consumes 2% of that road's life.

For example, damage from drilling trucks in PennDOT District 3-0 (Bradford, Columbia, Lycoming, Northumberland, Snyder, Sullivan, Tioga, and Union Counties) has been sustained and severe, and the District has had to post weight limits on 1500 miles of road since the start of Marcellus drilling. Overall, more than 4000 roads have been posted in Pennsylvania. Yet bond security costs for overweight truck travel on a posted road there – the financial incentive for a company to repair road damage – are limited to a maximum of $6,000 per mile for unpaved roads and $12,500 per mile for paved roads. This is adequate to cover only 10- 20% of the damage; road reconstruction can easily exceed $100,000 per mile. Additional public costs for protecting roads -- pre-bonding surveys, road condition surveys, new data collection systems, and posting roads -- are also significant.

Best Practices

The following is a set of best practices drawn from the experience of other states and shale plays:

- **Conduct a comprehensive traffic impact study** with the assistance of a traffic engineering firm to clearly define road structural classes (estimated cost: $3,000-$6,500).
- **Document baseline road conditions** and calculate the value of remaining road life (estimated cost: $1,000-$5,000).
- **Sign a Road Use Agreement** (RUA) at the time of permitting, requiring that the operator (drilling company) offset the predicted loss of useful life for the roads they will use at current reconstruction prices (estimated cost: $1,000-$3,000 for drafting).
- **Develop and implement a haul route management system** to keep heavy trucks off the most vulnerable roads (estimated cost: $3,000-$9,000).
- **Enforce load zoning**, ranging from routine patrols to high-intensity, multi-agency enforcement sweeps.

A comprehensive traffic impact study

A thorough study weighs different criteria to classify a given road into one of six structural classes, enabling municipalities to judge when that road's condition threatens public safety or the passage of critical operators such as emergency vehicles. It determines the total number of wheel loads of various magnitudes and repetitions the road can bear, describes the road's visual condition, and identifies the materials used to construct the road and their useful lifespans.

Variations in temperature change the stability of a road, and heavy truck traffic during the spring freeze-and-thaw cycle can wreak havoc. Test in May and again in August/September to collect a full range of data if possible; if not, test between June and October.

Document baseline road conditions

Take a video and photographic inventory of current road conditions, logging speed and where footage begins and ends geographically. Gather measurements of road length, width, pavement thickness, and sight distance.

Road Use Agreements (RUAs)

Some RUAs are complex documents conceived from a traffic impact study; others are simple contracts established years ago. A comprehensive RUA includes trigger clauses that require developers to submit haul routes to a town before a permit is issued, effectively connecting the RUA to road use. In New York, any RUA between a municipality and an operator should be placed on file with the NYS Department of Conservation as recommended in the SGEIS.

Haul route management

Heavy road use by Marcellus drillers lies at the legal confluence of the New York State Municipal Home Rule Law,[1] the Vehicle and Traffic Law,[2] and the Environmental Conservation Law (ECL),[3] a circumstance with no clear precedent. The statutory language of ECL-23 authorizes local governments to establish reasonable road regulations. Load zoning is permitted provided that the route provides access to all state routes entering or leaving town.[4] To be legally defensible, load limits must be based on a structural

evaluation rather than determined arbitrarily by weight. Municipalities may not pass ordinances that impose a tax or fee for the use of public roads[5], but comprehensive RUAs that link capacity of the road to permitting for high-impact, high-frequency truck traffic may be implemented with the expressed intent of public safety and preservation of the road.

Enforcement

Reports from Pennsylvania's Northern Tier suggest that natural gas operators are running trucks carrying loads over the legal limit of 80,000 pounds for a semi-trailer truck. Since January 2010, Pennsylvania State Police have conducted 5800 roadside inspections of industry trucks; 42 percent of those resulted in pulling either the driver or vehicle out of service. Enforcement efforts come at a price, however; Pennsylvania's Department of Environmental Protection has invested $550,000 from the state's Waste Transportation Safety Account into unannounced roadside inspection blitzes.

Conclusion

There are engineering, logistical, and legal obstacles to insuring good management of local roads in the face of abrupt, high-intensity truck travel. The burden for implementation and enforcement of RUAs will be substantial for many localities. It is unclear what assistance state agencies will provide, and the process is as yet decentralized.

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[1] Municipal Home Rule Law §10[2]

[2] N.Y. Veh. & Traf. Law Art. 41 § 1660-1664

[3] New York State Environment and Conservation Law §23- 0303(2)

[4] N.Y. Veh. & Traf. Law Art. 41 § 1660, paragraphs 10 and 17

[5] N.Y. Veh. & Traf. Law Art. 41 § 1604

Marcellus Shale: The Case for Severance Taxes

Sara Lepori

There are multiple social, environmental and economic costs associated with the boom/bust cycle of energy development. Research indicates that a well-structured tax policy can play a significant role in paying some of these costs and insuring long-term economic development in regions affected by natural resource extraction industries. This brief addresses two questions that are often asked about severance taxes: 1) Do state severance taxes inhibit industry investment? 2) How can severance tax revenue cover short and long term costs of drilling?

The Role of State Severance Taxes

A severance tax is a tax imposed on the value of nonrenewable natural resources that will be used outside the state from which they are extracted. Severance taxes are instated to cover costs associated with resource extraction and to compensate the state for the loss of a non-renewable resource. With the exception of New York and Pennsylvania, all significant producing states impose a severance tax on fossil fuel extraction. Reports released by the Independent Petroleum Association of America, the national association representing U.S. independent oil/natural gas producers, prepare the industry to be responsible for these taxes.

When towns "boom" as a result of energy extraction, there are increased job opportunities and a growing population. Along with this short-term growth come increased public costs: for planning & zoning and other administrative services, for intensified road traffic and reconstruction, and for increased demands on schools, social services and public safety. These costs are predominantly paid for by state, county, and municipal governments. When natural resource extraction ends, communities face different challenges from the "bust": a decreased population and tax base, for example. The public costs associated with extraction are usually covered through taxation of the extracted resource via a severance tax.

Do Severance Taxes Deter Industry Investment?

The question of whether severance taxes affect industry decisions regarding when and where to drill is controversial. Headwaters Economics (2008) shows that in the 1990s Montana and Wyoming made divergent tax policy decisions. Montana decreased its effective tax rate (the ratio of production value to tax revenue), while Wyoming increased its rate. A decade later, Wyoming's tax rate for the energy industry is approximately fifty percent higher than Montana's. Both states have experienced a surge in natural gas drilling, yet Wyoming's production value (the product of price times production volume) is 5 times as high as Montana's. It appears in comparing Wyoming with Montana that tax increases did not deter firms from investing.

Drilling is influenced first and foremost by reserves. The preponderance of evidence (Gerking, 2000, Kunce 2001) indicates that severance taxes have little effect on natural gas company decisions about where and when to drill. State severance taxes are deductible against federal corporate income tax liabilities, so their effect on the company's "bottom line is greatly reduced. Other factors such as gas price, labor costs, access to markets (e.g., oil and natural gas pipelines), technology, and regulations have the most significant effects on industry activities.

Some economic models indicate that severance taxes may affect the pace and scale of drilling. Considine's model (2009) showed a decrease of 30% in drilling activity in Pennsylvania, whereas an economic model completed by Center for Business and Economic Research of the University of Arkansas (2008) indicated a 13% decrease. These divergent conclusions suggest that while severance taxes do not curtail investment in drilling activity they may affect the pace and scale of drilling. Taxes can increase without risk of losing industry investment and a slower pace of drilling can benefit regions, enabling them to adjust to the impacts of the drilling economy over a longer period of time. Regardless of change in pace, drilling is ultimately driven by the reserves available.

Covering Public Costs

Studies of severance tax policy consistently make the following recommendations to insure that states cover the costs of drilling and insure long-term economic viability in drilling regions.

1. Create a tax that effectively pays for the short-term and long-term costs of drilling. States can impose a severance tax without risk of reducing production or industry jobs. If a state has a severance tax that is too low, shale gas extraction will require a significant amount of additional government services without commensurate fiscal benefits.

2. Distribute tax revenue predictably and fairly between state and local governments. There are many ways to allocate revenue that are aligned with the costs of drilling. Regardless of the exact distribution, the primary purpose of a severance tax is to cover costs born by the local and county governments.

3. Limit deductions and exemptions. Many states have relatively high tax rates but so many tax loopholes that the effective tax rate does not cover the cost of administering it, nor the short and long term costs of drilling.

For example, Colorado, the 6th largest state producer of natural gas, has a tax rate set on a sliding scale between 2-5%. The state subtracts property tax from the taxable value and exempts certain wells from taxation. As a result the realized severance tax is between 2.5-0.3% each year. Constructing a tax that is straightforward and simple makes compliance easier for gas producers and tax officials. Because the structure of the tax determines how volatile it will be, exemptions and loopholes should be minimized.

4. Establish a Permanent Fund. A Permanent Fund is the most effective way to promote long-term economic development. For example, every state in the intermountain west invests in a permanent find. The permanent fund serves to protect the state against future recessions, yearly revenue volatility, and to ensure ongoing fiscal benefits from the depletion of a non-renewable natural resource.

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