The Center for Rural Pennsylvania
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The Marcellus Shale Impacts Study: Chronicling Social and Economic Change in North Central and Southwest Pennsylvania

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Executive Summary

The Marcellus Shale is a natural gas-bearing geological formation that lies beneath portions of Pennsylvania, New York, Ohio, Maryland and West Virginia. Recent advances in hydraulic fracturing and horizontal drilling technologies have increased the technical and economic feasibility of unconventional gas extraction and led to rapid expansion of the industry in Pennsylvania. Between 2005 and mid-2013, 6,833 unconventional gas wells were drilled in the commonwealth (Pennsylvania Department of Environmental Protection, 2013).

The development of the Marcellus Shale has created significant questions about the potential implications for the commonwealth's communities and natural environment.

This research is the first wave of a longitudinal project examining the impacts of Marcellus Shale development in Pennsylvania. Overall, the research is exploring the social and economic impacts of Marcellus Shale development in Pennsylvania, focusing on the experiences of four study counties - Bradford, Greene, Lycoming, and Washington - with very high levels of natural gas extraction and related activities.

This phase of the study focused on aggregate change in the four study counties. It examined county-level indicators of change related to population, housing, local economies, crime, health and healthcare access, K-12 education, agriculture and local governments. It also examined the experiences of youth and low-income residents in communities with shale-based development.

Overall, the research had four goals: (1) Identify and document indicators of economic, social, institutional and infrastructural change related to Marcellus Shale development; (2) Analyze collected data to understand and interpret trends in relation to drilling activity and in comparison to historical and current regional, state and national trends; (3) Describe the experiences of critical populations and institutions relative to activity level; and (4) Examine and evaluate strategies communities have used to effectively manage change.

To achieve these goals, the researchers: formed topical advisory committees to provide background information about the topics; gathered publicly available data and performed descriptive analyses related to each topic; and conducted focus groups with representatives of agencies and organizations related to health, housing and human services, K-12 education, economic development and local businesses, agriculture, and local government. They also conducted additional focus groups with high-school youth.

The results from this phase of the study are available in nine topical reports, which are described below.

- Report #1: *Population Change and Marcellus Shale Development.* The analysis indicated that patterns of population change varied across the study counties, and that the associations with Marcellus Shale development are not clear.
- Report #2: *The Impact of Marcellus Shale Development on Health and Health Care.* Very few indicators in health or healthcare service delivery changed in relation to Marcellus Shale development, with the exception of increases in the number of complaints logged by responding emergency medical service personnel. Focus group data indicate increased demands on human service providers, including mental and behavioral health services. Many of the workers associated with the natural gas industry have employer-provided insurance, but that coverage is valid in other states and may not transfer to local areas.
- Report #3: *Marcellus Shale Gas Development and Impacts on Pennsylvania Schools and Education.* The analyses indicated very little change in enrollment, student demographics, and student outcomes associated with Marcellus Shale development. Drop-out rates were not changed either, although focus group data suggest the potential that industry-associated opportunities may affect post-secondary educational aspirations of youth.
- Report #4: *Youth Perspectives on Marcellus Shale Gas Development: Community Change and Future Prospects*. Youth described their views on the effects of the natural gas industry on their home communities; safety concerns about traffic and road conditions; destruction of natural areas; uncertainty about the impacts of the industry on their communities now and in the future; and relatively low interest in working for the industry. Most of the participants had at least ambivalent feelings about the changes they had seen taking place in their communities.
- Report #5: *Housing and Marcellus Shale Development*. The share of housing that was owner-occupied, rental or vacant varied more in counties with smaller populations and more limited housing stocks prior to Marcellus development. The median value of owner-occupied housing increased in the study counties more than the state average during the period of Marcellus Shale development. Focus group participants described the use of temporary housing by both natural gas workers and low-income families, displacement of local people from existing housing, and increased homelessness among low-income individuals and families.
- Report #6: *Effects of Marcellus Shale Development on the Criminal Justice System*. The analyses showed relatively little change in most indicators, with the exception of increased rates of calls for service for which the Pennsylvania State Police responded, arrests for driving

under the influence, and traffic violations in counties with high levels of Marcellus Shale activity.

- Report #7: *Local Government and Marcellus Shale Development.* Analysis of the county audit data through 2011 did not show clear effects of natural gas development on local government budgets. Local officials raised concerns related to impacts on roads from truck traffic, housing problems, their lack of preparation for the growth of the industry, and a lack of transparency by the natural gas industry. They reported spending impact fee dollars on new equipment or new infrastructure to replace what has been damaged, directly or indirectly, by drilling.
- Report #8: *Local Economic Impacts Related to Marcellus Shale Development.* Counties with the highest levels of drilling activity generally experienced increased business activity, employment, and wages. During the study period, the number of residents working increased only modestly, suggesting that many of the new jobs that had been created were going to non-residents who either commuted into the county or were living there temporarily.
- Report #9: *Establishing a Baseline for Measuring Agricultural Changes Related to Marcellus Shale Development*. Focus group data with farmers and representatives of agricultural services and businesses brought out the following themes: shortages in some farm inputs (e.g., lime) and difficulty of retaining farm labor due to Marcellus development; the ability of farmers to use lease and royalty income to stay in business and reinvest in their operations; changes in the types of operations (such as dairy to beef); intergenerational property transfer; mistrust of natural gas companies; lack of monitoring and company accountability; uncertainty about environmental impacts; uncertainty about long-term impacts; and conflicting views about the impacts on quality of life.

Additionally, the research documented strategies used by individuals, farms, businesses, local health, housing and human service agencies, and school districts to adapt to changes brought on by Marcellus Shale development. These include more consistent use of legal expertise and consultation, monitoring and management of well development activity, development of new products and business opportunities, and collaboration and planning across geographic and organizational boundaries. The research identified several themes that were discussed by focus group participants but were not specific to an individual topical report. These include community conflict and divisions, unequal distribution of the benefits and costs of development, concerns about the quality of life in their communities, and concerns about water quality.

There were a number of limitations to this research. First, the publicly available data are measured at the county level, and are aggregate indicators at specific points in time. As such, they cannot provide measures of the components that make up those aggregate data. Second, while county level analyses are useful to identify overall effects, county level data do not capture more localized data points. Third, the analyses cannot establish causality but rather assess an association in time. There are relatively few data points during Marcellus Shale activity, and the data that were identified were not specific to Marcellus Shale. Finally, it is difficult to define Marcellus Shale activity and who is part of the industry.

The researchers provided three overall policy considerations, as well as considerations related to each of the topics studied. The first overall policy consideration is to increase capacity to identify problematic change and implement collaborative strategies to respond as quickly as possible. The second overall policy consideration is to increase capacity to identify and collaboratively plan for future expected and unexpected change, thus improving the ability to take advantage of opportunities and minimize risks and problems associated with change. The final policy consideration relates to improving the data available to identify and understand changes. These considerations apply to Pennsylvania communities affected by Marcellus Shale development, but also to those impacted by other types of change, such as suburban sprawl, economic change, or population decline.

As stated previously, this research is the first wave of a longitudinal project describing the impacts of Marcellus Shale development in Pennsylvania. This phase focused on aggregate change in the study counties. However, one of the main lessons from this phase of the project is the need to examine the distribution of the risks and opportunities across communities and populations and over time. Tracking these changes over time can assist with identifying ways in which shorter-term gains can be leveraged into strategic and longer term planning that will maximize the opportunities for Pennsylvania's social, economic and environmental sustainability, both now and in the future. The systematic gathering and analysis over time of local, regional and state-level data will be critical in generating information that local stakeholders and state policymakers will need to effectively respond to these new and often unprecedented challenges and opportunities.

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The Center for Rural Pennsylvania is a bipartisan, bicameral legislative agency that serves as a resource for rural policy within the Pennsylvania General Assembly. It was created in 1987 under Act 16, the Rural Revitalization Act, to promote and sustain the vitality of Pennsylvania's rural and small communities.
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Introduction

The Marcellus Shale is a natural gas-bearing geologic formation that lies about a mile underneath the earth's surface beneath two-thirds of Pennsylvania, the southern tier of New York, and parts of Ohio, Maryland and West Virginia. The Marcellus formation has long been known to contain significant amounts of natural gas. However, the technology to efficiently and economically extract the gas from the Marcellus Shale and other similar gas-bearing geologies has only recently been developed (Brasier et al., 2011; Pifer, 2011; Waples, 2012). The Marcellus Shale is an unconventional gas reserve, so called because the gas is not concentrated within a reservoir underground, but rather is contained throughout and dispersed across a geology, in this case a shale layer (Pearson et al., 2012). Unconventional gas reserves therefore, represent substantial technological challenges for extracting gas from within the geology and bringing it to the surface where it can be made available for energy needs.

The feasibility of extracting unconventional natural gas changed in the early to mid-2000s with the refinement and combination of two existing technologies: hydraulic fracturing and horizontal drilling. While both technologies had been in use by the oil and gas industry for decades, the adaptation and refinement of both technologies for use in extracting unconventional gas was successfully employed in the early 2000s in Texas in the Barnett Shale Play in the Dallas-Fort Worth metropolitan area (Waples, 2012; Wilber, 2012). Using these technologies, well bores are drilled vertically to the gas bearing formation and then the drill bit is turned so that the bore extends horizontally along the formation, for a mile or more. In this manner, the well bore is able to intersect with a substantially greater area of the geology and can intersect perpendicularly to naturally-occurring fractures. The horizontal well bore is then punctured by a series of small explosive charges, which create openings into the shale layer emanating from the well bore. Water, along with lubricants, biocides and small particulates such as sand, is injected at high pressure into the well bore where the pressure of the water fractures the formation along naturally occurring fracture points or seams. The particulates help to hold the fractured layers apart, enabling the gas trapped within the geology to be released into the well bore, where it flows to the surface, along with hydraulic fracturing fluids initially injected into the well (Waples, 2012).

The combination of horizontal drilling and high volume hydraulic fracturing has vastly increased the technical and economic feasibility of unconventional gas extraction. In the case of the Marcellus Shale layer, while as recently as the early 2000s geologists estimated that less than two trillion cubic feet (TCF) of gas could feasibly be extracted, that figure increased to nearly 500 TCF by the mid-2000s, representing approximately 20 years' worth of domestic consumption. The Marcellus Shale was subsequently recognized as the largest unconventional gas reserve in the United States, and one of the largest worldwide (Coleman et al., 2011; Engelder, 2009; Milicy and Swezey, 2006). These new estimates spurred the rapid development of unconventional gas extraction in Pennsylvania in the second half of the 2000s, and by July 1, 2013, 6,833 unconventional gas wells had been drilled across the commonwealth (PA DEP, 2013), with as many as 60,000 or more wells predicted to be drilled across the entire formation (Johnson, 2010).

Unconventional Natural Gas Extraction and "Boomtown" Development

These estimates – and the increase in shale gas development in Pennsylvania since 2007 – are consistent with what social scientists refer to as "boomtown" development. Boomtowns are places that experience rapid growth in population and economic activity, often, although not always, as a consequence of natural resource development (Brown, Dorius, and Krannich, 2005; England and Albrecht, 1984; Krannich, 2012). Social scientists have long been interested in boomtown development because of the ways in which such rapid change creates new opportunities as well as new and often unanticipated stresses for people and communities (Brasier et al., 2011; Freudenburg and Wilson, 2002; Gramling and Freudenburg, 1990). For example, while sudden economic development can bring multiple new and unanticipated economic opportunities, new populations can place strains on housing availability, social and healthcare services, law enforcement and schools (Kohrs, 1974; Williamson and Kolb, 2011). Long-term residents may find the social fabric of their communities changed or threatened by the sudden presence of "newcomers," and some researchers have pointed to the association between boomtown development and increases in social problems such as drug and alcohol abuse, domestic violence, rising divorce rates and mental health issues (Camasso and Wilkinson, 1990; England and Albrecht, 1984; Freudenburg, Bacigalupi, and Landoll-Young, 1982). Finally, and especially in the case of boomtown development based around non-renewable energy resources, there is the dilemma of the "bust," or what happens when the resource is depleted to the extent that it is no longer economically feasible to continue extraction efforts. Without careful planning and diversified economic development, communities stand the very real chance of being in worse shape than they were before the boom, facing a pronounced economic contraction, outmigration and property devaluation (James and Aadland, 2011).

The development of the Marcellus Shale, and specifically the use of unconventional gas extraction technologies, has created significant questions in Pennsylvania, particularly related to the potential social and economic impacts. This report describes the social and economic impacts of Marcellus Shale development in Pennsylvania, focusing on the impacts on county-level indicators of change related to population, housing, local economies, crime, health and health care access, K-12 education, agriculture and local governments. Based on lessons learned from previous "boomtown" literature, this report also examines the experiences of populations that are likely to be affected disproportionately, specifically youth and low-income residents. The combination of broad, aggregate indicators and targeted measures allows for a more comprehensive examination of the impacts of Marcellus Shale development on Pennsylvania's communities.

Prior Research on Community and Economic Impacts of Marcellus Shale Development

Several researchers have begun to examine the impacts of Marcellus Shale development on Pennsylvania and the surrounding states. This section briefly reviews this literature, organized by topic.

Local Government: Two prior studies on the impacts of Marcellus Shale development on local governments relied on a survey of officials across the entire Marcellus Region (Kelsey and Ward, 2011), and a combination of focus groups and analyses of audit data from 2001 to 2009 in Susquehanna and

Washington counties (Jacobson and Kelsey, 2011). These studies found mixed effects. The majority (75 percent) of municipal governments in areas of Marcellus Shale activity said the development activity had not affected their tax or non-tax revenues, while about 18 percent said revenues had increased. About two-thirds of the governments with Marcellus Shale activity similarly reported that the public services they provided had not changed as a result of the activity (Kelsey and Ward, 2011). The statistical analysis of municipal spending and revenues in Susquehanna and Washington counties found no clear relationships with the level of Marcellus Shale activity in the jurisdictions. Their focus group participants, who were drawn from the analyzed municipalities, largely reported that they had not spent any additional monies on gas-related issues. Both studies acknowledged that their analysis was relatively early in the development of Marcellus Shale, and that it is important to keep monitoring to identify if or when impacts on local governments occur.

Economic Development: There have been several economic impact studies that have estimated the statewide economic impacts of Marcellus Shale activity in Pennsylvania. Considine et al. (2010) used data about industry spending in Pennsylvania and the economic impact model IMPLAN, and estimated that Marcellus shale development created or supported 44,098 jobs across Pennsylvania in 2009. These jobs included those being created directly within the natural gas companies, indirectly in companies interacting with the gas companies, and from worker and mineral right owner spending. In an update of this study (2011), they estimated that 139,889 jobs were created or supported in Pennsylvania in 2010. Their assumptions and findings were questioned by some academics (see, for example, Kinnaman, 2011; and Weinstein and Partridge, 2012).

Kelsey, Shields, Ladlee and Ward (2011) used geographic information system analysis and surveys to estimate how leasing and royalty dollars were distributed (among Pennsylvanians, non-Pennsylvanians, and state government), how many leasing and royalty dollars are saved and spent, and how much of the wages were going to non-Pennsylvania workers. These estimates were then used to refine economic impact models such as those used by previous researchers. They estimated that Marcellus Shale development created or supported about 23,884 total jobs across Pennsylvania in 2009 (about half of the Considine et al. study of 2009), including 9,372 jobs directly or indirectly related to industry spending.

A different methodology was used by Brundage et al. (2011), who were interested in identifying the workforce needs associated with shale gas development. They conducted extensive interviews with industry employees to identify all the specific occupational skills and time needed to drill and complete a Marcellus Shale well, and cross-checked the responses with a variety of sources. Based on the number of wells drilled in 2009, they estimated that 8,735 jobs were directly created in Pennsylvania that year due to Marcellus shale development. These results are not directly comparable to the overall Considine et al. and Kelsey et al. estimates because they focused solely on the jobs directly related to the well and pipeline, and did not consider the jobs created in supporting businesses, by workers spending their wages and salaries, and by mineral owners spending lease and royalty dollars.

The Center for Workforce Information and Analysis (CWIA) in the Pennsylvania Department of Labor and Industry releases monthly summary reports on employment by sector within Pennsylvania, organized by 'core' and 'ancillary' industries, and relying heavily on the Bureau of Economic Analysis (BEA) Quarterly Census of Employment and Wages (QCEW). Herzenberg (2011) analyzed the

employment numbers in one of these monthly reports, and said the CWIA data indicate that Marcellus Core industries created 9,288 jobs between late 2007 and late 2010.

Kelsey, Shields, Ladlee and Ward (2012a,b,c,d,e) used a combination of data (U.S. Bureau of Labor Statistics, geographic information systems, and surveys) to estimate the economic impact of Marcellus Shale development (using the IMPLAN model) for five counties (Bradford, Sullivan, Susquehanna, Tioga and Wyoming). They found that there were positive economic impacts occurring within these counties as a result of Marcellus Shale development, but the employment numbers seemed much more modest than some of the statewide economic impact studies would suggest.

Weinstein and Partridge (2011) similarly found that employment effects of natural gas development are modest, particularly in relatively large states. As part of a study predicting impacts of gas development in Ohio, they used U.S. Bureau of Economic Analysis data to compare employment and income in six high drilling Pennsylvania counties to six non-drilling counties in Pennsylvania. They found that employment effects in the heavily drilled counties were not large enough to be detected when compared to non-drilling counties. Based on U.S. Bureau of Labor Statistics data, they found a statewide gain of 10,000 direct and indirect jobs in the natural gas industry in Pennsylvania between 2004 and 2010.

There is some consistency in results across some of these prior studies, even though their methodologies and data sources varied significantly. The direct employment results in the Kelsey et al., Brundage et al., Weinstein and Partridge and Herzenberg studies varied between 8,735 and 10,000 jobs statewide, which is a quite close range, suggesting a measure of consistency and accuracy.

Housing: Housing has been identified as one of the most critical impacts of Marcellus Shale development. Using largely qualitative data from interviews with local elected and appointed officials, realtors, and gas company employees, Williamson and Kolb (2011) describe the housing needs of the natural gas industry and document concerns related to fulfilling those needs. As workers initially arrive in Marcellus communities, they occupy temporary housing units (hotels, company sponsored residential facilities, campgrounds and rental housing), preferably those that provide house-keeping and meals. The 'second wave' of workers, associated with company headquarters and regional offices (who are more likely to stay for longer time periods), tend to occupy rental and owner-occupied units. Both types of housing markets are being stretched, resulting in greater strain on families at the economic margins who are pushed down the 'housing ladder' toward units of lesser quality for higher prices or out of the market altogether. These impacts are most acute in the most rural areas experiencing high levels of activity. These are areas with relatively few housing options prior to the onset of Marcellus Shale development. Further, development capacity also varies across the region, and counties with lower levels of development prior to Marcellus Shale have significant barriers to attracting or inducing real estate developers to meet the additional housing needs in a timely fashion. There is also a concern about building too much housing that might not be needed after the boom stages.

The Institute for Public Policy and Economic Development (a consortium of nine colleges and universities in the Wilkes-Barre/Scranton area) conducted a housing study, and noted an increase in rental rates and a lack of availability of rental housing in counties with the highest levels of activity. This study, similar to Williamson and Kolb, found that those on the economic margins are having the most significant problems finding affordable housing. They argue that in many areas, affordability was a

problem prior to Marcellus Shale development but was made significantly worse by the influx of energy workers. Housing problems have other consequences as well, such as increased homelessness and difficulties for social service agencies that provide temporary housing and for child welfare agencies that assess living situations of children at risk.

Farren, et al., (2013) examined the relationship between wells drilled and employment in the gas industry and housing vacancy rates, fair market rent and median home values in 144 counties in Pennsylvania, Ohio, New York and West Virginia. They found a positive relationship between wells drilled in intensely drilled counties in Pennsylvania and fair market rent, and no relationship between median home value and vacancy rates and wells drilled or employment share in the energy sector.

In a different analysis, Kelsey and colleagues examined changes in market value and property values between 2007 and 2009. Using property sales data reported to the State Tax Equalization Board, Kelsey and colleagues found that market values were likely related to Marcellus activity: "Townships and boroughs with more Marcellus wells on average experienced larger average increases in market value than did those without Marcellus wells" (p. 5). This is not the case for counties. They also examined assessed value of properties, which is the taxable value of a property used to determine the amount of property taxes owed to counties, municipalities and school districts. They found that assessed values are higher in municipalities with Marcellus wells, but this is not related to the number of wells. Critically, they point out that these are averages across the municipalities, and thus do not reflect the effects on any particular property. The demand for worker housing, demand for land development of commercial property, ownership of subsurface rights and location of Marcellus-related infrastructure will affect the values of specific properties.

Agriculture: Other studies have documented some agricultural impacts from Marcellus Shale activities. In a qualitative study, Malin (2013) found that farmers discuss the natural gas developments as inevitable and that they have no real choice but to accept them. She further argues that the economic reasoning in support of the development is so powerful that they lack the agency and capacity to articulate an alternative.

Adams and Kelsey (2012) found that intensity of gas drilling and decline in dairy cow numbers seem to be associated. However, they caution that the data do not allow them to do more than speculate on the nature or direction of that association. Finkel et al. (2013: 189) conducted a similar study and found that, "Milk production and milk cows decreased in most counties since 1996, with larger decreases occurring from 2007 through 2011 (when unconventional drilling increased substantially) in five counties with the most wells drilled compared to six adjacent counties with fewer than 100 wells drilled." They also caution that this is a descriptive study that has not established causation.

The Center for Dairy Excellence conducted a survey of dairy farmers in the northern tier and southwest counties in the summer of 2011. The results indicated that, in the northern tier counties, 60.0 percent of dairy farmers intended to leave herd size unchanged, 6.5 percent planned to reduce herd size, 14.8 percent planned to increase herd size and 18.7 percent were uncertain. In the southwest counties, 65.7 percent intended to leave their herd size unchanged, 4.6 percent planned to reduce herd size, 24.1 percent planned to increase herd size and 5.6 percent remained uncertain (Frey, 2012). Unlike the Adams and Kelsey (2012) or the Finkel et al. (2013) study, the Center for Dairy Excellence data were not analyzed to control for intensity of drilling activity in counties where farmers are located. However,

the authors did include a variable measuring whether farmers received natural gas lease or royalty fees. In the northern tier, 62.9 percent of farmers receiving gas revenue would be more likely to modernize their dairy operation, 36.8 percent would be less likely to invest in their dairy operation and 48.1 percent would consider investing in alternative forms of agriculture. In the southwest, 50.6 percent of farmers receiving gas revenue would be more likely to modernize their dairy operation, 31.0 percent would be less likely to invest in their dairy operation and 58.8 percent would consider investing in alternative forms of agriculture (Frey 2012). These findings suggest that dairy farming could move in different directions as a result of the influx of gas drilling revenues.

Education: Schafft, Borlu, and Glenna (2013) studied the relationship between Marcellus Shale gas development and local perceptions of risk and opportunity through the lens of Pennsylvania high school administrators. They found that high school administrators tended to see both opportunities for economic growth and risks for environmental degradation and for uneven distribution of costs and benefits in their school districts and communities. They also found that the intensity of those perceptions corresponded with the level of drilling activity in their school districts. The findings suggest that people's perspectives on gas drilling are more complex than popular portrayals and that perceptions are connected to personal and professional experiences with drilling.

Community Relationships: Brasier et al. (2011) conducted interviews with community leaders experiencing the early stages of Marcellus Shale development to document areas of potential or current impacts on the local community. These areas include economic benefits, changed relationships among community members, aesthetics and environmental quality, agriculture, and roads and related physical infrastructure. Most prominent in the list of concerns are worries about fundamental changes to the social relationships and physical beauty of the places that residents call home (see also Perry, 2012). The level of activity and the stage of development interact with key community characteristics – particularly population size, proximity to population centers, access to transportation networks, level of existing infrastructure, and extractive history – to influence the perceptions of the impacts across places (Brasier et al., 2011).

Health: There is a paucity of research related to Marcellus Shale drilling activity and the impact of that activity on health and health status in Pennsylvania. McDermott-Levy and Kaktins (2012) noted: "Although there are numerous anecdotal reports of illnesses in humans and animals living in drilling areas, there is a notable lack of peer-reviewed research on the impacts." Using a community survey in Pennsylvania, Steinzor et al. (2013) determined that self-reported survey data, combined with environmental testing, can shed light on the link between drilling activity and perceived health. In an effort to assess impacts, Ferrar et al. (2013) documented self-reported health impacts and mental and physical health stressors perceived to result from Marcellus Shale development. Interviews were conducted with a convenience sample of 55 community residents living in proximity to drilling sites. Participants attributed 59 unique health impacts and 13 stressors to drilling activity, with stress cited as the most frequently occurring symptom. Researchers and clinical staff at the Southwest Pennsylvania Environmental Health Project conducted an assessment of the health impacts of drilling on individuals and families and found that the most common symptoms associated with drilling were skin rash or irritation, nausea or vomiting, abdominal pain, breathing difficulties or cough, and nosebleeds (Kriesky,

et al., 2013). They determined that their results mirrored those of other studies conducted in Pennsylvania communities experiencing Marcellus Shale drilling activity.

Crime: To date, research on the effects of Marcellus Shale activity has not found significantly increased criminal activity linked to the development of this resource. Kowalski and Zajac (2012) examined calls for service data from the Pennsylvania State Police and arrest data from the Uniform Crime Reporting program through the Federal Bureau of Investigation. They report no discernible longitudinal trends in their study counties (the seven counties with the highest number of wells drilled) or in comparison to other counties in the state.

Marcellus Shale Development: Looking Ahead

Despite Pennsylvania's history of coal, oil and gas development, in many respects the development of the Marcellus Shale is distinguished by its scale, the rapidity of the development and the production practices used. For these reasons it will be critically important to monitor the social, economic institutional and environmental impacts now and in the years to come. This report describes research conducted in the first part of a three-part longitudinal research project. This phase focused on aggregate change in the four study counties; however, one of the main findings from this part of the project is the need to examine more closely the distribution of the risks and opportunities across communities and populations and over time. Tracking these changes over time can assist with identifying ways in which shorter-term gains can be leveraged into strategic and longer term planning that will maximize the opportunities for Pennsylvania's social, economic and environmental sustainability, both now and in the future. The systematic gathering and analysis over time of local, regional and state-level data from multiple sources will be critical in generating information that local stakeholders and state policy-makers will need to effectively respond to these new and often unprecedented challenges and opportunities.

Goals and Objectives

This research was the first wave of a longitudinal project describing the impacts of Marcellus Shale development in four Pennsylvania counties– Bradford and Lycoming in the northern tier and Greene and Washington in the southwest. This first wave provided the foundation for future waves by (1) establishing relationships with appropriate stakeholders in the study counties; (2) identifying and collating critical secondary data resources; and (3) describing trends and impacts in the study counties where pre-Marcellus data are available. The results of this first wave of the project are presented in nine topical reports that summarize the research findings.

The project had four main goals and related objectives:

Goal 1: Identify and document indicators of economic, social, institutional and infrastructural change related to Marcellus Shale development. The specific objectives included:

- Establish an advisory committee to provide access to organizations and data resources.
- Identify and collect data to describe the Marcellus Shale development and context of each county, including level and type of Marcellus Shale development (e.g., permits, wells, rigs,

industry activity), history of extractive industries, geographic location, local economic conditions, proximity to population centers and transportation corridors.

- Identify relevant indicators across multiple sectors that include: population; employment; economic development; workforce development; municipal government; educational institutions; human services; healthcare services; criminal justice system; public safety and emergency services; housing; transportation networks (e.g., roads, rail); and community infrastructure (e.g., water/sewer).
- Identify and acquire appropriate data sources for these indicators to measure baseline conditions prior to Marcellus Shale development as well as data points during Marcellus Shale expansion.
- Assemble databases of these relevant indicators for the study counties as well as comparable counties to compare trends. The data sources are to be systematically documented.

Goal 2: Analyze collected data to understand and interpret trends in relation to drilling activity and in comparison to historical and current regional, state and national trends.

- Analyze change in the indicators of social, economic, institutional and infrastructure conditions in the study counties as they vary by: stage of development, location of natural gas infrastructure, location and number of wells and geographic and socio-economic characteristics of the counties.
- Analyze change in the indicators of social, economic, institutional and infrastructure conditions in the study counties in comparison to historical trends in these counties and to trends experienced by the region, state and nation.

Goal 3: Describe the experiences of critical populations and institutions relative to activity levels.

- Identify populations that may experience development differently (e.g., youth, low-income families, new residents). Identify institutions (e.g., education, health care, human service, local government, economic development) that play critical roles in addressing the effects of change.
- Develop and administer data collection protocols appropriate to each population.
- Employ mechanisms for retaining participation across multiple waves of longitudinal research.
- Describe the positive and negative experiences of these relevant populations and social institutions with Marcellus Shale development.

Goal 4: Examine and evaluate strategies communities have used to effectively manage change.

- Identify and categorize strategies that social institutions have employed to understand and adapt to changes brought on by Marcellus Shale development.
- Describe how these strategies have contributed to the management of change by these critical social institutions. Evaluate the validity of effectiveness claims by research participants.

Methodology

This study used a comparative case study approach within a longitudinal design to accomplish four goals and objectives. In this first wave, the emphasis was on identifying and acquiring appropriate data sources and describing trends over time using data that appropriately could be described as pre-Marcellus (prior to 2007) and early-Marcellus (2008-2012). For most of the quantitative research, comparisons were made between the trends in the study counties, trends in adjacent counties and the state as a whole to accurately understand the impacts of Marcellus activity in the study counties. (The exception to this approach was for the health and health services report, for which data were limited to the study counties only.) In addition, the trends are described for all Pennsylvania counties differentiated by level of Marcellus Shale activity. Consequently, the results describe trends in key indicators of economic, social, institutional and infrastructure change over time that may be associated with Marcellus Shale development. In-depth, qualitative data were used to interpret trends in the quantitative data as well as develop narratives about the experiences and processes of development in Bradford, Greene, Lycoming, and Washington counties.

Goal 1: Identify and document indicators of community, economic, institutional and infrastructural change related to Marcellus Shale development.

Advisory Committees

Critical stakeholders representing all sectors included in this research were initially identified and invited to participate in one of five topical advisory committees. These individuals provided access to local institutions, populations and data resources that facilitated data gathering, as well as provided input into the research plans. Their knowledge of the issues and their local communities provided important insights at key points in the research. Advisory committee members were organized by topical area and by region.

In addition to conference calls, all advisory committee members were invited to participate in one of two webinars. In advance of the sessions, participants were provided with a summary document containing the executive summaries of all the nine topical reports. The findings were briefly outlined during the webinar, and then participants were invited to ask questions, describe the extent to which the findings resonated with their own experiences and discuss the potential policy implications of the findings.

Secondary data sources:

Relevant indicators of social, economic, institutional and infrastructure conditions were identified and acquired. Data for the study counties, as well as other counties in the region, were acquired to enable comparisons. Data sources, manipulations and calculations were documented in the individual topical reports. The data sources included:

Basic information about the counties and levels of well development:

- **2000 Census, Social Explorer Tables:** U.S. Census Bureau. http://www.socialexplorer.com/.

- **Economic Research Service Rural-Urban Continuum Codes:** United States Department of Agriculture, 2013. http://www.ers.usda.gov/data-products/rural-urban-continuum-codes/.
- **Wells Drilled by County:** Pennsylvania Department of Environmental Protection, Office of Oil and Gas Management. http://www.depreportingservices.state.pa.us/.

Report #1, Population:

- **2000 Census:** Social Explorer Tables: U.S. Census Bureau. http://www.socialexplorer.com/.
- **2005/07 ACS (3-year estimates):** Social Explorer Tables. American Community Survey 2005/2007 (3-Year Estimates). U.S. Census Bureau. http://www.socialexplorer.com/.
- **2010 Census:** Social Explorer Tables: U.S. Census Bureau. http://www.socialexplorer.com/.

Report #2, Health and Health Care Service Delivery:

- **Pennsylvania Health Care Cost Containment Council**: Multiple tables. http://www.phc4.org/.
- **U.S. Department of Health and Human Services:** Centers for Medicare and Medicaid Services. http://www.cms.gov/.
- **U.S. Department of Health and Human Services:** Office of Women's Health**:** Quick Health Data. http://www.healthstatus2020.com/.
- **Pennsylvania Department of Public Welfare:** Multiple tables. http://listserv.dpw.state.pa.us/ma-food-stamps-and-cash-stats.html.
- **Pennsylvania Trauma Systems Foundation:** http://www.ptsf.org/.
- **Pennsylvania Department of Health, Bureau of Emergency Medical Services:** http://www.portal.health.state.pa.us/portal/server.pt/community/emergency_medical_services/14138.

Report #3, Education:

- **Pennsylvania Department of Education:** Data and Statistics. http://www.education.state.pa.us/portal/server.pt/community/data_and_statistics/7202.
- **National Center for Education Statistics:** Common Core of Data. http://nces.ed.gov/ccd/.

Report #5, Housing:

- **2000 Census:** Social Explorer Tables, U.S. Census Bureau. http://www.socialexplorer.com/.
- **2005/07 American Community Survey:** Social Explorer Tables. ACS 2005/2007 (3-Year Estimates), U.S. Census Bureau. http://www.socialexplorer.com/.
- **2009/11 American Community Survey:** Social Explorer Tables. ACS 2009/2011 (3-Year Estimates), U.S. Census Bureau. http://www.socialexplorer.com/.

Report #6, Criminal Justice System:

- **U.S. Census Intercensal Annual Estimates:** U.S. Census Bureau, Population Division, April 1, 2000 to July 1, 2010. http://www.census.gov/popest/data/intercensal/.
- **U.S. Census Post-Censal Annual Estimates:** U.S. Census Bureau, Population Division, April 1, 2010 to July 1, 2012. http://www.census.gov/popest/data/counties/totals/2012/index.html.

- **Pennsylvania State Police Calls for Service.**
- **Federal Bureau of Investigation:** U.S. Dept. of Justice. Uniform Crime Reporting Program Data. County-Level Detailed Arrest and Offense Data, 2001-2010. Ann Arbor, MI: Inter-university Consortium for Political and Social Research. http://www.icpsr.umich.edu/icpsrweb/ICPSR/.
- **Common Pleas Case Management System:** Common Pleas Case Management System. 2001-2010.
- **Magisterial Court Data:** Magisterial Court Data. 2001-2010.
- **Pennsylvania Commission on Sentencing**: 2001-2010. Pennsylvania Sentencing Data. Population Research Institute, Pennsylvania State University. http://sodapop.pop.psu.edu/data-collections/pcs.
- **County Jail Population Reports:** 2003-2010, Pennsylvania Commission on Crime and Delinquency. http://www.portal.state.pa.us/portal/server.pt?open=512&objID=5403&&PageID=505946&level=3&css=L3&mode=2.

Report #7, Local Government:

- **Local Government Audit Reports:** Pennsylvania Department of Community and Economic Development. 2007 to 2010. http://munstatspa.dced.state.pa.us/Reports.aspx.

Report #8, Economic Benefits

- **Bureau of Economic Analysis:** Local Areas Personal Income and Employment. 2007 through 2011. http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5#reqid=70&step=1&isuri=1.
- **Bureau of Economic Analysis** (2007): Regional Economic Accounts: Local Area Personal Income. Washington, D.C.: U.S. Department of Commerce. http://www.bea.gov/regional/pdf/overview/regional_lapi.pdf.
- **Bureau of Labor Statistics** (2012). "Quarterly Census of Employment and Wages." Washington, D.C.: U.S. Department of Labor. http://www.bls.gov/cew/.
- **Bureau of Labor Statistics:** Quarterly Census of Employment and Wages Databases, 2007 through 2011. http://www.bls.gov/cew/data.htm.
- **Pennsylvania Department of Revenue:** "Tax Compendium." 2007-08 through 2011-12. http://www.portal.state.pa.us/portal/server.pt/community/reports_and_statistics/17303/tax_compendium/602434.
- **Pennsylvania Department of Revenue:** "Personal Income Tax Statistics." 2007 through 2010.
- **U.S. Census County Business Patterns:** 2007 through 2011. http://censtats.census.gov/cgi-bin/cbpnaic/cbpsect.pl.
- **U.S. Census Bureau, Quick Facts:** http://quickfacts.census.gov/qfd/states/42/42015.html.

Report #9, Agriculture:

- **National Agricultural Statistics Service:** U.S. Department of Agriculture National Agricultural Statistics Service Annual Survey. 1997-2013. Quick Stats. http://www.nass.usda.gov/QuickStats/Screens/faqs.htm#program.

- **Agriculture Census 1997, 2002, 2007**: U.S. Department of Agriculture. Census of Agriculture. 1997, 2002, 2007. Quick Stats. http://www.nass.usda.gov/QuickStats/Screens/faqs.htm#program.

Most of these data were collected from publically available sources. The exceptions to this were: Pennsylvania sentencing data, acquired through Pennsylvania State University's Population Research Institute; the calls-for-service data, acquired directly from the Pennsylvania State Police; and the Emergency Medical Services data, provided by the Pennsylvania Trauma Systems Foundation under an agreement with the Pennsylvania Department of Health's Bureau of Emergency Medical Services.

In general, data for each of the topical areas were analyzed at the county level. The only exception was the education data, which were organized by school district. In addition, except for health, data were acquired for all counties in the commonwealth, which allowed for comparisons not only between the case study counties but also comparisons by region, level of development (i.e. typology) and the commonwealth. All data were collected at multiple points in time to examine longitudinal change. Many indicators were annual data, with the exceptions of the Census of Agriculture (every 5 years), the American Community Survey (ACS, 3-year estimates) and the U.S. Census of Population and Housing (every 10 years). ACS 3-year estimates provide data on population, housing and other indicators between censuses. These estimates are calculated using 3 years of randomly selected households across the state of Pennsylvania. These estimates are helpful in understanding mid-decade changes that may be occurring. Unless otherwise indicated, data from both the years of Marcellus Shale development and expansion and the years prior to Marcellus Shale development were included in the analyses to provide comparisons across time. For several of the topical areas, this meant using data from 2000 through 2010, 2011 or 2012 (depending on the amount of lag time in data availability).

Goal 2: Analyze collected data to understand and interpret trends in relation to drilling activity and in comparison to historical and current regional, state, and national trends.

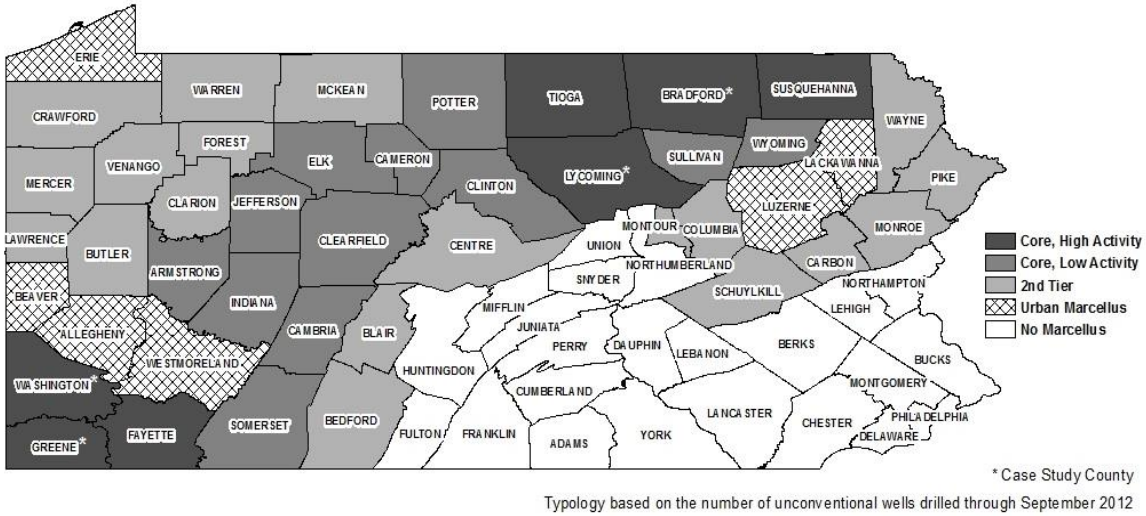
For most topical reports, descriptive statistics were calculated that measured change across time in the indicators for which multiple data points were acquired. These measures of change were assessed in relationship to one metric of Marcellus Shale development, the number of wells drilled annually, based on Department of Environmental Protection data. Pre-drilling trends were compared to trends after drilling began in each county to understand the potential effect of the activity on each of the indicators. To further assess potential changes from drilling activity, trends in the study counties were compared to trends in the surrounding counties and to those in the state as a whole. In addition, trends were examined for all counties differentiated by levels of Marcellus Shale activity. This approach was taken for reports #1 (Population), #3 (Education), #5 (Housing), #6 (Criminal Justice), #8 (Economic Benefits), and #9 (Agriculture).

The study counties were the primary focus of this research. They have experienced some of the highest levels of Marcellus Shale natural gas development in Pennsylvania, yet they have diverse populations, histories, economic bases and geographic locations. Each of the reports discusses the relevant differences among the counties that provide key points of comparison. Regional comparisons are also made, with two regions defined based on adjacency to the study counties. The southwest region consists of Greene and Washington and four neighboring counties (Allegheny, Beaver, Fayette

and Westmoreland). The northern tier region contains 12 counties: Bradford and Lycoming, and 10 neighboring counties (Clinton, Columbia, Montour, Northumberland, Potter, Sullivan, Susquehanna, Tioga, Union and Wyoming).

To further understand the effects of Marcellus Shale activity, the analyses in most of the topical reports compare all Pennsylvania counties based on their level of Marcellus Shale activity using a five-category county typology. The Marcellus Shale County Typology was created by combining definitions based on estimated shale value and actual development activity, including publicly available maps of the thickness, depth, and thermal maturity of the shale (McLaughlin, et al., 2012). Those counties with the highest geological potential for production of natural gas are classified as "core" counties, and those within the Marcellus Shale "footprint" but with lower potential for development are classified as "2nd Tier." The core area is further divided into two categories based on levels of well development activity during the main study period (2005 – 2010). There are seven counties (including the study counties) that account for 90 percent of the total number of wells drilled through June 30, 2013. These seven counties are classified as "core" counties with high drilling activity (see Figure 1). The remaining counties in the "core" are classified as "core" with low drilling activity. The typology also separates urban counties in both the "core" and "2nd Tier" classification because urban counties (as defined by the Center for Rural Pennsylvania) historically have differing population and economic dynamics. The final category includes all other counties not in the Marcellus Shale "footprint." Complete descriptions of the typology are provided in the appendices of the individual topical reports.

Figure 1. Marcellus Shale Typology



Goal 3: Describe the experiences of critical populations and institutions in relation to level of activity.

Previous boomtown literature has identified critical populations that tend to have unique experiences with rapid natural resource development because of the inability to isolate themselves from the social changes associated with development or the inability to benefit directly from development. These populations include youth, low-income residents and residents new to boomtowns, which tend to have more negative experiences. Critical institutions are those that tend to bear the direct impacts of

changing population dynamics and economic activities or those community sectors most affected by the leasing and drilling activity. These include (1) municipal governments; (2) public and nonprofit providers of healthcare services, human services, housing and K-12 education; (3) public and nonprofit organizations focused on economic and workforce development; (4) local businesses; and (5) agricultural service providers and businesses. The goals of this phase of the project included first identifying the appropriate means for data collection, then, where deemed feasible, collecting the relevant data. For most populations and institutions, the primary means of collecting data was through interviews and focus groups.

Critical Populations: Youth

Youth in grade 11 were targeted because this is a critical age in preparing for the transition from expectations to realization of careers and residential choice. Five focus groups were conducted with 36 youth in one school district from each of the study counties. (One district set up two focus groups.) To select the school districts, well count data through the end of 2012 from the Pennsylvania Department of Environmental Protection were used to calculate the number of Marcellus Shale gas wells drilled within each school district in the study counties. Within each county, the three districts with the most drilling were identified and one district per county was randomly selected for fieldwork. In these districts, project team members initially discussed the project with superintendents, principals and other teachers and district employees who could provide valuable perspectives on Marcellus-related community change and impacts on schools (e.g., business managers, bus drivers and guidance counselors) and who gave permission to work with the district. Administrators at each of the four districts were asked to identify a group of between six and eight 11th graders, with an even gender representation, representing more or less demographically "typical" students within the district. Hence, these student focus groups cannot be considered to be "statistically representative" of 11th graders in their district. However, the youth focus groups are notable for the consistency across districts in the views and experiences expressed by these students. In all but one focus group, no school administrators were present. In the focus group in which administrators were present and listening to the conversation, the students were notably more positive in their assessments of Marcellus community impacts. It is impossible to know whether in this case the attitudes and opinions expressed were influenced by either the way the district administrators chose student participants and/or their presence at the focus groups.

Critical Populations: Low-income residents and new residents

In consultation with advisory committee members and focus group participants, the researchers have developed a strategy to identify, contact and recruit low-income residents for participation in in-depth interviews in the next wave of the project. The researchers also assessed through research, conversations with key individuals, and discussions in focus groups multiple strategies for identifying new residents to communities. However, none of the approaches on their own were feasible in identifying a representative sample of new residents. Therefore, the researchers will further examine methods and other strategies to identify new residents for the next wave of the research project.

Critical Institutions: Overview

The critical institutions targeted in this phase of the project included: (1) municipal government; (2) public and nonprofit providers of healthcare services, human services, housing and K-12 education; (3) public and nonprofit organizations focused on economic and workforce development; (4) local businesses; and (5) agricultural service providers and businesses. Focus groups were the primary means of gathering data about each of these institutions in relation to Marcellus Shale development. Sixteen focus groups with representatives of these organizations were completed between November 2012 and June 2013, and included a total of 84 participants. Research participants in the following categories were recruited for focus groups: (1) local government (borough and township managers and staff), (2) representatives of health, housing and human service agencies, (3) representatives of K-12 educational systems, (4) local economic development agencies and businesses; and (5) representatives of local agricultural businesses and service agencies. For all topic areas except education, one focus group was held in the southwest region and one in the northern tier, yielding a total of two focus groups per topic area. Potential participants for focus groups on each topic area in each region were identified through the creation of lists of knowledgeable informants, developed in consultation with the appropriate advisory committees, personal contacts and focused Internet searches of local organizations and businesses. Invitations to participate were extended to these lists of potential participants in each region by mail or e-mail.

For the economic development focus group, invitations were sent to those knowledgeable in small business development, local economic development, workforce development, real estate and tourism. For the local government focus groups, invitations were sent to officials in municipalities across the study counties. For the health, housing and human services focus group, potential participants included representatives from healthcare facilities and human service agencies across the study counties, managers and workers from local clinics and hospitals, representatives from housing agencies and real estate agents. Potential participants for the agriculture focus groups included largely farmers. In total, more than 80 invitations were sent for these focus group topic areas resulting in nine total participants in the economic development focus groups, eight total participants in the local government focus groups, 10 total participants in the health, housing and human services focus groups, and nine total participants in the agriculture focus groups.

While in most school districts one educator focus group was held, one of the districts arranged two educator focus groups. This resulted in a total of five educator focus groups across the four-county study area. These were supplemented by two additional focus groups conducted with groups of school district superintendents at two separate Intermediate Unit meetings. Intermediate Units are comprised of multiple school districts, formed for the purpose of coordinating shared educational services. Intermediate Unit 1, in the southwest, covers Washington, Green and Fayette counties, while Intermediate Unit 17 covers Tioga, Bradford, Lycoming and Sullivan counties. One focus group also was held at the Southwestern Career and Technical Center with vocational educators. In total, seven focus groups were conducted with 47 educators and administrators across seven counties.

Data Analysis

All of the focus groups were recorded and the conversations transcribed. Following a constant comparative method of data analysis (Corbin and Strauss, 2008; Creswell, 2013), transcriptions and field notes were open-coded for perceptions of community change. Particular attention was paid to changes in local demographics, economic conditions, physical infrastructure and pressures on local social institutions. Axial coding also was conducted, creating open code subcategories. The research team developed additional codes as repeated patterns and themes in the data emerged, such as risk perception, inequality and safety. Initial differences in coding were reconciled through discussion among team members.

It should be noted that a limitation of focus group data is that they are not representative. The youth focus groups in particular represent the views of young people within four school districts, purposefully selected by school administrators in response to the request to recruit young people who were more or less representative of the larger student body within their schools. Yet, at the same time, many of the themes that were discussed were consistent across these communities and focus groups, despite the geographic differences across study sites.

Goal 4: Examine strategies communities have used to effectively manage change.

The focus group protocol included a question on how the organizations that focus group members represented have adapted to any changes they were experiencing related to Marcellus Shale development. The focus group data were coded specifically for this topic, examining strategies used by individuals, firms and organizations.

Results

The main deliverable was a set of nine topical research summaries, which are available at www.rural.palegislature.us. The reports are:

Report #1: Population Change and Marcellus Shale Development
Report #2: The Impact of Marcellus Shale Development on Health and Health Care
Report #3: Marcellus Shale Gas Development and Impacts on Pennsylvania Schools and Education
Report #4: Youth Perspectives on Marcellus Shale Gas Development: Community Change and Future Prospects
Report #5: Housing and Marcellus Shale Development
Report #6: Effects of Marcellus Shale Development on the Criminal Justice System
Report #7: Local Government and Marcellus Shale Development
Report #8: Local Economic Benefits Related to Marcellus Shale Development
Report #9: Establishing a Baseline for Measuring Agricultural Changes Related to Marcellus Shale Development

Following are profiles for each of the study counties, which summarize the findings within each county by topic; a summary of the organizational adaptations described by research participants; and additional issues raised by research participants, mostly related to community quality of life.

County Profiles

The following section summarizes the findings from all of the reports by county. Details about the data sources and calculations are available in the topical reports.

Bradford

- ***Population*** (2010): 62,622 (U.S. Census). Bradford experienced minimal change in the total number of residents during the decade (1 percent increase from 2000 to 2010), although population change did occur: a loss of about 3 percent of residents (from 2000 to 2005/7) was more than compensated for by a 4 percent population gain (2005/7 to 2010). Aging of the population and out-migration of those age 5 to 14 in 2000 (families with children and youth) also was observed, which is consistent with broader trends. There was also a slight increase in the working age population; for example, there were more residents age 35 to 54 in 2010, compared to the number of residents age 25 to 44 in 2000.
- ***Health***: Bradford County had three hospitals, located in Towanda, Troy and Sayre. Average inpatient hospitalizations were lower during the pre-Marcellus period (1998-2007) than during Marcellus development (2008-11) (7,769 versus 8,240; Pennsylvania Health Care Cost Containment Council). From 2000 to 2008, there were no Federally Qualified Health Centers (FQHCs) or Rural Health Clinics (RHCs) and the sole Community Mental Health Center (CMHC) in 2000 had closed by 2003. The number of uninsured under age 65 was 14.1 percent from 2005 to 2009 (U.S. Department of Health and Human Services). About 16 percent of the population was eligible for Medicaid (1999 to 2012); there was a steady increase from 1999 to 2007, followed by a slight dip in eligibility in 2008 that could be related to drilling activity. The number of Medicare-enrolled persons steadily increased from a low point in 2004. On average, 19.1 percent of the population was enrolled in Medicare from 1999-2010. During Marcellus Shale expansion (2008-11), there were higher averages for the total number of injuries reported compared to 2000-2007 (almost twice as high) as well as higher averages for motor vehicle accidents and falls (Pennsylvania Trauma Systems Foundation). In 2011, there were more than four times more EMS complaints compared to 2009. Focus group discussions with northern tier residents indicated that access to healthcare remains a major issue, especially when it comes to primary care.
- ***Education***: Despite expectations that gas industry development may prompt an influx of students, the county actually experienced continued decline with a loss of 8 percent in net school district enrollment from 2005/6 to 2010/11. However, some fluctuation occurred annually. The number of Individualized Education Plans (IEPs) increased nearly 14 percent from 2005/6 to 2010/11, so that 17 percent of students had IEPs by the decade end, although this was consistent with the statewide increase. The increase in the free/reduced lunch program participation was not quite as high as that for the state. Focus group participants expressed concerns about student aspirations, such as the

extent to which new employment opportunities may depress college aspirations. However, during this time period, dropout rates actually decreased slightly.

- ***Youth***: Youth indicated that they were scared about driving on the roads and concerned about accidents. Focus group participants often attributed this to gas industry traffic. A student who had volunteered as an emergency responder reported concerns about delays in response due to industry traffic. There were complaints about noise and light pollution. Youth in Bradford County expressed uncertainty about economic costs and benefits.
- ***Housing***: The housing stock increased over the decade, consistently, for a total 5 percent increase, so that there were just over 30,000 housing units by 2009/11. The rate of increase was slightly lower than statewide but consistent with regional change, and the median age of housing units was somewhat younger than statewide although consistent with the northern tier region. Nearly two-thirds (64 percent) of units were owner-occupied in 2000, although this decreased by 2005/7 and again by 2009/11, which was accompanied by a corresponding rise in vacancy rates from 15 percent in 2000 to 20 percent by 2009/11 (nearly 7 percentage points higher than in the other study counties and 9 percentage points higher than statewide). The median housing value was just over $116,000, which was much lower than the statewide median. There was a small increase in housing values of about $1,000 from 2000 to 2005/7, followed by a quite notable increase of 16 percent (much higher than the statewide increase of 6 percent) from 2005/7 to 2009/11, which may be associated with gas industry development. The percentage of renters spending more than 30 percent of income on rent increased from 29 percent to 36 percent from 2000 to 2005/7, but then stabilized. This was different from the northern tier region and statewide, where the percentage of renters spending more than 30 percent of income on rent continued to increase from 2005/7 to 2009/11. The median household income of owners decreased by about $2,000, to $52,500, which was consistent with regional change and the statewide rate of decrease, although it was still more than $10,000 less than the statewide median. Interestingly, there was a greater dip from 2000 to 2005/7 before values recovered in 2009/11, which also corresponds to the time period of Marcellus Shale development. Yet renter median household income decreased more dramatically by about $5,000, so that it was only about $26,000 in 2009/11; more of the loss occurred from 2000 to 2005/7 than in the latter half of the decade.
- ***Crime***: The number of calls for service to the Pennsylvania State Police increased to the highest levels of the study period in 2010, 2011, and 2012 (rates of 87.6, 98.9, and 92.8 incidents per 1,000 residents, respectively). Rates of reports of serious crime increased from 11 per 1,000 people in 2004 to 21 reports per 1,000 people in 2008, but declined slightly in the following years. Arrest rates for DUIs increased from 3.1 arrests (per 1,000 residents) in 2007 to 4.6 arrests per 1,000 residents in 2010. The rate of new criminal cases filed increased in 2008 (10.1 cases per 1,000 residents) and 2009 (10.9 cases per 1,000 residents), commensurate with well development, and then decreased in 2010 (10.1 cases per 1,000 residents). The rate of new civil case filings increased significantly from 2006 through 2008 (from 5.8 cases per 1,000 residents in 2005 to 10.9 cases per 1,000 residents in 2008) through 2008. Although the rate decreased somewhat in 2009 (9.4 cases per 1,000 residents), it increased again in 2010 (10.6 cases per 1,000 residents). Bradford County maintained fairly steady rates of traffic offenses between 2004 and 2008, and experienced a

significant increase in 2009 and 2010. The rate of adults sentenced for misdemeanor crimes was relatively steady from 2001 through 2006, and steadily increased through the remainder of the decade, coincident with well development. The number of offenders sentenced to county jail was fairly unchanged over the decade.

- ***Economics***: The number of tax returns with gross compensation income increased during the period of gas industry development, making it unique across the study counties. The relative importance of the mining sector, which includes natural gas, also increased the most in Bradford County, as it employed just 1.5 percent in 2007 compared to 5.8 percent by 2011. Total taxable income increased quite dramatically (19 percent) between 2007 and 2010, which was also the highest across the study counties. Given that the majority of the increase was in lease and royalty dollars, rather than in wage compensation, it would appear that mineral rights owners are the prime local beneficiaries.
- ***Agriculture***: Bradford County was 10th in Pennsylvania in 2012, the highest of the study counties, in terms of contribution to the value of state agricultural products sold. Dairy sales ($66.4 million) were more than six times higher than the other study counties, and the average farm size was 183 acres. Less than half of farms provided the primary source of household income and 61.6 percent of farms had sales volumes of less than $10,000. The number of farms decreased by 2.5 to 3 percent (1997 to 2002, and 2002 to 2007), and there was also a notable decline (-9.4 percent) in average acreage (farm size) over this period, as well as a drop in the number of dairy cows from 2009-2010.

Lycoming

- ***Population*** (2010): 116,111 (U.S. Census). Lycoming, which includes part of the Williamsport metropolitan area, began the decade with a population of 120,044 in 2000. The county experienced sustained loss over the decade of more than 3 percent. Out-migration occurred at slightly older ages than in Bradford County (i.e. those age 15 to 24 were a much larger group in 2000 than those age 25 to 34 in 2010). There was a relative increase in the male population, age 15 to 24, which could be associated with gas industry development.
- ***Health***: Lycoming County had four hospitals located in Williamsport, North Montoursville, Jersey Shore and Muncy Valley. The average number of inpatient hospitalizations was slightly higher during Marcellus drilling (14,474) versus (13,888) the pre-drilling period (Pennsylvania Health Care Cost Containment Council). From 2000 to 2008, Lycoming County did not have any Rural Health Clinics (RHCs), Community Mental Health Centers (CMHCs) or Federally Qualified Health Centers (FQHCs), although one FQHC was established in 2012. About one in 10 (11.4 percent) of those under age 65 were uninsured in the 2005-2009 period (U.S. Department of Health and Human Services) and an average of 18.6 percent of the population was enrolled in Medicare from 1999-2010. About 15 percent were eligible for Medicaid (1999-2012); there was a steady increase in this figure from 1999 to 2010, then a slight decline through 2012. There were higher averages of total injuries during the period of Marcellus Shale expansion (79 in 2008-11 versus 56 in 2000-2007), especially for motor vehicle and motorcycle accidents and falls (Pennsylvania Trauma Systems Foundation). There were over 2.5 times as many EMS complaints in 2011 compared to 2009. Focus group results of

northern tier residents indicated that access to healthcare, especially primary care, remains a major issue.

- ***Education***: Despite expectations that the student body might increase, there was a nearly 4 percent decline in net school district enrollment from 2005/6 to 2010/11. The number of students with Individualized Education Plans (IEPs) was virtually unchanged, yet an educator in a focus group indicated that differences across state policies have raised some questions for new students who do enroll, one of the issues that emerged in focus group discussions. The average percentage of students in the free/reduced lunch program was only slightly higher than the state average. High school dropout rates increased slightly, but this was true across the state and is not likely associated with Marcellus Shale development.
- ***Youth***: Focus group participants were uncertain about the benefits and costs of gas industry development, particularly in terms of traffic, road safety and the environment.
- ***Housing***: The housing stock increased (2000-2005/7) then declined (2005/7-2009/11) so that the housing stock at the end of the decade (2009/11) was virtually the same as in 2000 – there were more than 52,000 units. The median year that housing units were built was 1957, which was 3 years earlier than the statewide median and 6 years earlier than the median for the northern tier region. Of all housing units, 62 percent were owner-occupied in 2000, which fell to 60 percent by 2005/7, but then remained constant during the period of Marcellus Shale expansion. The percentage of renter-occupied units did not vary by more than 1 percentage point during the study period, and vacancy rates increased by 1 percent to 11.6 percent. While there was an increase in the median housing value by 2009/11 ($133,000), it was still much lower than the statewide median. The percentage of renters spending more than 30 percent of income on rent was on par with statewide rates, beginning with more than one-third in 2000 and climbing to 44 percent in 2005/7 and then to 46 percent by 2009/11. This was higher than the northern tier average. Owner-occupied median household income fell by about $2,000 during the decade, but was still slightly higher than the region. Renter median household income ($25,000) was slightly lower than in Bradford County, as renters experienced greater loss of income than owners (about $5,000 lost in median household value over the decade, mostly in the 2000 to 2005/7 period).
- ***Crime***: The rate for Pennsylvania State Police incident responses was relatively steady throughout the decade, with slight increases in 2010 and 2011 (69.2 and 72.2 incidents per 1,000 residents, respectively), followed by a decline in 2012 (69.7 incidents per 1,000 residents). The rate of reports of serious crime was relatively steady throughout the period of well development. The arrest rates for serious and minor offenses did not change relative to the period of well development. The arrest rates for driving under the influence were 3.8 arrests per 1,000 in 2007, then increased in 2008 (4.8 arrests) and 2009 (5.5 arrests), although the rate dipped slightly again in 2010 (5.1 arrests). The annual arrest rates for drug abuse violations were highly variable, with the highest rate of the decade occurring in 2007 (2.6 arrests per 1,000 residents) and the lowest rate in 2008 (1.1 arrests per 1,000 residents). The rates in 2009 and 2010 increased again to 1.9 and 2.2 arrests per 1,000 residents, respectively. The rates of new criminal cases filed increased slightly in the years just prior to well development, from 16.0 new cases filed per 1,000 residents in 2005 to 17.7 new cases filed

per 1,000 residents in 2007, and then began a general decline to a rate of 15.1 new cases per 1,000 residents in 2010. The rates of new civil case filings in the county increased in the years prior to well development, from 5.1 new civil cases per 1,000 residents in 2004 to 11.3 new civil cases per 1,000 residents in 2007. The rate then stayed steady through the rest of the decade. Lycoming County experienced a general decline in the rate of traffic violations from 2001 to 2006 followed by a trend toward increased rates from 2006 through 2010. In the years immediately preceding well development, the rate of individuals sentenced for misdemeanors was relatively steady. The rate increased slightly in 2008, and then declined in subsequent years. The number of inmates in county jail declined from 3.06 in 2003 to 2.77 per 1,000 residents in 2010.

- ***Economics***: Residents' total taxable income, as reported in state personal income tax returns, rose by nearly 7 percent from 2007 and 2010. Because the majority of the increase was in lease and royalty dollars, mineral rights owners were likely the primary local beneficiaries. There were overall employment losses in the county between 2007 and 2010, ranging between 1 percent (Pennsylvania Department of Revenue) and 4.4 percent (County Business Patterns). Importantly, county residents reported smaller decreases in employment than did businesses in the county, which suggests that many residents may work outside of the county (this is consistent with anecdotes that Williamsport is emerging as a regional "hub" for gas industry development, with many workers living there and commuting to drilling locations throughout the region). By 2011, businesses in the county were reporting stronger increases compared to 2007, ranging from a 0.4 percent decline (County Business Patterns) to a net increase of 2.1 percent (Bureau of Economic Analysis), and performing better than the state average.
- ***Agriculture***: Lycoming County was 31st in Pennsylvania in 2012 in terms of contribution to value of state agricultural products sold and had a total volume of dairy sales of under $10 million. The average farm size was 132 acres and important crops include Christmas trees, woody crops and tobacco. The number of farms increased by almost 19 percent from 1997 to 2002, and then decreased 8.5 percent from 2002 to 2007. There was also a small decline in the average farm size over 2002-2007.

Washington

- ***Population*** (2010): 207,820 (U.S. Census). Washington County, which is part of the Pittsburgh metropolitan area, was unique among the study counties as it experienced a steady increase in population, adding nearly 5,000 residents over the decade (202,897 residents in 2000). Compared to the other study counties, fewer adults left the county and some in-migration occurred, which may be related to college enrollment or more job opportunities.
- ***Health***: There was one hospital, Washington Hospital, located in Washington, the county seat. There were slightly more inpatient hospitalizations pre-Marcellus than during expansion (an average of 33,938 versus 33,774; Pennsylvania Health Care Cost Containment Council). There were five Federally Qualified Health Centers (FQHCs) in 2000, which increased to seven by 2008. Although the number of uninsured actually decreased over the time period, this may be connected to the number of persons eligible for Medicaid. According to federal criteria for Rural Health Clinics,

Washington County was not eligible; there were no Community Mental Health Centers (CMHCs) either. Of those under age 65, about 10.6 percent were uninsured from 2005 to 2009 (U.S. Department of Health and Human Services). The number of Medicare-enrolled persons steadily increased from a low point in 2004. About 20.3 percent were enrolled in Medicare from 1999-2010, and about 13.1 percent were Medicaid-eligible. The number of injuries due to falls was the only category that had a discernible trend, increasing over time, with an average of 144 in 2000-2007 versus 231 in 2008-11 (Pennsylvania Trauma Systems Foundation). More than 1.5 times as many falls were reported per year after gas industry development began, although the total number of injuries reported was only slightly higher. EMS classified complaints increased by more than 1,000 percent.

- ***Education***: There was a less than 2 percent decline in net school district enrollment from 2005/6 to 2010/11. The number of students with Individualized Education Plans (IEPs) increased by 12 percent from 2005/6 to 2010/11, so that 16 percent of students had IEPs. There was also a statewide increase during this time period. There was an increase in participation in the free and reduced school lunch program, although the increase was slightly lower than the statewide average. High school dropout rates increased slightly, although this was also true across the state.
- ***Youth***: Overall attitudes seemed to differ when compared to the other three study county focus group participants, as this was the only county where students seemed to generally express belief that gas industry development brought positive net economic gain.
- ***Housing***: The number of units increased over the decade, notably from 2000 to 2005/7 (5 percent), after which the pace of increase slowed somewhat. Even so, the county added about 6,000 units over the decade, ending with more than 93,000 (2009/11). The median year that housing units were built was comparable to the statewide median. Like the region and statewide, Washington County owner-occupancy rates decreased from 2000 to 2005/7 and again during 2009/11, as did the percentage of units that were renter-occupied. The percentage of units that were vacant increased from 7 percent to nearly 10 percent, which was still slightly lower than the statewide rate. There was a more than $30,000 increase in median housing values to $143,000 – the highest of the four study counties – but unlike the northern tier counties, most of the increase in median housing values occurred in the earlier half of the decade (19 percent increase from 2000 to 2005/7) compared to the latter half (only 6 percent increase from 2005/7 to 2009/11). In 2000, one-third of renters spent more than 30 percent of income on rent; this increased to 39 percent by 2005/7 and to 43 percent by 2009/11. The pattern was roughly consistent with the southwest region but was still lower than statewide. The median household income of owner-occupied units was almost comparable to the statewide median by 2009/11, at $62,000. The pattern was atypical in that median household income increased from 2000 to 2005/7 then fell slightly 2009/11. During this time period, however, renters fared as poorly as elsewhere, losing about $3,500 in median household income, ending the decade with a median income of about $25,000.
- ***Crime***: The rate of calls for service for which the Pennsylvania State Police responded increased from 58.8 per 1,000 residents in 2006 to 74.6 in 2010 and 74.5 in 2011. The rate decreased again in 2012 to 67.9 incidents per 1,000 residents. During the years with the largest number of wells drilled

(2009 and 2010), there were small declines in the rates of reports of serious crime when compared to previous years, as the rate of 19 reports per 1,000 people was comparable to the 2001 rate. The arrest rates for serious, minor and drug offenses in the county remained fairly consistent (or declined) during the years of active well development. The arrest rate for driving under the influence held relatively steady for 2007-2009 (between 3.4 and 3.7 arrests per 1,000 residents), then increased in 2010 (to 4.6 arrests per 1,000 residents). The rate of new criminal cases filed declined from 13.5 new criminal cases per 1,000 residents in 2005 to 12.1 new criminal cases per 1,000 residents in 2006, the first years of well development activity in the county. The rate remained steady in 2007 (12.0 new criminal cases per 1,000 residents), increased to 14.0 cases per 1,000 residents in 2008 and 2009, and declined slightly to 13.3 cases per 1,000 residents in 2010. The rate of new civil cases filed steadily decreased throughout the decade, from 2.2 new civil cases per 1,000 residents in 2001 to 1.4 new civil cases per 1,000 residents in 2009, with the exception of a large spike in the rate in 2010 (10.2 new civil cases per 1,000 residents). Washington County experienced variable rates of traffic violations throughout the decade, with steep increases in 2007 and 2008, a decrease in 2009, and a slight increase in 2010. There were steady rates of individuals sentenced for misdemeanors from 2001 through 2005, which was followed by a decline in 2006. The rate rebounded in 2007 and 2008, which was again followed by a general decline in 2009 and 2010. The average daily population rate in the county jail in 2006, when well development began to pick up in the county, was 149.1 inmates per 100,000 residents, and rose to 249.1 inmates per 100,000 residents in 2008. The rate decreased slightly to 188.6 inmates per 100,000 residents in 2010.

- ***Economic Impacts:*** The total taxable income of residents declined from 2007 to 2010, although this decline was lower than statewide. As in Greene County, increases in employment were reported to be higher by businesses than by residents. Given the larger total population, however, the economic impacts may not have been as pronounced as in other study counties.
- ***Agriculture:*** Washington County was 44th in Pennsylvania in terms of contribution to value of state agricultural products sold and dairy sales of less than $10 million. There were more non-farm opportunities compared to the other study counties and the majority of farm operators reported different (non-farming) primary occupations. Even so, Washington County had the highest number of sheep and lambs in the state and was second in value of sheep, goats, and related products. There was a dramatic increase (43.7 percent) from 1997-2002 in the number of farms, which was followed by a decline of 19.3 percent in the subsequent 5-year period, although there was no measurable change in average farm size.

Greene

- ***Population*** (2010): 38,686 (U.S. Census). Greene County lost around 2,000 residents over the decade, which was a notable decline given its small population. The number of women age 15 to 24 was slightly higher in 2010 than in 2000, although there were still more men than women in the young adult and adult age groups (in 2000, there were more than 3,000 men age 15 to 24 but only 2,600 women).

- ***Health***: There was one hospital, the Southwest Regional Medical Center, located in the county seat of Waynesburg. The average number of inpatient hospitalizations was higher during Marcellus drilling expansion than in the pre-Marcellus era (4,934 versus 4,833; Pennsylvania Health Care Cost Containment Council). The number of Federally Qualified Health Centers (FQHCs) increased from five in 2000 to eight in 2008 and the first Rural Health Clinic (RHC) opened in 2006. This and the increase in FQHCs may be connected to an increase in the number of uninsured. There were no Community Mental Health Centers (CMHCs) from 2000 to 2008. The number of uninsured under age 65, from 2005-2009, was 11.1 percent (U.S. Department of Health and Human Services) and there was a spike in 2009. The number of Medicare-enrolled persons steadily increased from a low point in 2004. An average of 17.9 percent of the population was enrolled in Medicare from 1999-2010 (which was a relatively low percentage among the study counties), but there was a relatively high percentage of Medicaid-eligible persons (21.2 percent; Pennsylvania Department of Public Welfare). There were slightly lower reported figures for total injuries (Pennsylvania Trauma Systems Foundation), but the number of EMS complaints by category increased by more than 3,000 percent.
- ***Education***: There was an 8 percent decline in school district enrollment from 2005/6 to 2010/11. The number of students with Individualized Education Plans (IEPs) was virtually unchanged despite a statewide increase. The percentage of students qualifying for free and reduced lunch increased notably and reached 46 percent by 2010/11, which was the highest of the study counties. High school dropout rates increased only slightly.
- ***Youth***: In focus groups, youth expressed uncertainty about the positive and negative impacts of gas well development. Among their concerns were gas industry traffic, adverse effects on wildlife, and complaints about noise and light pollution.
- ***Housing***: The number of housing units increased (2000-2005/7) then declined (2005/7-2009/11), which created a small net loss over the decade as there were just 16,440 units in 2009/11. The median year that housing units were built was comparable to the statewide median. Owner-occupancy of housing units fell from 2000 to 2005/7 and again to 2009/11. Among all units, 63 percent were owner-occupied in 2009/11, about 24 percent were renter-occupied and almost 13 percent were vacant. The county began and ended with the lowest median housing value of the study counties, at just $75,000 in 2000 and about $91,000 in 2009/11. About one-third of renters were spending more than 30 percent of income on rent at the beginning of the decade. The percentage rose to 42 percent by 2005/7 and to 46 percent by 2009/11, which was relatively consistent with the state. A slightly different pattern was observed in median household income of owners, whose household income first fell slightly from $50,000 in 2000 to $49,000 in 2005/7, but then increased to $54,000 in 2009/11. Renters fared poorly in the first half of the decade, as the median household income dropped from $22,000 to $19,000, but this loss was almost completely re-gained from 2005/7 to 2009/11 – which was the period of Marcellus Shale expansion. Focus group results, however, indicated that housing availability and rent increases were particularly problematic and may have been associated with gas industry workers pricing low-income families out of the housing market and perhaps even out of the area (prompting them to move), which

could at least partially explain the "recovery" in the median household income of renters in Greene by 2009/11.

- ***Crime***: The rate of Pennsylvania State Police incident responses was quite variable over the study period. The first year of significant well development (2008) saw an increase from the previous year to a rate of 139.7 incidents per 1,000 residents, but then a drop in 2009 to a rate similar to 2007 (129.1 incidents per 1,000 residents). The following years (2010 and 2011) saw increased rates (130.4 and 134.6 incidents per 1,000 residents, respectively) followed by a decline in 2012 to the lowest rate in the study period (120.5 incidents per 1,000 residents). The rate of reports of serious crimes gradually climbed from 2005 through 2008, when it leveled off. There were general declines in arrest rates for serious, minor, and drug offenses, but the rate of driving under the influence arrests rose from 5.3 arrests per 1,000 people in 2008 to 6.8 in 2010. During the period of active well development (2008-2010), trends indicated increasing rates of new criminal cases; however, like the other study counties, the rate dipped again in 2010. The rate of new civil cases filed in the county steadily increased from 2001 through 2006, then increased significantly in 2007 and again in 2010, commensurate with well development. The trend for the rate of traffic violations was very slowly increasing from 2004 through 2008. The rate dropped in 2009, but then rebounded to earlier levels in 2010. After a slight dip in 2005, the rates of individuals sentenced for misdemeanors sharply increased in 2006, and quickly declined in 2007 and 2008. The decade ended with rates that were higher than those at the beginning of the decade. The average daily population rate of inmates in the county jail declined from a high of 279.1 inmates per 100,000 residents in 2004 to 208.9 inmates per 100,000 residents in 2009. The rate then increased to 253.3 inmates per 100,000 residents in 2010.
- ***Economics***: The total taxable income of residents declined during the study period, coinciding with the beginning of gas industry development, although this loss was smaller than statewide. Federal employment data showed an increase from 4 percent to 10 percent whereas state tax returns had a decrease of 4 percent, suggesting that many new jobs may be going to non-county residents.
- ***Agriculture***: Greene County ranked 58th in Pennsylvania in contribution to value of state agricultural products sold and had dairy sales of less than $10 million. Forage was a top crop item, as in the other study counties. The number of farms increased slightly by 2 percent (1997-2002), which was followed by a more notable increase of 41.3 percent from 2002 to 2007. Over the latter period, there was also a decline in average farm size of nearly 25 percent.

Adaptations

Focus group participants were asked to reflect on the types and effectiveness of strategies their sectors or organizations had used to manage and adapt to changes experienced in their clients, services, or communities related to Marcellus Shale development. The following section describes the types of responses organized by relevant unit (individual, firm, agency, government).

Individuals

Individuals described strategies to manage the changes they have experienced in their communities ranging from legal arrangements (leases and amendments) to finding economic opportunities to considering moving out of the area. Several focus group participants discussed leasing, and the importance of having a lawyer, but that having a lawyer alone wasn't enough. They learned over time the importance of monitoring the implementation of their lease themselves. As one landowner stated, *"We had as good a counsel as anybody could possibly want, and you still get taken advantage of."* Another observed,

> *"The other thing is, even if you have it in your agreement, like my father-in-law had it all worked out. They were gonna run the water pipeline around the edge of the field so it didn't—and they just wore him down and wore him down and wore him down until he's finally like, fine. Put the water line through the center of the field. Because they—that was the easiest way for them. It didn't matter that it was gonna be a management nightmare for the farmer."*

Water testing was of particular concern:

> *"I had the water testing built into my lease because that was one concern that I had, and I literally had to threaten a court action to stop drilling activity for them to do it before they started a well. They wouldn't do it, they wouldn't do it, and I finally said you're ready to start putting a well pad in here and you haven't followed the terms of my contract. Guess what – the next day they had four guys there testing my water from five different wells."*

Some participants saw the changes in the community related to Marcellus Shale as an economic opportunity. Some property owners talked about taking advantage of cheaper natural gas by converting their homes from coal or oil to natural gas. Others are raising their prices for housing and are expanding their housing availability. One participant described how one person converted a building he owned into apartments and office space: *"It was rented before it was finished, all four units."* Others, however, emphasized the economic uncertainty of Marcellus Shale development. The slowdown in gas production during 2012 taught some landowners and workers that they should not radically change their lives, farms or businesses just because they are making more money, since that money may not be around forever. One participant explained how someone he knew had had his hours cut dramatically because of the instability of the industry. He described the general thinking as:

> *"People have gotten used to that idea a little more, so they're not rushing out to make a commitment to maybe build an addition on the house or take out an additional loan for something or other because, 'I know six months ago, I was working 80 hours, but this month, I've been working 20, 30 hours a week, so I'm gonna hold off on rushing out to make that purchase or build that addition or do that because not entirely sure that next week how many hours I'm gonna have.'"*

On the other end of the spectrum, some people are considering moving away. As one participant stated, *"I don't think I want to stay in this area."* Another said, *"The county here where it really boomed, a lot of people are thinking, let's get out. I think since it's slowed down I don't think you have quite as*

much but trying to get through [name of town] to our office to the courthouse there, a former 10 minute drive was now 45 minutes. You're just sitting and sitting." Some farmers are finding that their children want to leave. One explained,

> *"This isn't a pretty story, but I have three children that were all interested in pursuing agriculture and my one son is still farming with me, but when he saw the impacts to the gas drilling in the area overall a couple years ago, he said, dad, I don't know if I really want to invest the rest of my life in this area. That was a huge blow, and it really hit me when they actually started putting the gas pad next to my farm here because all of a sudden there's this huge amount of traffic going on and it's a huge impact to what you're dealing with there in maybe a short period of time, but you realize this is going to go on for another 20-30 years all over the place, here, there, everywhere you know, and our road is probably going to be a major link to another 10-20 square miles out to the west because of where we are located. It's like we're going to have to live with this for a long time."*

Farms

Farmers have sought ways to adapt to the changes brought on by the development of the Marcellus Shale. Farmers are using the money to alter their operations and to reinvest in their operations. As one participant stated, *"It helped them stay in business."* And some children of farmers are moving back to the farms because drilling revenues are giving farmers new opportunities to expand and upgrade, such as improving their livestock breeds. However, as one focus group participant pointed out, the wise farmers are using the new incomes to prepare for the transfer of property to their children, because the higher property values will raise taxes on sales or inheritance transfers. One offered an idea on how the state could develop an adaptation strategy to deal with this problem: *"I was thinking that if the state actually had a tax structure to encourage these farmers to let a new young beginning farmer use their property at no cost in exchange for a tax break from the royalty money that they are getting, that would be a terrific thing to enable that next generation to actually do some of that."*

Farmers whose operations have been interrupted by drilling activities and road congestion are turning towards minor acts of resistance. One offered a story to illustrate: *"I had a friend of mine, he farms all over the place and he was really getting irate with the traffic and so on and the signs up, 'truck crossing ahead/please stop', he started driving right past the flagman and saying, I've got a job to do here, I'm farming these acres, I cannot wait for your traffic to cross the road."*

Whether it is because of drilling activities increasing access to previously unusable ground or to pastureland becoming taken over by drilling activities, farmers are changing their management practices. One participant explained, *"The way they handle their animals, especially if you have a lot of well pads. In a grazing situation, it means a lot of additional fencing because when you have that kind of traffic coming in and out and you're trying to keep your animals—yeah. It's a lot more management."*

Businesses

Like farms, local businesses are seeking ways to adapt to the changes from Marcellus Shale development. Focus group participants reported many changes, including businesses that are changing their hours of operation, expanding their services and product lines and cross-pollinating to better meet the needs of the gas industry. For example, the tourism offices in some communities are helping to inform gas workers of services, businesses and off-hours opportunities. Local companies are creating new products to serve the needs of the industry, such as devising new water-retention products. Small airports are developing shuttle services to transport workers. Campgrounds are expanding their operations. And some landowners are building campgrounds on their property. As one participant explained, *"If somebody had a bottom that wasn't being used for pasture and cows, they were putting in camping hookups, and they popped up all over our county."* Participants also described how restaurants are adapting by adjusting menus to accommodate the tastes of gas workers and raising prices. New restaurants, including national chains, are opening.

Focus group participants reported that some businesses are responding to the availability of natural gas by converting their vehicle fleets to natural gas. And new businesses are emerging to establish natural gas service stations. Other new business opportunities that meet the needs of the natural gas workforce have been created as well. As one focus group participant explained, *"There is a little old lady by one of our campgrounds now that actually is taking in laundry and advertising, but restaurants now, some of the restaurants are delivering to hotels and stuff where we've never had that before. Like I said, the grocery stores I know have stayed open longer."* Other new businesses include maid services, catering, and various machinery and other cleaning operations.

Banks are adjusting the ways that they provide loans for real estate purchases and realtors are changing the way they structure sales. For example, as one participant noted, *"It has affected our local banks even just in the lending because now people are selling their house without their mineral rights, and all the normal forms they would typically use, everything has changed, and …they had no idea for the first couple of years going forward. It was really holding up a lot of different transactions with banks."* Banks also are looking to provide investment services for their clients who have come upon newfound wealth.

Business support organizations, such as tourism boards and chambers of commerce, are using income from local hotel taxes to expand their services to provide outreach and consulting to the gas industry. One participant explained,

> *"We've hired an additional consultant who is now working in sales for us, where before, we really didn't have the product to go out and get … small meetings or large meetings to come to our area, and now we're doing that with the number of hotels that we have…. we have now the product to sell. We actually have meeting spaces and hotel rooms, enough hotel rooms that, and even with the natural gas people staying in the hotels, there are still a lot of very slow times over the weekends and different things."*

These organizations send out information to gas companies and their employees, they are attending expos nationwide and they are hosting expos in Pennsylvania.

Not all the adaptations in business operations are successful. Some companies that tried to expand into water hauling discovered that the gas industry imported their own trucks. One participant explained,

> *"I think most of the locals in our area thought they needed to run right out and purchase water trucks, and they were all gonna be hotshot operators, and so now they've financed their homes to purchase these trucks, and they ended up bringing in these companies from outside the area that were already established with these companies, and they didn't hire the locals, so that has negatively impacted the residents as well."*

Educational Organizations

Focus group participants reported that workforce training institutions are expanding their services. One participant explained, *"Well, I have a whole staff now and infrastructure that 5, 6 years ago I didn't have, six people dedicated just to provide educational outreach just to this industry in this area, so it's a tremendous impact for the college."*

The challenges for K-12 schools have been varied, from uncertainties about school enrollments to unknown needs for curriculum adjustments to managing safety for school children on buses. In response, school administrators have sought opportunities to learn more about the industry. Some schools have been aggressive in *"educating themselves"* by sending representatives to information sessions and conferences held by Penn State and the gas industry. Schools have taken it upon themselves to keep their communities educated about developments, including such things as air quality. Some are providing educational services on leases and inviting gas companies to public forums to educate parents and the community. They are setting up social media strategies to communicate with parents quickly. One participant explained that the school got a chemical company to do *"some pro bono work for us when the initial well was being drilled across the street from us. They did a baseline on air quality; they did fault rollups, and it came out that there was not a substantial impact or nothing life-threatening, dangerous from that. We posted that on our website because of the concerns about the community and the parents and the staff."* One participant explained that it is very important to go to information sessions hosted by the gas industry because it may be necessary in the future to use the contacts when something goes wrong: *"If you're contacted by companies that are involved or they invite you off to an open house, go, because it's those contacts that really—when you do have a problem, if you have a name and a number to call someone, I think that would be very important to them."*

School administrators report specifically trying to address the needs of children whose parents work in the gas industry. There was general agreement among focus group participants that most gas workers are not bringing their families with them, but that those who do bring their families are mostly transient. One participant explained, *"Our strategies have been to try to remediate those students the best we can and somehow help them receive some kind of education to help them in the future. If these kids continue to go from school to school to school, it's an ultimate failure for them. A lot of the jobs are not family-oriented. I think that we all know that. That's a shame for this industry, but it is what it is."*

Some schools have adjusted their curricula to accommodate the workforce needs of the gas industry. One company donated $5,000 per year to a school to promote the creation of classes useful for the gas company. However, that money ended after 5 years. One participant stated that it was important for schools not to make dramatic changes to their curricula because the market is still "*too volatile.*"

> *"The takeaway for me, as a superintendent, what I've learned over the last few years, I'm not going to make major changes because of this gas industry. We're not going to decide to close buildings or build buildings based on potential kids coming or going. We're not going to make major curriculum changes because of the potential of increased jobs. We may tweak some things here or there. We may teach a little more welding. We may do some little things. We're not going to make huge curriculum changes because of this industry."*

One particular challenge reported by school administrators is managing the safety and schedules of school buses with the number of additional trucks related to the natural gas industry on the same roads. Schools have had to create channels of communication with the local companies, sometimes forcibly, to make sure that their buses are able to run on schedule. One participant explained that when the gas company is blocking bus traffic, they have to

> *"impose our will. Either comply or we're just going to start pulling permits, the school buses have to get through, and for the most part, the problem at the very beginning was communications. …the last thing a [drilling] superintendent wants to tell his production manager is, I gotta hold those water trucks for 40 minutes while I wait on a bus. Once we were able to reach those proper channels and get a little higher up the ladder, per se, then they were able to move … we gave them a schedule for each bus route, what time and they have done very well with keeping the traffic off at those times. It delays them ever so slightly but if you throw a bus in the middle of a hundred trucks, that's a huge delay for both sides."*

However, other school administrators have found that some companies are a little less willing to work with them to accommodate bus schedules. When they refuse to follow their agreements, it is necessary to document the problems and be persistent. One explained,

> *"For the most part, you'll find they work with you, but every now and then it's almost as if it's a test to see how much can we push you, what are our limits, what are our boundaries, and every now and then you have to remind them this is what your boundary is, and we will shut that road down. We have roads that are bonded and those that aren't, and I said, I got gas well traffic on this road, no you don't, yeah I do, no you don't. You show me pictures and I'll believe you. You want pictures. So I called the people who were complaining on that road and said he wants pictures. That was on a Friday, before the weekend was out, I had a ton of pictures. So I sent it to them and they said, oh, um, we're going to put up signs. … I said, the road you have bonded you have destroyed, so now they're not dumb, they're finding an alternate path, and next thing I know, complaints again. I said, your sign isn't working, and he goes, we're going to put out a directive. Really, the sign didn't work and you think the directive is going to work?*

And so then I catch him on another road, and I said, hey, you better get those signs up there and don't forget those useless directives."

Because the gas industry is hiring so many Commercial Driver License (CDL) drivers, schools are finding it necessary to be creative to make sure that they maintain their bus drivers. At least two schools recruited bus drivers from the coaching staff, custodians and cafeteria workers.

Health, Housing and Human Service Agencies

Focus group participants described shortages of low-income housing and increased homelessness as a result of rental property owners raising their prices and evicting current residents. Many low-income residents are moving into houses and apartments with other families. They have proactively sought to educate individuals, families, and related service agencies about definitions of homelessness that include living in temporary housing (such as campgrounds) and living with other families ("doubling up"). They have sought creative solutions to providing families with funds through alternative programs, such as offsetting transportation costs through vouchers, which make other household funds available for housing costs. One participant reported that his/her agency had added a staff member to serve as an advocate and connect clients to the services they need.

Municipalities and social service agencies are forming task forces and focus groups to discuss the challenges of providing low-income housing. One participant explained,

"We brought developers in. We have a housing focus group, where we're trying to encourage developers to come into [study] County to develop some sort of housing. We just finished our transitional house. It opened in November…It's a transitional house for the homeless—it's an 18-month program. It will remain that, due to the funding that we received to build it. It will remain that for 10 years. After 10 years, you have the option to change it to whatever. We are working on a developer for senior housing….They don't have the income. They're on a very fixed income. The idea is to be able to offer them affordable housing, to where they'll sell their houses, then, to possibly a landlord that will then work with us for our low income. It's kind of like a cycle. Someone that can come in and afford to work and develop the place, fix it up, and sell it out to or rent it out to a family that can afford it."

Some government leaders are becoming more proactive on addressing the housing issues. One participant explained,

"I think that our commissioners have taken a pretty aggressive look at the housing shortage, the windfalls of money that are coming into the area, the potential for investment within the communities, and I know that they've even taken the time, a few of the municipalities and the commissioners, to meet with the banks to encourage them to look at some type of community investment CD so we can revitalize our community with money that's being created right here. I think the positives are endless, honestly."

Another participant described efforts to encourage local businesses to invest in low-income housing.

Focus group participants described how the development of the natural gas industry has stressed a system that was already having difficulty meeting the needs of the local population. *"Access to health*

care has been an ongoing challenge as well. Good and bad with natural gas is it exacerbates the access to healthcare issue." Demand has increased for most services, particularly adding stress to emergency services. Focus group participants also addressed the need for mental and behavioral health services which they perceive to be an increased burden on that sector of county human services.

The use of hydraulic fracturing has added to residents' lists of health concerns. One member of a focus group commented on the need for services in her county based on assessments conducted by her agency.

> *"We've done a number of health assessments…I just completed one here in 2013. In terms of health needs…it's the big three: tobacco, diet and exercise. However, we have always put an open-ended question very near the beginning of the survey. We ask them, "What do you think's the most important issue in our community?" In the most recent one, a couple of people responded: fracking, which we had never, obviously, had that before. There are some community perceptions that there are some health issues there."*

In response, some health care agencies have developed mechanisms to coordinate services across municipal boundaries and across agencies to respond to client needs:

> *"We were able to dovetail—'cuz remember, once you cross that [line from town to town}, you're technically in [section of the county]. I know the district overlaps there, but we decided that our children needed a place to go to get their community mental health. We were able to do that through administration and support that says, this is where we are as a community. This is where we can best service our children and our families. It happened because there's a coordinated effort between human services, school administration, and community. That's what we do best. When a hiccup comes along, like the Marcellus Shale industry, we go, okay, we're accommodating. We're going to deal with it. We're going to move forward."*

Fire departments need to be upgraded to cope with new challenges. As one participant said, *"Fire departments too, because there have been incidents where fire companies have responded to events—let's put it that way. We're talking about volunteer fire companies. A lot of times, they're told to just stay away, stay back, control the traffic. Our thing is so specialized up there that we're the ones who have to take care of it. I've heard an official say, when they have the hearings… "We'll have training for the local firemen," and all that stuff. I don't know."*

Governments

In response to Marcellus Shale development, municipal governments have tried to conduct strategic planning and develop long-term strategies. But it has not always been successful. As one participant stated,

> *"This thing is so new… It's escaped those types of things that you might expect. I'm on a planning commission here in the county too. I know it's only about 5 or 6 years ago that we requested that [energy company], one of the first in the area, come to the*

planning commission to explain what might lie ahead for this county. At that time, they couldn't even explain what was going to happen. From a planning standpoint, you can't plan. From a tracking standpoint, you can't track."

Some municipal governments have learned that it is important to develop strong policies and agreements and to enforce them. One participant explained, "*At the township level, you come up to an agreement with them. All right, you're gonna use this road, and stay off of that road. The well drilling company tells their subcontractors, you're gonna use this road. They'll still take that other road and then you have to say, the water trucks are going back this other road, the equipment truck—no, they're not. No, they're not. Then you have to have one of the residents actually take pictures."*

They have also learned that local government positions are more important now and that the positions need to be filled with qualified people, even though qualified people are often in short supply.

"The problem is that we don't have any of our own experts. We have to rely on the expertise of companies, but the thing is, is that we're wary of them because of some of the incidents that have happened. It does require some expertise to understand how these things work, and what the potential problems might be. Of course, companies, they're working in their best interest. That's just a fact of life. That's what a for-profit company is."

Moreover, there is recognition that strong leadership is critical: "*These supervisors don't take the bull by the horn. They just let things slide and that's—I think it's their responsibility to do this."* Another participant emphasized the need for good communication skills: *"…the township supervisors that have a better approach and they don't do it hard-nose, they end up getting more than the guy that starts forcing them."*

Some municipal governments are looking to generate revenue from property that the borough or township owns. *"I can tell you the communities themselves, some of them are looking to make money off the gas industry. If they have a community area…a little bit of property, can I lease this to the pipeline people or can I lease it to somebody else? A number of communities are actually trying to make money off of it themselves."* One community is building a new electric power plant that will be fueled with natural gas to take advantage of the relatively cheap supply of gas.

Local government participants expressed support for Act 13, even though it has restricted their ability to regulate drilling activities. *"The impact fee has been a great boon to us….it's the same with farmers. All of a sudden—you have all this rust sitting around and now, you're able to buy a new tractor. You're able to buy a new truck. You're able to buy new high lift and replace that junk that you had sitting around. You're able to take better care of your roads. The impact fee has really been a great benefit…."*

Local governments are establishing task forces with the goal of developing more comprehensive strategies.

"Well I just know part of a local taskforce here, natural gas taskforce where you have all the commissioners, local elected officials. You have the mayor's office. You have everybody coming together, and I remember that group meeting …before the Marcellus back in 2006, 2007, before things were even really rolling here, just to talk about bringing, trying to make this an attractive place for new business to come in, just looking at ways of what's happening in terms of jobs, housing, health care, schools, just trying to

address the infrastructure issues, and making sure that as a county, things are taken care of, and in fact, at a local meeting a few weeks ago with Act 13 being able to reinvest a lot of those dollars in bridge infrastructure, recreation, parks, really trying to make those priorities, so that you do get that balance of the impact of having the industry here."

Some local governments are reconsidering their comprehensive plans. Others are using revenues to invest in infrastructure, such as installing public water and sewage services. One participant explained, *"That's kind of what we've been thinking – the long-range approach, sewage, doing the appropriate things that needed to be done to enhance that chance of a water supply. We want to close some roads, that gives us a little bit of bartering power to aid us in those city water lines to be run in our directions."*

Local governments, like other landowners, have realized the need to be vigilant about water testing and monitoring the implementation of their leases. One participant explained,

"We have to keep our eyes wide open as you said, to the tell-tale signs of damages, water pollution, independent testing, I'm telling you. There are groups out there that would willingly come to your municipalities and test your water that have no affiliation with DEP or any state regulatory system. Those are the type of people you want out there every 30 days doing the dip, to let them test it, let them share the information with you, monitor your systems. If there's a well that is tainted or so on, we send them there and we have them tested."

Emergent Themes

Although participants were not asked explicitly about quality of life, it was an issue that was raised repeatedly in the focus groups. Participants' perceptions of the changes in the quality of life in their counties were framed in terms of their individual quality of life, the quality of community life as a whole and the distribution of the benefits and the cost of the development across their communities. Participants in the focus groups discussed the ways in which perceived changes in the quality of life were related to perceptions about the industry itself, divided opinions about the effects of the development, and their attachment to place.

Communities Divided

Participants across all of the focus groups noted the ways in which their communities were divided over the perceived benefits and costs of industry development. Some economic benefits accrue to local residents through the expansion of local businesses and the creation of new jobs; however, much of the significant influx of money seems to be coming to residents through the leasing of sub-soil mineral rights to the gas industry. As one township supervisor observed:

Respondent: "*I get the phone calls, so I get the complaints and there's definitely a lot more complaints than we ever had, and I would have to say that…*

Moderator: "*Complaints on…?*

Respondent: "*Any number of things. The complaint's on the truck traffic that's too fast, it's got the road blocked. I mean everything you can possibly think of. When they cut that turn, they run through my yard. There are a lot of people who are complaining. I tend to find that the people who probably do the most complaining are probably the people who did not benefit financially from a lease."*

Participants across the focus groups discussed the ways in which they saw these divisions within their communities playing out – between the "shaleionaires" and the have-nots.

"*I think there's two different types of people. There are the type of person who wants to make as much money out of it as they can and don't care about the repercussions, whereas you have those other people who really, really are concerned about the repercussions to their farm, but they still want to get in on the action. I think it's two altogether separate individuals. There's no in between."*

Others saw the issues as dividing along the lines of those who agreed to lease their land and those who did not. As one educator observed: "*there are a lot of people in this community who absolutely refuse to lease their land. You have a very split community."* While participants did not give specific reasons that landowners might not want to lease, in characterizing the differences between factions, participants provided several clues as to the basis upon which landowners might have made those decisions or why opinions about leasing might differ across the community. One possible explanation was provided by an educator who elaborated on what she saw as a conflict about the build-up of particular sectors of community infrastructure, particularly opinions about the connection between industry presence and the need for temporary and low-income housing:

"*I just think we have competing factions. People that want us to develop and get that infrastructure and have housing—we don't have any low-income housing developments in our district. You know what I'm saying? There's not low-income housing. There's not a trailer court. There are factions that are happy with that. Then there's some of us, we would like some family homes, some development going on.*"

Other participants focused on the divisions that they had observed about differing perceptions of the effects of the Marcellus Shale development on environmental sustainability and community health: "*It seems, as with anything controversial… You can have [name of person] and her farm who says, "My cows are glowing, and the water is on fire." You live next door, [name of participant], and you're saying, "I swim in the water. I drink the water. My baby takes a bath in the water." There's no—everything is so up in the air about the health issues."* Another noted:

"*There's a split between the people. There's, "I don't wanna upset the environment", and there's people—not to offend anybody, but there's people in this town who are greedy and wanna get the money in from the gas. Then there's people that look at it the way everyone else here is talking. "Get out. You're ruining our place. There's no more trees. There's no more animals. It's urbanizing, and that's not what everyone wants*

here." Then again, there are people with a lot of land that want the money and want what comes with it."

Some participants, particularly the youth participants, reported that community members had shown open hostility to each other or in displays directed towards the gas companies themselves. They reported that people would actively kick seismic monitors that companies had installed around town out of the ground. Others told stories of hostilities between neighbors over leasing agreements being held up because a neighbor was waiting for a larger payout from the gas company for their rights.

As a result of these community divisions and some of the open hostility, human service providers and school districts representatives both reported that they had to be careful about the ways in which they associated themselves with the industry, particularly in the southwest. One educator noted that he had to be careful: *"You can try to educate everyone about what's going on, but don't try to take a side on this side or that side or whatever. Focus on what's best for the kids."* Representatives from health and human service organizations in this area reported similar feelings and told two illuminating stories:

> *"I said that, before, we had, as an organization, thought about doing a conference on Marcellus Shale…. We had asked advice from some former board members, and one of them, who was very well-versed in lots of political stuff, basically said, "Don't touch it with a ten-foot pole." He said it's so polarized that you're either an angel or a devil. You're either on one side or the other. There's no middle ground. I think sometimes that pits neighbor against neighbor, or municipality against its residents, because municipalities are trying to make ordinances, zoning stuff, to try to make things so that people can live together."*

> *"We had, at the end of 2011, got a check in the mail for $10,000 from somebody I'd never heard of. I called the people and I said this was a great surprise, this was fantastic. The woman said, "We just sold our drilling rights, and we wanted to do something for our community." I'd been running a Christmas ad, saying, when you're making your gift-giving decisions, please remember to give a gift to United Way, and you'll help all of these local agencies. The woman said, "My husband and I decided we can help all these different agencies if we give to United Way." I was going to put another ad together, with a stock picture of someone—not the people, cuz they wanted to remain anonymous—saying, "When we sold the drilling rights to our property, we made a gift to United Way to help all these agencies." Our board members were like, "Do not associate us, even though they know our pockets are lined. Don't put that in the newspaper, or we may lose more contributors than we gain."*

Overall, the Marcellus development is a politically and personally divisive issue across all sectors of the community, from interpersonal relationships between neighbors to local government and human service provision.

Quality of life: Higher for all or higher for some?

Some focus group participants described how the economic benefits from Marcellus Shale were leading to increases in the material quality of local residents' lives through the alleviation of economic hardship. One participant described the changes for residents of their county from long-term economic hardship to economic abundance:

> *"[The shale gas industry has] put a lot of money in this county and if you drive and I won't mention townships because it doesn't matter, we all have sections of the county like this, it was like Appalachia. I mean the people who lived there, their farms were poor, they went out of business, there's four or five cars and they make one run out of four or five, and their lawnmower's laid there and the brush was growing up and the house was half built and three kinds of siding on it. And that's the way it was. You drive down through there now there's nice manicured yards, they got one decent new car, the junk is gone, the house is fixed up, roof and all one color. I'm not being sarcastic or smart but it made those people proud to have a few dollars that they could better themselves."*

Some observations about changes in the quality of life were related to the perception that gas workers did not share the commitment to local community life that long-term residents felt, as demonstrated by their physical treatment of the places they lived. One educator remarked:

> "*I live right in the town of [name of town] and I'm very concerned about the social fabric of the town breaking down. On any given street now, homes are lived in now by gas people, whether they're families or whether they're groups of men that are renting a home. There's no commitment to the community as far as they're concerned. Those that are renting, they're not really contributing to the tax base either. If you walk around [name of town], [it's] starting to look like a third-world community. There's no care. People don't keep up the properties. If anything, there's property destruction."*

In discussing either actual or potential worries about changes to the quality of life, participants repeatedly brought up water quality. One participant described this experience: "*I am one of the households that are on bottled water right now because we did have a spill. The frack got away from them up in [name of] County on [name of] Road. We were evacuated for two nights, and they had to change the whole well head, so they were afraid of an explosion, but we still can't drink our water. They're testing it weekly.*" Others, perhaps familiar with stories either personally or in the media about potential environmental risks allegedly associated with drilling, actively worried about the potential of these issues to change their quality of life.

Attachment to place and resident mobility

Participants reflected on the ways in which the social and environmental changes they perceived to be occurring had affected their feelings about the places in which they lived. For example: "*One of my favorite things in the whole world when you're having a rough week is to go to [name of] Lake in my canoe and sit out there and fish, and I have a big, huge, loud, noisy well out there. It's just amazing to*

me. That's the part—I think sometimes it breaks my heart that the scenery has been just transformed." Another said: "*I love living out—I live five miles out of town. I have this absolute beautiful country scenery. I don't want to look out my door and see this compression station that's up the hill. I don't."* And another remarked: "*I love being in the woods, and it's almost like ever since the industry came into the county, there's just less woods around. The land is just pretty much gettin' tore up. So to speak, they put it back, but it's just there's almost not the same feeling in the county as what there was 5, 6 years back.*" Another participant described the changes on the landscape this way: "*After the well is done or the pond's done, the land has to be put back to its original use, or if it's farmland, it has to be back into a field. If it was forest or woods, it has to be, trees have to be replanted…. It's still not the way it was before though. There's all these scars."*

For some residents, these changes inspired the feelings that they ought to become more politically involved to have some say over preserving what would happen to the land and to the places in which they lived. One focus group participant said:

> "*If I want to sustain life here, and I want my kids to grow up here in that same type of atmosphere that I did, that's not going to happen just sitting there thinking that, you really have to go to out and strive to achieve that, and it's easier said than done, and a lot of people who have joined in with us for that certain goal for the county, have dropped to the wayside because it's so stressful."*

Others either expressed a desire to leave or discussed encounters that they had had with other residents who were considering leaving the community. One respondent noted: "*I had someone say, did you lease your farm? I said, as a matter of fact, I don't own the rights on my farm, and that shut them up. I said, but I'll tell you this, if I did, I would have sold them. Me and my two kids would probably have moved someplace else.*" Another focus group participant described a situation in her own family, in which they live next to a property in which the owner has leased. She described an encounter between the landowner and her husband:

> "*He says, "You don't understand. You have no idea what it's gonna be like when these trucks are running up and down this road 24/7, all day long,… up and back and down the hill. Now the road's a mess. You have no idea." His comment to my husband was, "I don't wanna live here anyway. I'm gonna move out of here." I thought my husband was gonna choke him. I really did. He's like, "I'm glad you have that option because you have 100 plus acres and you think you're gonna get rich from it, cuz you're not."*

One participant expressed feelings of uncertainty about the trade-offs between the development and the loss of the natural beauty of the area: "*What about the people who actually like living here and want to live here? I feel like I have a split personality, or maybe I want the benefits but I don't want the challenge. I want my cake and eat it, too.*" This uncertainty echoes the uncertainty that was seen across many of the topic areas discussed in the focus groups. Participants in most focus groups expressed uncertainty about what the future would bring and about the balance of any short-term economic benefits and the long-term risks to their communities and natural resources.

Conclusions

This section describes data limitations, broad themes across the study counties and topics and key lessons from this phase of the research that will guide future research.

Limitations of the Data and Analyses

The quantitative and qualitative data analyses described here have some limitations that need to be understood when interpreting the research findings.

Aggregate Data: The secondary data are measured at the county level, and as such, are aggregate indicators at specific points in time. They cannot provide measures of the components that make up those aggregate data. For example, the population figures represent counts at specific points in time, but do not indicate the extent to which the population figures represent the degree to which residents have entered or exited the county or changes in the composition of that population.

Unit of analysis: The county level analyses are useful to identify overall effects within the broad communities hosting Marcellus Shale development. In addition, many common data sources are only available at the county or larger geographic unit level, such as the FBI Uniform Crime Reporting program, the Bureau of Economic Analysis, the National Agricultural Statistics, and the Pennsylvania Department of Revenue data. However, much of the Marcellus Shale development is concentrated at a much smaller scale (usually specific municipalities), rather than being evenly distributed throughout the counties. The county-level analysis likely misses localized effects of development that could occur due to a higher concentration of activity in a small area. Possible changes in these localities may be hidden in the county-level data because they are unavoidably combined with information from the county's less active areas. Thus, the results reflect the overall experience at the county level, and should not be interpreted as describing what may be occurring on a more localized basis.

Establishing Causality: The analyses described here cannot establish causality; instead, they assess associations in time. In other words, these analyses can only determine if changes in social conditions occurred that coincided with the period of Marcellus Shale development. Several other major changes occurred during the same time period (e.g., recession, housing downturn, floods resulting from Hurricane Irene and Tropical Storm Lee, and major local developments such as the casino in Washington County) , and it is difficult to separate the effects of these influences from the activity associated with Marcellus Shale development.

Limited Data Points during Marcellus Shale Development: Most of the data series are limited in the number of years during Marcellus Shale development (in most cases ending in 2010 or 2011). It is difficult to describe trends with only a few data points, particularly as the levels of activity varied over that time period. As additional data become available, future studies can more accurately portray trends during this period. In addition, this study focused on descriptive statistics; more multivariate and inferential statistics will be useful for describing trends and associating them with Marcellus Shale development. More years of experience (and thus more years of data) will create greater opportunity for deeper quantitative investigations comparing the experience of different counties relative to shale gas development.

Analyses Only Represent "the Boom" Stage: Relatedly, the data analyzed here were only from the early stages of the "boom" part of the development cycle, in which the most positive employment and income impacts can be anticipated. These data do not allow any determination of what is likely to occur in these counties when unconventional natural gas drilling inevitably slows or ends altogether, or how much activity will occur (in terms of wells and related development) before this time comes. Further, cumulative impacts of these activities in communities and on the landscape are not apparent because development is still in its relatively early stages. This project only has been able to consider the effects through this first stage; the full impacts and implications of the development will only be known once the bust is occurring. Importantly, many of the focus group participants understood this and expressed concern about what will happen when the bust occurs. This perspective was perhaps best represented by a respondent in one of the agriculture focus groups, who said "ask us in 10 years" in answer to the question about whether gas drilling will be good or bad for their region.

While not a complete bust, the downturn of drilling activity, which began in 2011, should provide an opportunity in future research to explore the implications of such a change, and particularly how local residents, businesses, service providers and others coped with the sudden decrease in activity. Because much of the secondary data lags by a year or two, it currently is not possible to do such analysis. The same limitation likewise occurs with examining the impact of using Act 13 funds to offset community challenges related to Marcellus Shale development. The Public Utility Commission's reports on Act 13 dollar allocations to local governments are currently available, as are the initial reports from the local governments about how those dollars are being spent. Yet an accurate and complete understanding of the impact of those dollars is impossible without putting them into the context of local government budgets, to identify specifically whether and how overall spending by local governments changed as a result of the monies. Anecdotes, focus group comments and some newspaper articles, for example, suggest that some local governments are simply substituting the Act 13 money on a dollar-for-dollar basis for road or other spending they had already been doing, freeing up General or Liquid Fuels Fund dollars for other non-Act 13 approved purposes. The local government audit report data for 2012 and 2013, necessary for such analysis, will not become available for several years.

Data Not Specific to Marcellus Shale: Causality is difficult to determine because the datasets used in this study were not created for the purpose of measuring the impacts of Marcellus Shale development. Many of the indicators are not exact measures of issues about which residents expressed the greatest concern. The indicators also may not reflect the exact nature of potential community changes related to Marcellus Shale development. Therefore, drawing direct connections between the drilling of wells and socio-economic changes in a community would be untenable without a greater understanding of the specific mechanisms by which those changes were occurring.

Difficult to Define Marcellus Shale Activity: The data, as they are collected, are not directly tied to Marcellus Shale activities. If data are collected and associated directly with activity, they are not reported in a consistent, quantifiable, publically available format. This is related to two difficulties. First, it is very difficult to identify the geographic locus of Marcellus Shale development. Wells are easily identifiable through Pennsylvania Department of Environmental Protection data, which include GPS coordinates, spud dates and other information specific to the on-site drilling activity. Yet wells are only one element in the overall development activity occurring in these counties, which includes (but is not

limited to) pipeline construction, compressor stations, water withdrawal and storage sites, pipe and other storage yards, maintenance facilities, regional offices, worker housing, truck traffic between infrastructure and wells, and road repair and upgrades. Many of these other activities occur far from specific well sites. In addition, the focus groups, anecdotes, press articles and the investigative team's experience indicate that much of this activity is carried out through a complex web of regional and local hubs involving myriad subcontractors, with the hubs varying by the stage of the process and location. For example, anecdotes and interviews suggest that many of the workers operating in Bradford County are based in the Williamsport area due to the greater availability of housing there. Towanda has many repair facilities, while much of the water comes from local collection points. Despite the geographic and interrelated complexities of these activities, only well locations are actively reported and tracked statewide. Water withdrawal sites are mapped by the Susquehanna River Basin Commission within that watershed, yet such transparency is less evident in other basins. Other Marcellus Shale-related activities are not comprehensively tracked or recorded, making it difficult to identify where impacts of such activity may be occurring. It is difficult to identify and examine the impacts of an activity when the locations of where those activities are occurring on the landscape are not known accurately or fully. This means that analysis of Marcellus Shale development must solely rely upon wells as the primary metric for Marcellus Shale development, even though it very much incompletely represents the scope, breadth and geographic locations of the unconventional gas development activity. Further, each component of the natural gas development process likely is linked to different kinds of community impacts. For example, the presence of transient workers is most likely linked to housing issues, but the location of wells is more directly linked to truck traffic and related concerns.

Further complicating defining and identifying Marcellus Shale activity is identifying which specific firms or workers are truly "Marcellus Shale-related." For example, if a local diner adds five employees due to an increase in business related to natural gas development, should these new employees be considered Marcellus Shale-related? Is the driver for a local stone quarry, who delivers aggregate for road repairs or well pad construction, Marcellus Shale-related, even though she is officially working for a local quarry? Is a mechanic who left his job with the local auto dealership to work for a sub-contractor servicing drilling equipment considered Marcellus-shale related, even though he has lived in the area most of his life? And if one of these employees is arrested for DUI or otherwise is involved in an accident, is this a Marcellus Shale-related event? An important corollary of this is that it is inappropriate to blame natural gas companies, subcontractors or workers for all the negative impacts the communities may be experiencing. This perpetuates a stereotype that has limited basis in fact.

Limited Set of Topics: The focus of this research project was largely on the broad aggregate social impacts and the experiences of specific institutions. However, issues that focus group participants repeatedly surfaced (yet were not specifically asked) included community relationships, quality of life and environmental quality. Water quality, particularly private drinking water supplies, arose multiple times. Respondents described their own experiences with tainted water supplies or the experiences of others they know. These kinds of experiences can serve to define the types and magnitude of the risks of development, and can combine to inform a narrative about the impacts of development in a particular place. They also can reveal divisions within a community and the perceived ability of the natural gas industry and regulators to control that risk. Other environmental concerns also were

mentioned, including air quality, integrity of ecological systems and wildlife habitat, fragmentation of forests and the beauty of landscapes they value. Relatedly, concerns were raised about the current and future quality of life in their communities. These concerns were related to changes in the relationships among community members and conflict among neighbors and groups within the community. These twin issues–community relationships and environmental quality–were linked in many focus groups participants' descriptions, and tied to their attachment to their communities.

Broad Themes and Overall Findings

Two main themes stand out from this project's findings, and relate directly to the directions needed for the next wave of this research project.

Differences between the qualitative and quantitative findings: Across several of the topical areas there were differences in findings between the aggregate secondary data results and the focus group results. In general, the secondary data reported relatively little aggregate change, yet the focus group participants (and advisory committee members) indicated significant change for specific groups, organizations and locations. As discussed previously, the majority of the secondary data that were used were aggregated to the county level. Therefore, pockets within counties were masked by county averages or county totals. In contrast, many of the focus group participants worked or were affiliated with agencies or organizations that may have been more exposed to the impacts of development or were living in those pockets of high impacts. Both of these levels of analysis are worthy for this study, and provide differing perspectives on the impacts of Marcellus Shale development. This does, however, point to a key finding of this research to date (discussed in the next section), and that is that the social and economic impacts of Marcellus Shale development are unevenly distributed across people, places and stages of development.

Distribution of Both Risks and Opportunities: Similar to the findings from previous "boomtown" research, the findings from this project suggest clearly that the impacts (both risks and opportunities for rewards) are distributed unevenly across people, across places and over time. People can differentially experience development because of their existing resources such as wealth and income that influence their ability to invest in areas of economic growth or manage problems such as rising housing costs; access to land and ownership of subsurface rights to gain financially from development; human capital in the form of education and training to work in occupations desired by the new economic opportunities; and personal social networks that allow them to seek economic opportunities or manage negative consequences of development. Communities also differ in their degree of pre-existing resources to respond to rapid development. For example, counties that invested in their county planning resources and staff have been able to respond more quickly to the needs of the industry in terms of leasing and land management and in terms of community needs for information and planning.

Geographic location influences the types of activity likely to occur, such as the quality of the shale, the presence of water for hydraulic fracturing, pipelines, existing transportation infrastructure (road, rail, air) and commercial facilities. Places like Williamsport (Lycoming County) and Canonsburg (Washington County), which are developing into regional "hubs" because of their location and proximity to major areas of well development, are likely to have differing sets of opportunities and risks than other

communities. They are well connected via road and rail to areas with a significant number of wells and have the commercial space to accommodate materials and office space needed for industrial growth. Further, communities with relatively little pre-existing housing stock and/or retail facilities are less able to "capture" the dollars locally, and will benefit less financially than other communities.

Finally, the pace of development will likely vary over time and by location, creating differing sets of risks and opportunities across time. As the productive capacity of some wells diminishes, drilling companies will likely exploit landholdings in other parts of the state. The ways in which the activity will move across the state, and at what time scale, are uncertain and unpredictable, and increases the challenges for communities as they try to plan for the changes associated with development.

Next Steps: Mapping the Risks and Opportunities Associated with Marcellus Shale Development

The next wave of the project will focus more explicitly on describing the distribution of risks and opportunities across people, places, and time. It will focus on defining the characteristics of communities and social groups that meaningfully affect their experiences of development. It also will focus on a more fine-grained depiction of those impacts within the study counties. The main methodological technique will be surveys and interviews. It is important not only for researchers, but more significantly for policy makers and local stakeholders, to understand what the opportunities and risks are, how they are distributed over time and space and how they affect different segments of local populations. Pennsylvania will be far better placed to make informed policy decisions that can help to minimize risks and maximize opportunities for Pennsylvanians, both in the short- and long-term.

Policy Considerations

This research was intended to provide a baseline for identifying and understanding the impact of gas development on Pennsylvania counties with the highest levels of Marcellus Shale drilling activity. As has been described in this final report and in the topical reports, the influence of Marcellus Shale development goes well beyond that associated with drilling to encompass the full set of activities associated with Marcellus Shale development (construction of pipelines and compressor stations; water withdrawal sites; sand and gravel mining; and transport of large volumes of water, materials and large equipment) and the secondary effects on local communities and residents. Some impacts are felt immediately—increases in truck traffic, for example—while others occur over time. Some impacts affect a large share of the local population, again traffic is a good example of this, but most others are experienced by subsets of the population and depend on the characteristics of those individuals and where they live. The variations in who is affected, when, and how they are affected make it more challenging to identify impacts, especially using existing data sets. Changes affecting subgroups of the population (for example, low income families) are more readily identified by staff and volunteers in the relevant human services and nonprofit organizations or by communicating with members of those groups directly.

The rapidity with which some changes occur and the speed with which gas companies enter and leave local areas make it difficult to suggest one particular strategy that might be used to minimize negative

effects and make the most of the opportunities associated with Marcellus Shale development. Short- and longer-term impacts occur and both short- and longer-term policy strategies are needed. In addition, policies specific to each topic area may be necessary, but also require coordination across topics to avoid redundancy, conflict, and unintended consequences.

Three overall policy goals are identified first. These are followed by topic-specific considerations.

The first overall policy consideration is to increase capacity to identify problematic change and implement collaborative strategies to respond as quickly as possible. The second is to increase capacity to identify and collaboratively plan for future expected and unexpected change, thus improving the ability to take advantage of opportunities and minimize risks and problems associated with change. There are several specific strategies related to this second consideration. The final policy consideration relates to improving the data available to identify and understand change. These considerations apply to Pennsylvania's communities affected by Marcellus Shale development, but also to those impacted by other types of change, such as suburban sprawl, economic change, or population decline.

Increase Capacity to Identify and Respond Quickly to Change

There needs to be a means for timely communication between natural gas companies and local officials (at regional, county and local levels) so that natural gas companies can share what they know of their plans to enable local jurisdictions to prepare and respond more quickly and effectively. For example, natural gas companies could be encouraged to work with local planning offices and those who work in various aspects of housing (e.g., realtors, hotel and motel managers, housing authorities) to detail needs for housing or other services in advance of the natural gas companies' presence in the region. Strategies to encourage regular communication, cooperation and coordination among those responding to changes resulting from Marcellus Shale development across the local area/region need to be identified and implemented. Areas affected most initially include roads and traffic management, law enforcement, housing, and water-related utilities and management organizations. For example, local committees can be encouraged and supported with financial and technical resources to bring together key stakeholders (natural gas company representatives, local housing agencies and nonprofit organizations, private sector developers, environmental organizations, municipal governments) to identify reasonable short-term solutions to major concerns. Consideration of longer terms strategies would then allow for timely development of options, such as new housing options. A number of counties have developed task forces that have effectively begun to address issues associated with natural gas development. However, there has been, to date, little financial or technical support provided to task forces to facilitate their work.

Increase Capacity to Cooperate Across Municipal and Organizational Boundaries

A second, important and fairly consistent theme across the focus groups and advisory group discussions was a need to increase the capacity of involved entities to plan for and proactively respond to Marcellus Shale development, and to do so cooperatively. The concerns expressed include a need for

more information, training and the ability to respond, as well as more effective ways to work across jurisdictions and across governmental, nonprofit and for-profit organizations.

Pennsylvania's system of local government, with many autonomous jurisdictions, has been a strength throughout the commonwealth's history. Citizens have easier access to municipal governments than county or state government due to their local nature. Residents typically feel they have a greater voice in the local decisions that affect their lives. But, this multiplicity of local governments may be a hindrance with regard to responding to the opportunities and challenges arising from Marcellus Shale development. Many of the municipal governments in the Marcellus Shale region have relatively small populations, with part-time supervisors and one or no paid staff, and thus lack capacity and resources for detailed and on-going planning. This applies to county government as well. For example, one larger county in the Marcellus Shale region has almost 30 permanent staff in their county planning office, while a neighboring county has only one staff person in that position. More importantly, natural gas development activity is truly regional in scope, with work crews and firms moving frequently between municipalities and counties. The infrastructure supporting Marcellus activity, such as water withdrawal sites, compressor stations, worker housing, material storage sites, maintenance facilities, and quarries for aggregate have regional "catchments." Expecting individual governments to plan for and respond appropriately to this regional and often fast-moving development on their own is unrealistic, if not impossible. In addition, decisions made in one jurisdiction affect neighboring jurisdictions and often result in a patchwork of land uses, sometimes with conflicting land uses located next to each other but across municipal boundaries. The patchwork does not maintain desired attributes of places nor make the most effective use of resources.

Thus, there is a need to encourage development of regional collaborations across local governments to coordinate their activities, communicate and collectively plan for and track major changes related to Marcellus Shale development, and ultimately other forms of development. Such collaborations need to be across county lines, just like Marcellus Shale activity (and most other modern development), rather than county-by-county. A regional effort also reduces competition between municipalities or counties for preferred land uses, a practice that can reduce benefits for all. Regional planning entities could be empowered with specific authority for the broad range of planning issues related to Marcellus Shale, for example, and given the authority to convene region-wide efforts to bring together municipal and county officials and planning staff to examine these issues. Incentives could be offered to county and municipal planning agencies to work with regional entities to build and implement a regional planning framework. Final decisions on implementing change would need to remain at the local level.

Increase Availability of Planning and Technical Staff Support

In addition to increased regional communication and collaboration, there is a need to increase the capacity of municipal and county governments to plan for and respond to the opportunities and challenges of Marcellus Shale (and other) activity. This includes continued education for local officials, such as has been offered by the Governor's Center for Local Government Services and the state's local government associations. Yet education by itself does little to help local governments without sufficient staff to focus on these issues. There is a need to explore ways of providing specific assistance to local

governments, such as could be done through the regional planning collaboration mentioned above. In addition, circuit-rider-style assistance in planning should be explored, in which trained planning, code enforcement, public safety and perhaps community education personnel could work for a group of neighboring local governments. By its nature, this would increase local capacity within each local government at much lower cost than having each jurisdiction hire its own staff, and via the circuit-rider role, would automatically increase collaboration, coordination, and communication between the jurisdictions. The circuit riders could report to the regional entity or county planning offices (assuming the county offices have adequate resources to provide oversight and direction).

Increase Coordination among State Agencies

It would be useful if state agencies themselves provided clearer communication, coordination and collaboration on Marcellus Shale-related issues, such as between the state agencies of Environmental Protection, Conservation and Natural Resources, Community and Economic Development, Education, Transportation, Public Welfare, Labor and Industry, and Health. Such coordination may already be occurring behind the scenes, yet there would be great value to enhanced visibility of such efforts. Policy decisions on this issue by one department can have clear implications and impact on other departments. In addition, greater communication can assist with responding appropriately to opportunities or challenges as they arise. A potential model for such collaboration is the Interagency Land Use Task Force that operated during the Rendell administration. Members of the Task Force included representatives from the policy offices in the state agencies that have major responsibilities for or impact on land use within Pennsylvania, and they met monthly to update each other on their department's activities. A similar approach may be very effective regarding Marcellus Shale.

Increase Availability of Timely, Adequate Information for Decision-Making

One of the consistent findings across all the thematic areas is that much of the information necessary to fully track and understand the impacts of Marcellus Shale development is not being consistently collected or reported. Without such information, it is extremely difficult to identify opportunities and challenges that should be addressed, much less how Marcellus Shale activity is affecting local communities, services, economies, and residents.

Thus, there is need for a more proactive and intentional system for collecting information on key factors that may be affected by Marcellus Shale activity. Several state agencies, including the Department of Community and Economic Development, Department of Environmental Protection, Department of Labor and Industry, and Department of Health, already track and report some information pertinent to Marcellus Shale activity. It is likely that they could increase the breadth of the information they collect to better measure impacts of Marcellus activity at much lower cost than other entities, because they already have the structure, systems and personnel required to gather and report such information.

The data collection and reporting process needs to be transparent, with the information readily available to the general public. This is currently being done by many of the agencies mentioned above; for example, the Department of Environmental Protection's website with well data, Labor and Industry's

'Fast Facts' on Marcellus-related employment, and the Department of Community and Economic Development's local government financial statistics are all excellent examples of how critical information can be made easily available to the public. The concern with some of these data is the lag in making the data available to the public. Other data are collected at the national level but not frequently. For example the Census of Agriculture is conducted every 5 years, providing no insight into changes in agriculture in the intervening period.

The research team identified specific areas where additional information would be of great use to local and state officials, citizens, state agencies, researchers and others in understanding the impacts of Marcellus Shale development. These types of information or changes in behaviors were often identified by the focus group members – individuals who work closely with people in the areas affected by Marcellus Shale development.

Health Data. There is need for the collection of healthcare use and health status indicator data related to Marcellus Shale and other changes that occur. This is required to establish a 'baseline' of the health of the population in Pennsylvania at a given time, but also to allow for comparison in the future. Identifying whether there are changes in health status associated with Marcellus Shale activity requires the collection of the same information over time. This includes health status of residents living near Marcellus activity as well as individuals who do not live near Marcellus activity. The health status of workers in the industry also should be considered. If conceived of more broadly, such a data system would provide the ability to monitor changes in the health status of the residents of Pennsylvania over time, improving the ability to project changes in health and the need for health services.

Healthcare providers and public health professionals should be a key resource in such an effort to identify the effectiveness of current health data collection efforts, and what additional patient and consumer healthcare use and health status indicators are necessary to assess the relationship between these data and Marcellus Shale drilling activity and other changes that might occur in the future.

Vulnerable Populations. While Marcellus Shale development is spurring economic growth, evidence also suggests that it is creating insecurity for some local residents unable to take advantage of new economic opportunities. Consequences identified in focus groups include increases in residential displacement and homelessness, including among school-aged children. This occurred in areas that previously had experienced little or no homelessness. It is important that data collection explicitly focus on vulnerable populations in the counties with Marcellus Shale activity, including issues such as housing, homelessness and income. The data need to be collected so that they can be examined at multiple scales (municipal, county) and across multiple places. These data would be useful to policy makers and program providers in Marcellus areas, but also across the commonwealth.

Ownership of Mineral Rights. As the state tax data indicate, the largest beneficiaries of Marcellus Shale activity are mineral right owners, who receive the lease and royalty dollars generated by natural gas extraction. There are no clear, easily accessible records of mineral right ownership in Pennsylvania, which means no one really knows who these beneficiaries are, how many of them live in the counties with drilling or live elsewhere in Pennsylvania, and how many live outside the commonwealth. Furthermore, it isn't clear how much of this mineral right ownership is by individuals and families versus companies. Indeed, many surface owners are themselves unaware of the ownership status of the subsurface rights for their own properties.

Because surface and mineral rights can be severed, mineral right ownership information should be readily available to the public. There are no clear records about where such rights have been severed, much less what percentage of the land area has been severed from the underlying mineral rights. Anecdotes and experience suggest that this is fairly common in the areas of western Pennsylvania where coal, oil and prior natural gas development has occurred. The lack of such openness about mineral right ownership makes it difficult for surface owners to learn who may own the mineral rights under their land, provides neighbors with no information about who actually controls decisions about natural gas extraction on nearby land, and similarly creates major difficulties and higher costs for the gas companies trying to learn the same information. It also makes it impossible to accurately identify who is receiving the economic benefits of shale gas development. Such public blindness about mineral rights contrasts strongly with the clear public records and reporting of land ownership. County governments carefully track and record surface ownership, with the information easily available to the public through county planning departments and tax assessment offices. Mineral right ownership also needs to be tracked and made available to the public.

School District Enrollments and Turnover. The Pennsylvania Department of Education tracks and reports school district enrollments annually. This has allowed enrollment trends in the Marcellus Shale region to be examined. Enrollments generally have continued their declines. The currently collected annual data do not, however, measure student turnover (students leaving and new students entering) within districts. The result is policy makers and local stakeholders may underestimate the degree to which student transiency is occurring across the region and how student movement may or may not be associated with the development of the gas industry. The collection of such data could be added to information requested from school districts as part of the enrollment data reporting. Student transiency increases costs for school districts, can disrupt classrooms and can be harmful to the educational success of transient students if these students do not receive needed assistance.

Local Government Audit Data. For more than 40 years, the Pennsylvania Department of Community and Economic Development has collected annual audit data from Pennsylvania local governments, including municipalities and counties. This rich data set allows comparisons of revenues and expenditures over time, and across counties and types of governments, and is a very useful resource. The available data from county governments, however, has lagged or been inconsistent in the past years (for example, data from Bradford and several other counties is missing from the 2010 and 2011 data sets), which makes it difficult to look at trends over time. Such gaps likely result more from action (or inaction) by the local jurisdictions than from the state agency, but regardless, need to be addressed.

Revenue. It is important to recognize that school districts and the county and municipal governments that own land leased for natural gas extraction may receive significant revenues from leasing and royalties; these are direct financial benefits. Yet the amount they receive will not relate directly to the overall costs they may experience across their jurisdiction. In addition, some may be tempted to use these windfalls for basic operations (keeping taxes low in the years the monies are received) rather than use the monies for capital expenditures and other investments in their communities' future. Given the uncertainty and relatively short-term nature of natural gas leasing and royalty income, these funds may be most effectively used to address short-term or special needs or projects, or invested to generate longer-term revenue streams. The natural gas money provides a great opportunity for local jurisdictions

to: provide increased services to those affected negatively by housing shortages; improve infrastructure; or create parks or other investments to be enjoyed by current and future generations.

Alternatively, some portion of natural gas revenues coming to local and state government now could be put in trust to cover the costs of uncertain or unknown environmental damage resulting from current natural gas extraction activity. Current generations of Pennsylvanians are paying for acid mine drainage that was created by natural resource extraction carried out by an earlier generation. Properly targeted, the Act 13 dollars could be used to help future residents deal with unknown issues that may arise from unconventional natural gas extraction.

Data Collection and Tracking System: In addition to the specific areas noted above, there needs to be a system through which data could be collected on key indicators of community and economic well-being that would inform and influence the allocation of impact fees generated through Act 13. For example, increased numbers of arrests for driving under the influence, as noted in Report #6, puts additional burdens on law enforcement, the courts, and drug and alcohol treatment providers. Tracking the numbers within each county on a timely basis would provide needed information for allocation of funds. Such a data collection system would need to be consistent across jurisdictions and conducted over time to adequately gauge demand and capacity. In addition, this system would need to be supported through staffing to provide technical assistance and statistical analyses for local government units. Additional research is also needed to identify potential thresholds of activities beyond which additional staffing is needed. In other words, at what point is the capacity of a community service agency maximized, and additional investments in staff needed to accommodate growth?

Topic-Specific Considerations

In addition to the general considerations described above, the findings from the individual topical analyses in this project lead to the following policy considerations:

Population: The population data revealed the difficulty of tracking the influx of gas workers using traditional data sources that count the population. Other ways of counting temporary residents need to be identified. This could include working with gas companies to encourage them to share the numbers of workers they plan to send to particular areas, and determining how many related workers come in support of gas extraction activities. This information can help local and state officials plan for increased demand for some services and facilities, and the need for increased enforcement efforts related to traffic violations. Local businesses, such as restaurants, could use this information to plan for increased business activity.

Health and Health Care Services: The data suggest the need to support funding for the Pennsylvania Department of Health to collect healthcare use and health status indicator data related to Marcellus Shale drilling activity so that baseline data can be established against which future data collection activity can be assessed. In addition, healthcare providers need assistance assessing current data collection efforts for patients and consumers on healthcare use and health status indicators to assess the relationship between these data and Marcellus Shale drilling activity.

Education: State-level education data would appear to suggest that school demographics and student outcomes show little, if any, effect from the development of Marcellus Shale. Overall, enrollments

across much of the region have continued to show slow and steady declines (as opposed to the enrollment spikes anticipated by some educators), and there similarly appears to be little, if any, impact on the demographic composition of students attending public schools in the study counties. However, the focus group data with educators and students across the study counties describe impacts that may not be discernable through aggregated district data, including concerns about public safety for students, increased risk of dropout among at-risk students, changes in post-secondary aspirations, and changes in community satisfaction. Youth in particular expressed concern with changes affecting their communities, and with the possibilities for family-sustaining, local jobs associated with the gas industry. For these reasons, it will be important for policy makers interested in the impacts of shale gas development on schools and youth to rely on several data sources, including data that records the direct experiences of local residents representing a variety of segments of the community.

Housing: The influx of individuals working or seeking jobs in the gas industry and related activities (pipeline construction, site preparation) increases the demand for housing, raising rents and potentially displacing long-time residents. These effects are larger in areas with smaller populations and housing stocks. Strategies to increase housing for gas workers, such as converting existing structures (e.g., empty school buildings) to efficiency or one-bedroom units would meet the immediate housing needs of gas workers, but could then be repurposed to meet the housing needs of elderly and/or low-income individuals or families when gas workers move on. Funds from Act 13 dollars could be set aside to provide a supplement to Section 8 funds to enable low-income renters to afford local housing priced above Section 8 limits, to pay for emergency housing for displaced residents and support homeless shelters. The impact of gas workers living in campgrounds, hotels and motels on the local tourism industry needs to be examined, especially in areas that were heavily reliant on tourism prior to Marcellus Shale development.

Crime: The analyses of data related to criminal activity indicate that measures of calls for service to which the Pennsylvania State Police responded, traffic offenses, and driving under the influence were higher during periods of Marcellus Shale development in most of the study counties. Other indicators were higher for individual counties. Because of the public safety concerns these offenses pose, there needs to be greater attention paid to resources available for law enforcement agencies and the court systems (primarily common pleas and magisterial) that process these offenses. Additional funds could also be used for targeted enforcement activities. Further, support could be provided for additional outreach with natural gas companies and subcontractors to address these issues. At the state level, Act 13 funds could be provided to the Pennsylvania State Police to offset increased demand for its services, particularly in municipalities in which the PSP provides full- and part-time coverage.

Agriculture: Based on the concerns expressed during the focus groups, and because of the importance of water for agricultural production, it seems reasonable to recommend policies to mandate more intensive water monitoring throughout the Marcellus region. Because the Marcellus drilling development has increased property values, policies may be needed to facilitate intergenerational transfer of farmland to facilitate farming, such as legal and other services related to succession planning.

Conclusion

The study's findings demonstrate that the benefits and risks of Marcellus Shale development are unevenly distributed across places, over time and across groups. State and local public policy needs to be attuned to these differences, and adjusted as required as more is learned about how the development is affecting Pennsylvania communities, residents and the environment. Acknowledging these risks and opportunities and understanding who is most likely to benefit—or not–will be critical to managing development over time in ways that recognize the diversity of Pennsylvania's local economies and are environmentally, economically and socially sustainable.

References

Abdalla, C.W. 2010. *Water Withdrawals for Development of Marcellus Shale Gas in Pennsylvania*. Marcellus Education Fact Sheet. University Park, PA: Penn State College of Agricultural Sciences, Cooperative Extension.

Adams, R. and T.W. Kelsey. 2012. "Pennsylvania Dairy Farms and Marcellus Shale, 2007 – 2010."
Marcellus Education Fact Sheet. University Park, PA: Penn State Cooperative Extension.

American Community Survey: Selected Population Profile (Pennsylvania). US Census Bureau. 2005/07 3-year ACS data. http://factfinder2.census.gov/. Accessed August 2012.

Axinn, W.G., and L.D. Pearce. 2006. Mixed method data collection strategies. New York: Cambridge University Press.

Boden, L.I. and E.A. Spieler. 2001. Social and Economic Impacts of Workplace Illness and Injury: Current and Future Directions for Research. *American Journal of Industrial Medicine*, 40:398-402.

Brasier, K.J., M.R. Filteau, D.K. McLaughlin, J. Jacquet, R.C. Stedman, T.W. Kelsey, and S.J. Goetz. 2011. "Residents' Perceptions of Community and Environmental Impacts from Development of Natural Gas in the Marcellus Shale: A Comparison of Pennsylvania and New York Cases." *Journal of Rural Social Sciences*. 26(1): 32-61.

Brown, R.B., S.F. Dorius, and R.S. Krannich. 2005. "The Boom-Bust-Recovery Cycle: Dynamics of Change in Community Satisfaction and Social Integration in Delta, Utah." *Rural Sociology* 70(1): 28-49.

Brundage, T.L., J. Jacquet, T.W. Kelsey, J.R. Ladlee, J. Lobdell, J.F. Lorson, L.L. Michael, and T. Murphy. "Pennsylvania Statewide Marcellus Shale Workforce Needs Assessment." Marcellus Shale Education and Training Center. Summer, 2011. 60 pages.

Bureau of Economic Analysis. 2007. Regional Economic Accounts: Local Area Personal Income." Washington, D.C.: U.S. Department of Commerce. http://www.bea.gov/regional/pdf/overview/regional_lapi.pdf.

Bureau of Economic Analysis. Local Areas Personal Income and Employment. 2007 through 2011. http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=5#reqid=70&step=1&isuri=1.

Bureau of Justice Statistics. N.d. Criminal Justice System Flowchart. URL: http://bjs.ojp.usdoj.gov/content/largechart.cfm. Accessed January 16, 2013.

Bureau of Labor Statistics Spotlight on Statistics: The Recession of 2007-2009. US Bureau of Labor Statistics. http://www.bls.gov/spotlight/2012/recession/. Accessed October 25, 2012.

Bureau of Labor Statistics. 2012. “Quarterly Census of Employment and Wages.” Washington, D.C.: U.S. Department of Labor. http://www.bls.gov/cew/.

Bureau of Labor Statistics: Quarterly Census of Employment and Wages Databases. 2007 through 2011. http://www.bls.gov/cew/data.htm.

Camasso, M.J. and K.P. Wilkinson. 1990. “Severe Child Maltreatment in Ecological Perspective: The Case of the Western Energy Boom.” *Journal of Social Service Research* 13(3): 1-18.

Center for Workforce Information and Analysis. 2011. “Marcellus Shale Fast Fact.” Harrisburg, PA: Pennsylvania Department of Labor and Industry. Multiple months.

Centers for Disease Control and Prevention, National Center for Health Statistics. *NCHS Data on Injuries*. http://www.cdc.gov/nchs/data/factsheets/factsheet_injury.htm. Accessed July 15, 2012.

Centers for Medicare and Medicaid Services (CMS). 2013. *Community Mental Health Center Fact Sheet.* http://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandComplianc/CommunityHealthCenters.html. Accessed July 15, 2012.

Centers for Medicare and Medicaid Services (CMS). 2013. *Federally Qualified Health Center Fact Sheet.* http://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/downloads/fqhcfactsheet.pdf. Accessed July 15, 2012.

Centers for Medicare and Medicaid Services (CMS). 2013. *Rural Health Clinic Fact Sheet.* http://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/downloads/RuralHlthClinfctsht.pdf. Accessed July 15, 2012.

Centers for Medicare and Medicaid Services. http://www.cms.gov/. Provided July 15, 2013.

Coleman, J.L., R.C. Milici, T.A. Cook, R.R. Charpentier, M. Kirschbaum, T.R. Klett, R.M. Pollastro, and C.J. Schenk. 2011. *Assessment of Undiscovered Oil and Gas Resources of the Devonian Marcellus Shale of the Appalachian Basin Province, 2011*. Fact Sheet 2011-3092. Reston, VA: US Geologic Survey.

Considine, T.J., R. Watson, and S. Blumsack. 2010. “The Economic Impacts of the Pennsylvania Marcellus Shale Natural Gas Play: An Update.” University Park, PA: College of Earth and Mineral Sciences, Pennsylvania State University.

Corbin, J.M. and A.L. Strauss. 2008. Basics of qualitative research. Thousand Oaks, CA: Sage.

Creswell, J.W. 1998. Qualitative inquiry and research design: Choosing among five traditions. Thousand Oaks, CA: Sage.

Creswell, J.W. 2013. Research design: qualitative, quantitative and mixed methods approaches. Thousand Oaks, CA: Sage.

Criminal Justice Information Services Division, 2013. *National Incident-Based Reporting System (NIBRS) User Manual*. US Department of Justice, Federal Bureau of Investigation. URL:http://www.fbi.gov/about-us/cjis/ucr/additional-ucr-publications/ucr_handbook.pdf. Accessed June 3, 2013.

Dell, B.P., N. Lockshin, and S. Gruber. 2008. “Bernstein E&Ps: Where Is the Core of the Marcellus?” Report published by Sanford C. Bernstein and Co., LLC, a subsidiary of AllianceBernstein L.P. New York, NY.

DEP Office of Oil and Gas Management: Wells Drilled by County. Pennsylvania Department of Environmental Protection. http://www.depreportingservices.state.pa.us/. Accessed July 4, 2013.

Dimitri, C., A. Effland, and N. Conklin. 2005. *The 20th Century Transformation of U.S. Agriculture and Farm Policy.* USDA ERS (http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib3.aspx).

Economic Research Service, USDA. 2013. Rural-Urban Continuum Codes: Documentation. http://www.ers.usda.gov/data-products/rural-urban-continuum-codes/

Engelder, T. 2009. "Marcellus." *Fort Worth Basin Oil & Gas Magazine*. August: 18-22.

England, J.L. and S.L. Albrecht. 1984. "Boomtowns and Social Disruption." *Rural Sociology* 49: 230-46.

Farren, M., A. Weinstein, M. Partridge and M. Betz. 2013. Too Many Heads and Not Enough Beds: Will Shale Development Cause a Housing Shortage? The Swank Program in Rural-Urban Policy, Ohio State University, Columbus, Ohio. Retrieved from http://go.osu.edu/shale_housing_rpt.

Ferrar, K.J., J. Kriesky, C.L. Christen, L.P. Marshall, S.L. Malone, R.K. Sharma, D.R. Michanowicz, and B.D. Goldstein. 2013. Assessment and longitudinal analysis of health impacts and stressors perceived to result from unconventional shale gas development in the Marcellus Shale region. *International Journal of Occupational and Environmental Health*, 19(2):104-12.

Finkel, M.L., J. Selegean, J. Hays, and N. Kondamudi. 2013. "Marcellus Shale Drilling's Impact on the Dairy Industry in Pennsylvania: A Descriptive Report." *New Solutions* 23(1): 189- 201.

Freudenburg, W.R. 1982. "Balance and Bias in Boomtown Research." *Pacific Sociological Review* 25:323-338.

Freudenburg, W.R. and L.J. Wilson. 2002. "Mining the Data: Analyzing the Economic Implications of Mining for Nonmetropolitan Regions." *Sociological Inquiry* 72(4): 549-575.

Freudenburg, W.R., and R.E.]ones. 1991. "Criminal Behavior and Rapid Community Growth: Examining the Evidence." *Rural Sociology* 56(4);619-645.

Freudenburg, W.R., L.M. Bacigalupi, and C. Landoll-Young. 1982. "Mental Health Consequences of Rapid Community Growth: A Report from the Longitudinal Study of Boomtown Mental Health Impacts." *Journal of Health and Human Resources Administration* 4(3): 334-351.

Frey, J. 2011. "The Future of the Pennsylvania Dairy Industry with the Impact of Natural Gas." Presentation to Dairy Industry Stakeholders. December 1. Harrisburg, PA: Center for Dairy Excellence.

Geographic Identifiers (G001). 2010 Census Summary File 2 (SF2). Decennial Census. US Census Bureau. http://factfinder2.census.gov/. Accessed October 6, 2012.

Gramling, R. and W.R. Freudenburg. 1990. "A Closer Look at 'Local Control': Communities, Commodities, and the Collapse of the Coast." *Rural Sociology* 55(4): 541-558.

Harper, J.A. 2008. "The Marcellus Shale – An Old "New" Gas Reservoir in Pennsylvania." *Pennsylvania Geology* 38:2-13.

Headwaters Economics. 2009. "Fossil Fuel Extraction as a County Economic Development Strategy: Are Energy-focusing Counties Benefiting?" Bozeman, MT. Headwaters Economics.

Herzenberg, S. 2011. "Drilling Deeper into Job Claims: The Actual Contribution of Marcellus Shale to Pennsylvania Job Growth." Harrisburg, PA: Keystone Research Center.

Hoppe, R. and P. Korb. 2006. *Understanding U.S. Farm Exits.* USDA Economic Research Service. Retrieved November 21, 2012. http://ers.usda.gov/publications/err-economic-research-report/err21.aspx.

Howarth, R.W., R. Santoro, and A. Ingraffea. 2011. "Methane from the Greenhouse-Gas Footprint of Natural Gas from Shale Formations. *Climatic Change*. 106: 679-690.

Hunter, L.M., R.S. Krannich and M.D. Smith. 2002. "Rural Migration, Rapid Growth, and Fear of Crime." *Rural Sociology* 67(1): 71-89.

Jacobson, M. and T.W. Kelsey. "Impacts of Marcellus Shale Development on Municipal Governments in Susquehanna and Washington Counties, 2010." Penn State Cooperative Extension. Marcellus Education Fact Sheet. 2011.

James, A. and D. Aadland. 2011. "The Curse of Natural Resources: An Empirical Investigation of U.S. Counties." *Resource and Energy Economics*. 33: 440-453.

Johnson, N. 2010. *Pennsylvania Energy Impacts Assessment: Marcellus Shale Natural Gas and Wind*. Arlington, VA: The Nature Conservancy.

Kelly, A. 2012. Estimating Migration to Pennsylvania Counties Due to Marcellus Shale Drilling. M.S. thesis in Rural Sociology and Demography. The Pennsylvania State University.

Kelsey, T.W., A. Metcalf, and R. Salcedo. 2012. "Marcellus Shale: Land Ownership, Local Voice, and the Distribution of Lease and Royalty Dollars." Center for Economic and Community Development White Paper Series. University Park, PA: Penn State University.

Kelsey, T.W., and M.M. Ward. 2011 "Natural Gas Drilling Effects on Municipal Governments Throughout Pennsylvania's Marcellus Shale Region, 2010." Penn State Cooperative Extension. Marcellus Education Fact Sheet.

Kelsey, T.W., M. Shields, J.R. Ladlee, and M. Ward. 2012a. "Economic Impacts of Marcellus Shale in Bradford County: Employment and Income in 2010." Marcellus Shale Education and Training Center.

Kelsey, T.W., M. Shields, J.R. Ladlee, and M. Ward. 2012b. "Economic Impacts of Marcellus Shale in Sullivan County: Employment and Income in 2010." Marcellus Shale Education and Training Center.

Kelsey, T.W., M. Shields, J.R. Ladlee, and M. Ward. 2012c. "Economic Impacts of Marcellus Shale in Susquehanna County: Employment and Income in 2010." Marcellus Shale Education and Training Center.

Kelsey, T.W., M. Shields, J.R. Ladlee, and M. Ward. 2012d. "Economic Impacts of Marcellus Shale in Tioga County: Employment and Income in 2010." Marcellus Shale Education and Training Center.

Kelsey, T.W., M. Shields, J.R. Ladlee, and M. Ward. 2012e. "Economic Impacts of Marcellus Shale in Wyoming: Employment and Income in 2010." Marcellus Shale Education and Training Center.

Kelsey, T.W., M. Shields, J.R. Ladlee, and M. Ward. 2011. "Economic Impacts of Marcellus Shale in Pennsylvania: Employment and Income in 2009." Marcellus Shale Education and Training Center.

Kelsey, T.W., R. Adams, and S. Milchak. 2012. Real Property Tax Base, Market Values, and Marcellus Shale: 2007-2009. CECD Research Paper Series. http://cecd.aers.psu.edu

Kinnaman, T.C. 2011. The Economic Impact of Shale Gas Extraction: A Review of Existing Studies. Ecological Economics. Pp. 1243-1249.

Klinger, D.A., and George S. Bridges. 1997. "Measurement error in calls-for-service as an indicator of crime." *Criminology* 35(4):705-726.

Kohrs, E.V. 1974. *Social Consequences of Boom Town Growth in Wyoming*. Paper presented at the Rocky Mountain American Association of the Advancement of Science Meeting, April 24-26. Laramie, Wyoming.

Kowalski, L. and G. Zajac. 2012. *A Preliminary Examination of Marcellus Shale Drilling Activity and Crime Trends in Pennsylvania*. Justice Center for Research, Pennsylvania State University.URL: http://justicecenter.psu.edu/research/documents/MarcellusFinalReport.pdf.

Krannich, R.S., T. Greider and R.L. Little. 1985. "Rapid Growth and Fear of Crime: A Four-Community Comparison." *Rural Sociology* 50 (2): 193-209.

Krannich, R.S. 2012. "Social Change in Natural Resource-based Rural Communities: The Evolution of Sociological Research and Knowledge as Influenced by William R. Freudenburg." *Journal of Environmental Studies and Sciences* 2(1):18-27. Accessed July 11, 2013.

Kreisky, J. 2013. "Health Issues and Concerns Related to Unconventional Gas Development." Southwest Pennsylvania Environmental Health Project. http://www.environmentalhealthproject.org/.

Lee, D.S., J.D. Herman, D. Elsworth, H.T. Kim, and H.S. Lee. 2011. "A Critical Evaluation of Unconventional Gas Recovery from the Marcellus Shale, Northeastern United States." *KSCE Journal of Civil Engineering* 15(4):679-687.

Levy, M. 2010. "Drillers Rack Up 1,400 Violations. *Centre Daily Times*. Aug. 4. A1+.

Lockie, S., M. Franettovich, V. Petkova-Timmer, J. Rolfe, and G. Ivanova. "Coal Mining and the Resource Community Cycle: a Longitudinal Assessment of the Social Impacts of the Coppabella Coal Mine." Environmental Impact Assessment Review 29, no. 5 (2009): 330–339.

Lycoming County Department of Planning & Community Development. 2012. The Impacts of the Marcellus Shale Industry on Housing in Lycoming County. Retrieved from http://www.lyco.org/Departments/PlanningandCommunityDevelopment.aspx.

Malin, S. 2013. "There's no real choice but to sign: neoliberalization and normalization of hydraulic fracturing on Pennsylvania farmland." *Journal of Environmental Studies and Sciences.* http://link.springer.com/article/10.1007%2Fs13412-013-0115-2. Accessed July 10, 2013.

McDermott-Levy, R. and N. Kaktins. 2012. "Preserving health in the Marcellus region." *Pennsylvania Nurse* September, 67(3):4-10.

McLaughlin, D.K., M.A. Martin, A.L. Gunsallus, K. Brasier and K.D. Davis. 2012. "Does Marcellus Shale Natural Gas Extraction Contribute to Increasing Inequality Among Pennsylvania's Families and Communities?" Paper presented at the Annual Meeting of the Rural Sociological Society, Chicago, Il., August.

Milici, R.C. and C.S. Swezey. 2006. *Assessment of Appalachian Basin Oil and Gas Resources: Devonian Shale – Middle and Upper Paleozoic Total Petroleum System*. Open-File Report Series 2006-1237. Reston, VA: US Geologic Survey.

National Highway Transportation Safety Administration (NHTSA), 2013. Emergency Medical Services. http://www.ems.gov/mission.htm. Accessed July 2, 2013

Negro, S.E. 2012. "Fracking Wars: Federal, State and Local Conflicts over the Regulation of Natural Gas Activities." *Zoning and Planning Law Report*. 35(2):1-16.

Parkins, J.R and A.C. Angell. 2010. "Linking Social Structure, Fragmentation, and Substance Abuse in a Resource-based Community." *Community, Work and Family* 14(1): 39–55.

Pearson, I., P. Zeniewski, F. Gracceva, P. Zastera, C. McGlade, S. Sorrell, J. Spears and G. Thonhauser. 2012. *Unconventional Gas: Potential Energy Market Impacts*. Petten, The Netherlands: European Commission, Joint Research Centre.

Pennsylvania Certified Organic. 2012. *Guidance for Natural Gas Exploration and Drilling on Certified Organic Farms.* http://www.paorganic.org/forms.

Pennsylvania Commission on Crime and Delinquency. 2010. County Jail Population. URL: http://www.portal.state.pa.us/portal/server.pt?open=512&objID=5403&&PageID=505946&level=3&css=L3&mode=2. Accessed July 19, 2013.

Pennsylvania Department of Environmental Protection (DEP). Office of Oil and Gas Management: Wells Drilled by County. http://www.depreportingservices.state.pa.us/. Accessed October 6, 2010.

Pennsylvania Department of Public Welfare. http://listserv.dpw.state.pa.us/ma-food-stamps-and-cash-stats.html. Provided July 12, 2013.

Pennsylvania Department of Revenue. "Tax Compendium." 2007-08; through 2011-12. http://www.portal.state.pa.us/portal/server.pt/community/reports_and_statistics/17303/tax_compendium/602434.

Pennsylvania Department of Revenue. "Personal Income Tax Statistics." 2007 through 2010.

Pennsylvania Department of Transportation. Data from an unpublished PennDOT PowerPoint presentation. 2011.

Pennsylvania Sentencing Commission. Pennsylvania Sentencing Data *[2001-2010]*. Pennsylvania Sentencing Commission. University Park, Pa.: Population Research Institute, Penn State.

Perry, S. 2012. "Development, Land Use, and Collective Trauma: The Marcellus Shale Gas Boom in Rural Pennsylvania." *Culture, Agriculture, Food and Environment* 34 (1): 81–92.

Pifer, R. 2011. "What a Short, Strange Trip It's Been: Moving Forward After Five Years of Marcellus Shale Development. *Pittsburgh Law Review*. 72: 615-70.

Ruddell, R. 2011. "Boomtown Policing: Responding to the Dark Side of Resource Development." *Policing* 5 (4): 328- 342.

Schafft, K.A., and C. Biddle. (forthcoming). "Youth Perspectives on Marcellus Shale Gas Development: Community Change and Future Prospects." Pennsylvania State University.

Schafft, K.A., Y. Borlu, and L. Glenna. 2013. "The Relationship Between Marcellus Shale Gas Development in Pennsylvania and Local Perception of Risk and Opportunity." *Rural Sociology*. 78(2): 143-166.

Seyfrtt, C.L. and N.C. Sadler-Hammer. 1988. "Social Impact of Rapid Energy Development on Rural Youth: A Statewide Comparison." *Society & Natural Resources* 1(1): 57-67.

Snyder, H.N. 2012. *Arrest in the United States, 1990-2010*. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics. NCJ 239423. http://www.bjs.gov/index.cfm?ty=pbdetail&iid=4515. Accessed January 17, 2013.

Social Explorer Tables: Census 2000 (SE), Social Explorer; U.S. Census Bureau. http://www.socialexplorer.com/. Accessed July 12, 2013.

Soeder, D.J. and W.M. Kappel. 2009. *Water Resources and Natural Gas Production from Marcellus Shale*. USGS Fact Sheet 2009-3032. Baltimore, MD: US Geologic Survey.

StataCorp. 2011. *Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP.

Steinzor, N., W. Subra and L. Sumi L. 2013. "Investigating links between shale gas development and health impacts through a community survey project in Pennsylvania." *New Solutions* 23(1):55-83.

Stokowski, P.A. 1996. "Crime Patterns and Gaming Development in Rural Colorado." *Journal of Travel Research*. 34:63-69

U.S. Census Bureau, 2013. Small Area Health Insurance Estimate (SAHIE). http://www.census.gov/hhes/www/sahie/. Accessed July 12, 2012.

U.S. Census Bureau, Population Estimates. http://www.census.gov/popest/. Provided July 15, 2013.

U.S. Census Bureau, Quick Facts. http://quickfacts.census.gov/qfd/states/42/42015.html.

U.S. Census Bureau. American Community Survey Tables: 2009 - 2011, ACS 2009 - 2011 (3-Year Estimates). http://www.socialexplorer.com/. Accessed July 12, 2013.

U.S. Census Bureau. Social Explorer Tables: Census 2000, Census 2010, ACS 2009 to 2011 (3-Year Estimates) (SE), Social Explorer. http://www.socialexplorer.com/. Accessed July 12, 2013.

U.S. Census County Business Patterns. 2007 through 2011. http://censtats.census.gov/cgi-bin/cbpnaic/cbpsect.pl.

U.S. Department of Health and Human Services (DHHS), 2012. HealthyPeople.gov. *Access to Care*. http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=1. Accessed July 12, 2012.

United States Department of Agriculture Census of Agriculture. http://www.nass.usda.gov/QuickStats/Screens/faqs.htm#program.

United States Department of Agriculture's National Agricultural Statistics Service. 2013. *Farms, Land in Farms, and Livestock Operations: 2012 Summary.* http://usda01.library.cornell.edu/usda/current/FarmLandIn/FarmLandIn-02-19-2013.pdf.

United States Department of Justice. Federal Bureau of Investigation. Uniform Crime Reporting Program Data [United States]: County-Level Detailed Arrest and Offense Data, 2008. ICPSR27644-v1. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2011-04-21. doi:10.3886/ICPSR27644.v1

United States Department of Justice. Office of Justice Programs. Bureau of Justice Statistics. Census of State and Local Law Enforcement Agencies (CSLLEA), 2008. ICPSR27681-v1. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2011-08-03. doi:10.3886/ICPSR27681.v1

US Census Bureau. Table 1.Intercensal Estimates of the Resident Population for Counties of Pennsylvania: April 1, 2000 to July 1, 2010 (CO-EST00INT-01-42). Source: US Census Bureau, Population Division.

Waples, D.A. 2012. *The Natural Gas Industry in Appalachia*. Jefferson, NC: McFarland & Co.

Weidner, K. 2008. *Natural Gas Exploration: A Landowner's Guide to Leasing Land in Pennsylvania.* University Park, PA: Penn State Cooperative Extension. http://pubs.cas.psu.edu/FreePubs/pdfs/ua448.pdf.

Weinstein, A.L., and M.D. Partridge. 2011. "The Economic Value of Shale Natural Gas in Ohio." Columbus, OH: College of Food, Agricultural, and Environmental Sciences, Ohio State University. 35 pages.

Wilber, T. 2012. *Under the Surface: Fracking, Fortunes, and the Fate of the Marcellus Shale*. Ithaca: Cornell University Press.

Williamson, J. and B. Kolb. 2011. *Marcellus Natural Gas Development's Effect on Housing in Pennsylvania*. Williamsport, PA: Lycoming College Center for the Study of Community and the Economy.

Williamson, J. and B. Kolb. 2011. Marcellus Natural Gas Development's Effect on Housing in Pennsylvania. Center for the Study of Community and the Economy (CSCE). Retrieved from http://www.housingalliancepa.org/sites/default/files/resources/Lycoming-PHFA%20Marcellus_report.pdf.

Wrightstone, G. (2008). Marcellus Shale Geologic Controls on Production. Texas Keystone Incorporated. http://www.papgrocks.org/wrightstone_p.pdf. Accessed October 8, 2012.

Zajac, G. and L. Kowalski. 2012a. An Examination of Pennsylvania State Police Coverage of Municipalities. Justice Center for Research, Pennsylvania State University. http://justicecenter.psu.edu/research/documents/PSPFinalReportJusticeCenterversion.pdf. Accessed July 11, 2013.

Zajac, G. and L. Kowalski. 2012b. An Examination of Pennsylvania Rural County Jails. The Center for Rural Pennsylvania. http://www.rural.palegislature.us/documents/reports/rural_county_jails_2012.pdf. Accessed July 19, 2013.

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