

Acknowledgements

The authors would like to thank the residents and officials in Greene County interviewed for this report for their time and for their subsequent assistance.

We wish to thank the Stoneman Family Foundation, Heinz Endowments, Hillsdale Fund and Park Foundation for their generous support for the Multistate Shale Research Collaborative.

A special thank you to Stephanie Frank for layout and design, to Diane McCormick for copyediting and to Michael Wood for research and data assistance.

Located in the southwestern corner of Pennsylvania, Greene County is no stranger to extractive industries, with a long history of coal mining, conventional gas drilling, and, most recently, unconventional gas drilling. Greene County had more than 500 unconventional gas wells drilled between 2006 and 2012 (nearly one gas well per square mile), 8% of the state total. This “modern gold rush” has brought with it both benefits and costs.

This report documents the impacts that gas drilling has had on the county economy, roads, housing, social services, schools, and hospitals. The report is part of a larger Multi-State Shale Research Collaborative examination of the social costs of gas drilling in rural communities (other case studies focus on Tioga County, Pennsylvania, Carroll County, Ohio, and Wetzel County, West Virginia). Interviews were conducted with local officials and experts to understand how gas drilling has impacted Greene County communities, services, and local government. We supplemented qualitative interviews with data collection and analysis where possible.

What did our research reveal? Greene County enjoyed some of the promised benefits of gas development, but those benefits came with costs to individuals and the community. The county experienced a significant increase in jobs, new income for residents, and increased sales activity for local businesses. At the same time, industry growth increased heavy truck traffic, safety concerns, and road damage; made housing hard to find and increased rents; and stressed social services, police, and local officials, all of which played catch up after the sudden spike in activity.

Our findings:

- *As a result of one-time signing bonuses and ongoing royalty payments, income has risen in Greene County.* \$158 million was paid for 404 oil and gas deeds in 2011, a significant increase from the \$4.2 million paid for 90 deeds the previous year. Because non-residents own one-third of the land, much of this income left the county. Land ownership is also highly concentrated, further limiting the benefits to county residents.
- *Greene County experienced 40% growth in private-sector employment between 2005 and 2012, the highest growth by far in the region.* Growth is highest in construction (192.5% growth), natural resources and mining (68.9% growth), and leisure and hospitality (40.9% growth). The county unemployment rate has been consistently about 1.5% below the state average since drilling picked up towards the end of 2010.
- *An increase in heavy truck traffic associated with the oil and gas boom deteriorated roads, increased noise, safety concerns, and repair costs.* Roads and bridges not meant for such heavy use by large trucks have been damaged and highway maintenance costs have increased.
- *An influx of out-of-state oil and gas workers drove up rents and further exacerbated an already existing housing shortage in the county.* Rents, stagnant in the rest of Pennsylvania during and after the recession, increased by 7% to 12% (at the 20th, 50th, and 80th percentile of the rental cost distribution), with the biggest hike at the higher end of the market. Anecdotal reports claimed much higher increases – a doubling or tripling of rents – in specific cases. Higher rents benefited landlords but put a financial strain on renters, including low-income seniors on fixed incomes. For some county residents, higher rents were cushioned by higher incomes; indicative of this, the share of county residents paying more than 30% of their income in rent rose by less in Greene County (14%) during the drilling boom, a period of recession and slow recovery nationally, than over the same period in the rest of Pennsylvania (30%).
- *The shortage of affordable housing exacerbated by the oil and gas boom led to more children being split from parents and higher demand for foster care services.* Some low-income families unable to secure adequate housing were separated, and children were put into the foster care system. Since 2009-10, the number of children in foster care due to “inadequate housing” has been between 30% and 40%, compared to 15% right before the boom began (in 2008-09). The increased cost of foster care has put a financial strain on Greene County Human Services.

- *Crime increased in conjunction with drilling*, according to interviews, and data for Cumberland Township, the municipality with the largest number of drilling permits from 2006-12, and data over a longer period for Greene County. The township received nearly double the number of calls in 2011 (3,086) compared to 2008 (1,549), with a small drop off in 2012. Pennsylvania State Police data show a 31% increase in “serious crimes” in Greene County from 1999-2001 to 2010-12, compared to a 6% decline statewide.
- *Greene County’s high school drop-out rate rose above the statewide average during the height of the gas boom (2009-2012)*. Anecdotal evidence suggests that some high school students dropped out of school to take advantage of new, higher-paying industry jobs in the county. Social service staff reported seeing more young men without high school diplomas seeking services because they have been recently laid off by companies moving elsewhere.
- *Emergency room visits to Greene’s one hospital increased by more than 50% from the first part of the 2000s to 2010-12*. A hospital official said this resulted not from drilling but from a 2005 hospital takeover by a for-profit corporation that improved services and the hospital’s reputation. Another local health expert said that anywhere from one-third to two-thirds of the increase could be the result of the health and safety impacts of drilling.

Across the board, it is clear that the county was unprepared for the impacts of drilling and had few tools available to manage the boom. Almost all local sources perceived drilling to have come out of nowhere with only a short lag time from the arrival of the land men to intense extraction activity. The activity, and the impacts, were on multiple fronts, affecting different county agencies and various municipalities simultaneously. The cumulative impact was, at times, overwhelming to the local officials and human service professionals on the front lines.

For areas yet to experience a shale extraction boom, a clear lesson from Greene County is that more must be done by states and localities to prepare and respond better – to anticipate impacts, to have tools in place to avoid or mitigate impacts, to receive advanced and regular information from drillers on their plans, and to access resources to address infrastructure and human service needs in a predictable and timely way.

An untold part of the Greene County story concerns the future. The county’s history of extraction has left behind a legacy of environmental damage and poverty. Acknowledging its promising economic beginning, the growth in shale gas development makes the county more dependent on resource extraction, and vulnerable to a decline as swift as its rise.

“Every program I have is impacted by housing—foster, drug and alcohol, disability, mental health.”

~Karen Bennett,
Director, Greene County
Dept. of Human Services

This research is a part of a larger effort by the Multi-State Shale Research Collaborative to document human and social service impacts of increased drilling. To launch this effort, the Collaborative conducted this case study and similar studies of Tioga County, Pennsylvania, Carroll County, Ohio, and Wetzel County, West Virginia.

Our methodology for undertaking the case studies began with a review of research literature, including case studies of social and human service impacts in specific counties or regions: Sublette County, Wyoming (Ecosystems Research Group, 2008; 2009; Jacquet 2009); Bradford County, Pennsylvania (Perry 2012); Northwest Colorado (Redifer, Joufflas, Chase & Morris, 2007); Sweetwater County, Wyoming, and Mesa and Garfield County, Colorado (Headwaters Economics 2008; 2009); and more than two dozen counties in New York and Pennsylvania (Alter & Ooms, 2010).

For the Pennsylvania case studies, we supplemented the research literature by reviewing testimony from legislative hearings and hearings organized by the Citizens' Marcellus Shale Commission. Hearings identified impact areas that were similar to those in the literature (see, for example, Coolidge 2011; Hill 2011; Schaeffer 2011; Troxell 2011).

To select two case study counties in Pennsylvania, and one each in West Virginia and Ohio, we screened counties first based on the level of unconventional gas drilling activity. In West Virginia and Ohio, this factor alone largely determined the selection of Wetzel and Carroll counties. In Pennsylvania, a half-dozen counties stood out with levels of drilling activity far above the rest of the state. To select among these counties, we considered two other variables: how rural the county was (measured by low population density) and economic vulnerability (measured by poverty and income). Both of these variables are proxies for lower levels of human and social service capacity: if substantial human and social service impacts occur with drilling, they are more likely to be revealed by case studies of poorer, more rural counties. Finally, Greene and Tioga were selected because of their contrasts: Greene with a history of mineral extraction, Tioga with very little; Greene with both wet and dry gas, Tioga with predominantly dry gas.

To guide the overall study of human and social service impacts (not just the case studies), the research team conducted interviews with state-level associations of human and social service providers (e.g., County Commissioners, Head Start, school boards, hospitals) and, in some cases, with statewide non-profits.

To identify interviewees in Greene and other case study counties, the research team sought to identify key county professionals in each human service area, in some cases with the help of statewide associations and non-profits.

Prior to conducting interviews, researchers from Pennsylvania, West Virginia, and Ohio developed common interview guides for each human service impact area based on the research literature and on guides on drilling impacts developed for local governments (Rodgers et al. 2008 and Dahl, Price and Kalish 2010). In Greene County, we conducted semi-structured interviews with 29 informants, which lasted, on average, one hour each.

By definition, the qualitative components of this and the three companion case studies reveal the qualitative dynamics of drilling's impact and how it varies in different county contexts. Qualitative analysis cannot provide quantitative evidence that indicates how much drilling translates into particular levels of human service or infrastructure impacts.

In this and the companion case studies, we supplement our qualitative interviews with quantitative data provided directly by local officials and human service agencies, or extracted from official government data sources.

III. Greene County Demographics: Rural, Low-income, and Aging

Evaluating the impact of unconventional gas extraction on Greene County must start from an understanding of the county before drillers arrived and the most immediate changes in standard socioeconomic indicators. Greene is a rural county in Pennsylvania's southwestern corner, covering 576 square miles of rolling hills. The county seat of Waynesburg is about 60 miles south of Pittsburgh geographically but, in other respects, a world away from its urban neighbor.

- **Population:** Greene County had a population of 38,085 in 2012 (Bureau of Economic Analysis 2014). Like many other counties targeted for mineral extraction, the county is sparsely populated, with 67 people per square mile compared to the state average of 284. Residents are racially homogenous – 95% white, 3.3% black or African American, and 1.2% Hispanic or of Latino origin (Center for Rural Pennsylvania). However, social service agencies reported a growing need for Spanish translation due to increases in the Latino population in recent years.
- **Education:** In Greene County, nearly half the residents, 49%, have a high school diploma or equivalency, 36.4% had some college or more, and 14.6% had no high school diploma (Center for Rural PA).
- **Employment:** More than one quarter, or 27.8%, of Greene County workers are employed in the natural resources and mining industry – higher than any county in the state (Center for Rural PA).
- **Unemployment:** Greene County's unemployment rate was slightly higher than the state average from 2005 to 2008. However, this trend reversed in 2009, when the rate fell below the state average. As of December 2013, Greene County's unemployment rate was 5.3%, below Pennsylvania's 6.9%.
- **Housing:** The county's housing stock is 69.4% single-family homes, 10.2% apartment buildings, and 17.2% mobile homes, a figure far higher than the state average of 4.3%. Seventy-three percent of residences are owner-occupied, and 28% are rentals (Center for Rural PA). The median housing value in Greene County between 2007 and 2011 was an inexpensive \$84,500, just more than half of Pennsylvania's \$163,200 median.
- **Age:** Those 65 or older made up 15.7% of the population in 2010, but that rate is expected to reach 27.9% by 2030, exceeding the state average of 22.5% (Pennsylvania Housing Finance Agency 2012).
- **Income:** Greene is one of Pennsylvania's poorest counties, but the growth of gas-industry and related employment has sent poverty rates down and median household incomes up. Greene County's average poverty rate of 15.9% between 2007 and 2011 was the sixth highest in the state and higher than the state average of 12.6% (American Community Survey 2014). However, poverty in the county fell from 17.5% in 2009 to 15.5% in 2011 (Center for Rural PA). The rate of households considered low-income, earning below \$34,999 a year, is 42.2%. Close to half of Greene County students, 44.5%, qualified for free and reduced school lunch in 2011 (Center for Rural PA). Median household income averaged \$42,565 between 2007 and 2011, which represents only 82% of the statewide median of \$51,651. However, median income rose 26.9% between 2006 and 2011.

Greene County is no stranger to extractive industries and now is highly dependent on two types of extraction — coal and gas. With a long history of coal mining, Greene County was the highest coal-producing county in Pennsylvania (Cato 2013). It is home to the world's largest underground coal mine, Bailey Mine, operated by the Pittsburgh-based coal, oil, and gas company CONSOL Energy (Shrum 2013).

Muddled Responsibility

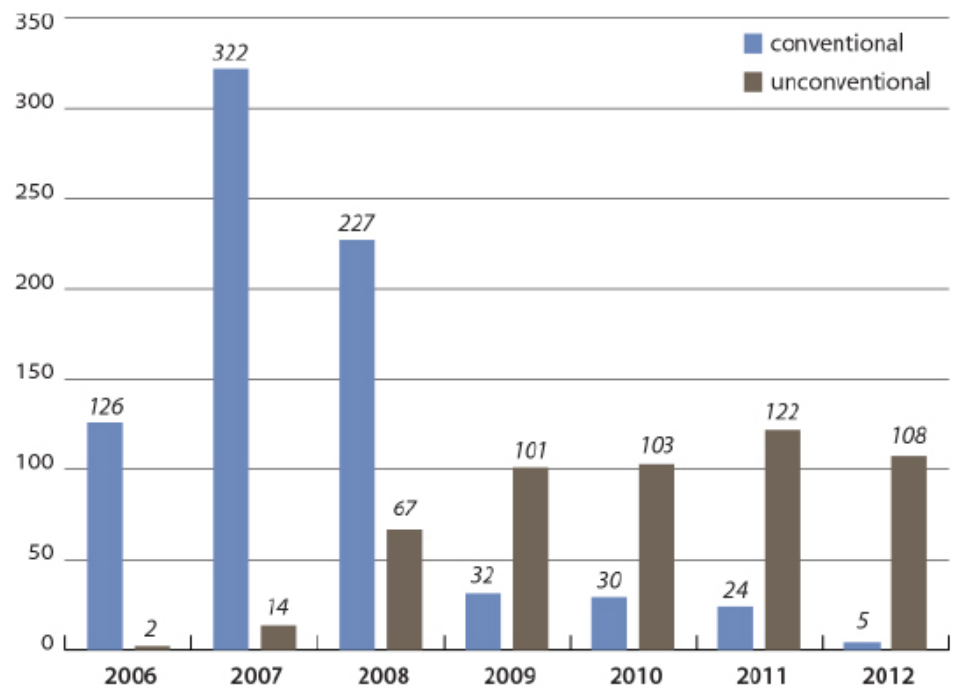
Coal mining has a long history of environmental damage in Greene County – including air pollution, forest destruction from mountaintop removal, and pollution of rivers and local water supplies. This makes it more difficult to disentangle the distinct environmental impacts of hydraulic fracturing and allows the two industries to engage in a “coal vs. gas blame game” when the community raises concerns about environmental or road and bridge damage (Authors' Interviews). Drilling in or near old coal fields also puts Greene County and its residents “in the crosshairs of a grand energy experiment” in terms of potential interacting environmental effects and combined impacts, says Patrick Greuter, director of Coalfield Justice, an environmental group (Shrum 2013).

Hydraulic Fracturing Moves In

In Greene County and statewide, shallow natural gas wells, also known as “conventional” wells, have accessed natural gas in porous, natural rock formations for more than 50 years. Unconventional gas drilling, introduced to Pennsylvania in 2004, thrusts water, sand, and a complex array of chemicals into wells to fracture the rock and release the natural gas. This hydraulic fracturing is much more expensive than conventional drilling but also produces vastly more gas — 4 to 5 million cubic feet per day vs. 250 cubic feet per day (Yerace 2012).

In 2007 and 2008, Greene County residents noted a rise in vehicles with out-of-state license plates and land men going door-to-door seeking to lease mineral rights from landowners. All that activity was followed in 2009 by a major spike in permits — 181 issued, up from 69 the year before. In 2009, the county leased its own mineral rights to land under the airport, on the fairgrounds, and under a Walmart site. In 2010, county residents say, the drilling boom started, as they saw an influx of workers, more heavy truck traffic, crowded bars and restaurants, and an increase in trailer parks. The county also saw a spike in the number of producing wells, from 89 in 2009 to 190 in 2010. (See Table 1.)

**Figure 1. Conventional and Unconventional Gas Wells
Greene County, PA 2006-2012**



Source. Pennsylvania Department of Environmental Protection, Office of Oil and Gas Management, Spud Data Report, 2006-2012.

“One day there was no drilling, the next they were starting to drill”
~Greene County Commissioners

Greene County began to see a decrease in rigs in late 2011 and early 2012, which signaled that the initial boom was beginning to subside. Local residents reported there were fewer people in the county, at bars and restaurants, and in trailer parks. Permits slowed down in 2012 (see Table 1), although the number of new wells fell only slightly that year to 108, down from 122 in 2011. (See Figure 1)

Greene County has 8% of the state’s total number of unconventional wells, less than half of the state leader Bradford County (with 18%). Measured by well density per square mile, a better measure of drilling intensity within an area, Greene is second to Bradford County (Pennsylvania Department of Environmental Protection).

Figure 1 presents annual data since 2006 on the number of new conventional and unconventional wells drilled in Greene County. It shows that new conventional gas wells in Greene County have declined drastically since 2007, while unconventional gas wells increased between 2006 and 2009. Between 2009 and 2012, the number of new gas wells has remained relatively stable at 101 to 122 a year. As of 2012, new unconventional gas wells far outnumbered conventional gas wells, at 108 to 5.

Since the shale boom began, according to county residents, drillers have moved westward within the county in search of “wet gas,” more profitable than methane-only dry gas for the additional by-products it produces. In western-center Greene County, drillers have recently targeted Center Township, obtaining 50 drilling permits in 2012.

Table 1: Producing Wells in Greene County, 2006-2012

GREENE COUNTY MUNICIPALITY	Producing Wells By Year						
	2006	2007	2008	2009	2010	2011	2012
Aleppo Twp	0	0	1	1	1	1	1
Center Twp	0	0	6	22	25	27	41
Cumberland Twp	1	3	11	37	69	91	105
Dunkard Twp	0	1	7	11	24	24	26
Franklin Twp	0	0	0	0	1	6	14
Gilmore Twp	0	0	0	0	2	2	2
Gray Twp	0	0	0	0	0	0	0
Greene Twp	0	0	1	3	9	12	13
Jackson Twp	0	0	0	0	0	0	2
Jefferson Twp	0	0	2	4	12	19	22
Monongahela Twp	0	0	1	2	10	10	16
Morgan Twp	0	0	0	4	10	32	43
Morris Twp	0	1	1	4	24	58	85
Perry Twp	0	0	0	1	1	1	1
Richhill Twp	0	0	0	0	0	0	0
Springhill Twp	0	0	0	0	0	0	0
Washington Twp	0	0	0	0	0	0	8
Wayne Twp	0	0	0	0	0	0	0
Whiteley Twp	0	0	0	0	2	2	2
TOTAL	1	5	30	89	190	285	381

Source: Multi-State Shale Research Collaborative based on drilling data reported by the Pennsylvania Department of Environmental Protection

A number of officials we interviewed commented on the lack of preparation time and knowledge about the gas industry. One official reported: “Literally, one day, it happened overnight. What is that noise? It was the trucks driving by” (Authors’ Interviews). There was no forewarning and little communication between the industry and local officials, which made it difficult to respond in any systematic or coordinated way. “When Marcellus Shale hit, there was no planning, we were just reacting. It took several years to get a handle on what was happening,” said Karen Bennett of the Greene County Human Services Department. Moreover, officials had no idea what to expect. One official said that her best understanding came from a presentation by a colleague from another heavily-drilled community (Authors’ Interviews).

Similarly, the County Planning Commission needed time to build a knowledge base about the gas industry, because even the terms industry used were foreign to local

officials. The oil and gas industry came into Greene so suddenly, it was hard for the Commission to respond because so little was known about the industry, companies’ needs, and the potential problems that would arise. This has left the Commission and other county departments running to catch up.

“Control over change,” wrote philosopher and futurist Marshall McLuhan, “would seem to consist in moving not with it but ahead of it” (*Understanding Media: The Extensions of Man*). By this standard, the change that hydraulic fracturing wrought on Greene County has not been controlled. Unconventional drilling arrived at a lightning pace, bringing benefits but also disruptions, with the county still struggling to play catch up.

Natural gas extraction occurs in three phases, each with its own “distinct effect on the local socioeconomics,” according to Ecosystems Research Group (2008).

- **Development:** In this labor-intensive period, companies search for and acquire land and sub-surface mineral rights, do seismic testing, build and expand roads, construct well pads, drill wells, and build pipelines and compressor stations. During this phase, communities experience a large influx of temporary workers and truck traffic.
- **Production:** Gas is produced and transported, wells are maintained, and fracking waste and wastewater are managed. The number of workers required drops during this period.
- **Post-production:** A well’s average life span is about 40 years, but the volume of natural gas extracted peaks in the first three to five years and then tapers off. In post-production, machinery is removed, wells are plugged, and the project concludes (Ecosystems Research Group 2008).

The next section looks at the impact of these three phases on income, jobs, roads, housing, crime, schools, and health. It documents that fracking has brought both benefits and costs.

A. Income: Windfalls from Signing Bonuses and Royalties

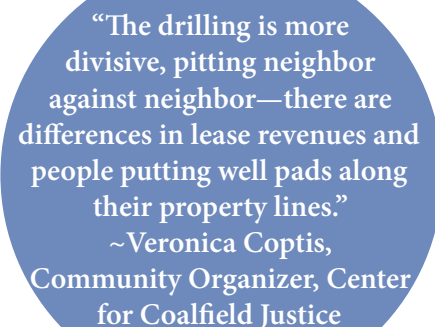
Greene County is experiencing “a modern gold rush,” reports the Greene County Conservation District (Greene County, PA, n.d.b.). The new money from leases and royalties has seeped through the local economy, presenting benefits and some challenges.

Benefits: Income, Revenue, Sales

The most tangible and immediate benefit for landowners are one-time signing bonuses with lease agreements. Royalties, or regular payments for the gas extracted, provide additional ongoing income.

Strikingly, \$158 million changed hands in 2011 as a result of the transfer of 404 oil and gas-related deeds (including transfers of mineral right and right-of-way access) – a huge spike from the \$4.2 million exchanged for the transfer of 90 deeds just one year before. The 2011 oil and gas-related deeds totaled 45% of all transactions, a drastic increase from only 15% the year before.

Figure 2 identifies all recorded real estate transfers in Greene County and the share credited to oil and gas deeds from 2005 to 2012.



“The drilling is more divisive, pitting neighbor against neighbor—there are differences in lease revenues and people putting well pads along their property lines.”
~Veronica Coptis,
Community Organizer, Center
for Coalfield Justice

With the new income, farmers have purchased new equipment, and local restaurant and others businesses have been busier. County Commissioners reported that one local tractor store had more business in the last five years than in previous decades. A small local grocery store saw business triple. Rising motor vehicle sales tax revenue document the increase in sales at local car dealerships. (See Figure 3.)

Figure 2. Oil & Gas-Related Deed Transactions, Greene County, PA, 2005-2012

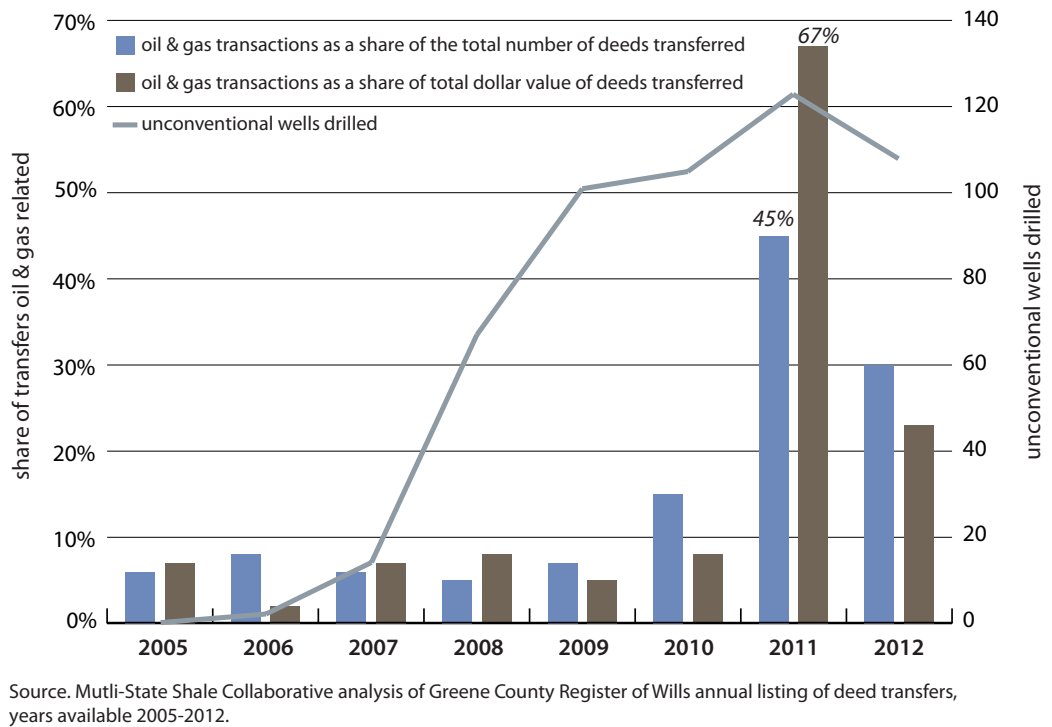
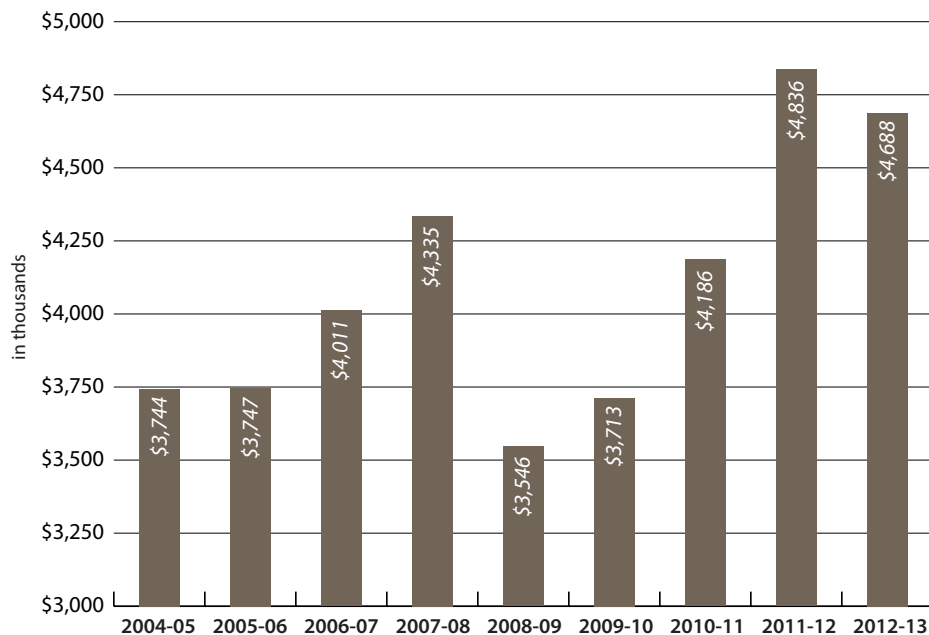


Figure 3. Motor Vehicle Sales Tax Collections, Greene County, PA 2003-2012



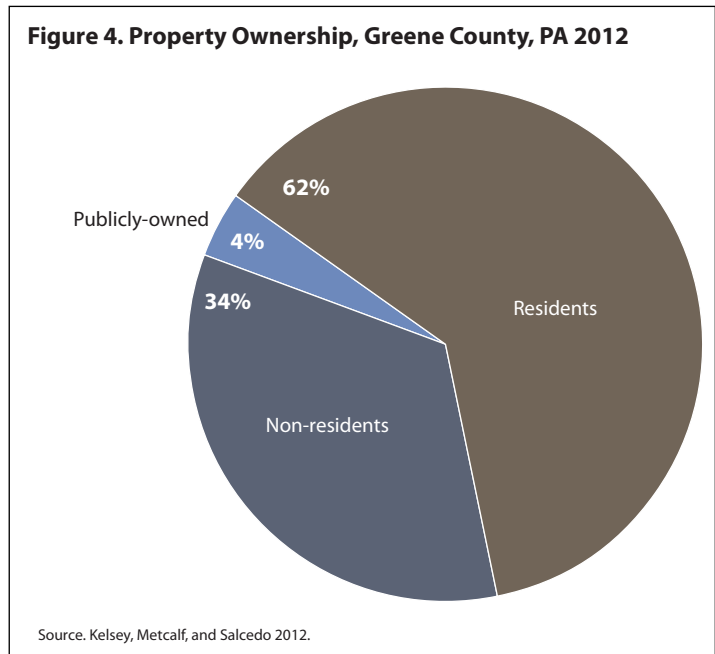
Source. Pennsylvania Department of Revenue.

Challenges: Inequity, Inadequate Royalties, and Leakage

More money has brought more challenges. For example, not all leases negotiated between individual landowners and oil and gas companies are created equal. Early in the boom, some landowners did not realize the value of the natural gas under their feet and signed leases for \$5 per acre. After 2009, other landowners were getting as much as \$5,000 per acre. Reportedly, these vast differences have caused tensions and divisiveness among neighbors in Greene County, as has been documented in other heavily drilled areas (Authors' Interviews).

Pennsylvania’s Guaranteed Minimum Royalty Act of 1979 requires companies to pay owners a minimum 12.5% royalty on the value of the oil or gas produced. However, recent reports indicate that some oil and gas companies are deducting transportation and processing costs from royalty payments, and using complicated formulas and accounting to avoid paying the full royalties they owe, a practice criticized by Governor Tom Corbett and Attorney General Kathleen Kane (Lustgarten 2013; Cusick 2013a). A Propublica analysis of lease agreements and court and government documents found that underpayments were widespread and that “manipulation of costs and other data by oil companies is keeping billions of dollars in royalties out of the hands of private and government landholders” (Lustgarten 2013; Cusick 2013a). The Pennsylvania General Assembly is considering legislation that would address this issue (Zwick 2014).

While signing bonuses and royalties have undeniably generated more money, the benefits do not always remain locally. Some money leaves the community, going to out-of-state landowners, transient workers, and other spending outside the county (Kelsey et al. 2011). An estimated 62% of Greene County land is owned by county residents. Non-residents own 34%, and the remaining 4% is publicly owned. Within the county, property ownership is concentrated in the hands of a few, with 20% of the landowners in the county owning 91.9% of the property (Kelsey, Metcalf and Salcedo 2012). (See Figure 4.)



B. Jobs and Employment: Most Sectors are Up

Greene County recorded employment growth of 30.5% between 2005 (11,788) and 2012 (15,380), far outpacing the other 22 counties in Pennsylvania, West Virginia, and Ohio with 100 or more shale wells. Washington County in Pennsylvania came in second, at 13.2% (Mauro et al 2013, p.18). The employment growth in Greene occurred entirely in the private sector, which grew by 40.2%, while public-sector jobs decreased minimally (2.8%). (See Table 2.)

Looking at individual sectors, construction rose 192.5% between 2005 and 2012, the largest employment growth in the county and a dramatic difference from the statewide 11.1% decline. Natural resources and mining, the largest industry in the county, also added 1,741 new jobs, a 68.9% increase.

Other sectors in which employment significantly increased between 2005 and 2012 include leisure and hospitality, up 40.9%; financial activities, 27.7%; trade, transportation, and utilities, 26.3%; other services, 22.1%; and education and health services, 21.9%. Two new hotels have opened and restaurants are hiring, employing local residents to meet increased demand. Manufacturing saw the greatest employment decline (37.6%), more than double the statewide decline in manufacturing employment.

Table 2. Employment change 2005 to 2012 by sector in Greene County					
Sector	2005	2012	2005 to 2012		Pennsylvania, 2005 to 2012
			Change	Percent Change	Percent Change
Total, all industries	11,788	15,380	3,592	30.5%	0.5%
Private	9,122	12,791	3,669	40.2%	1.0%
Natural Resources and Mining	2,528	4,269	1,741	68.9%	38.6%
Construction	415	1,214	799	192.5%	-11.1%
Manufacturing	607	379	-228	-37.6%	-16.9%
Trade, Transportation, and Utilities	2,083	2,630	547	26.3%	-2.1%
Information	90	71	-19	-21.1%	-17.5%
Financial Activities	343	438	95	27.7%	-7.5%
Professional and Business Services	511	576	65	12.7%	11.4%
Education and Health Services	1,577	1,923	346	21.9%	13.9%
Leisure and Hospitality	579	816	237	40.9%	8.2%
Other Services	389	475	86	22.1%	-2.2%
Public	2,665	2,590	-75	-2.8%	-3.4%
Federal	138	126	-12	-8.7%	-5.4%
State	898	909	11	1.2%	-1.1%
Local	1,629	1,555	-74	-4.5%	-3.6%

Source. Multi-State Shale Research Collaborative based on Quarterly Census of Employment and Wages data

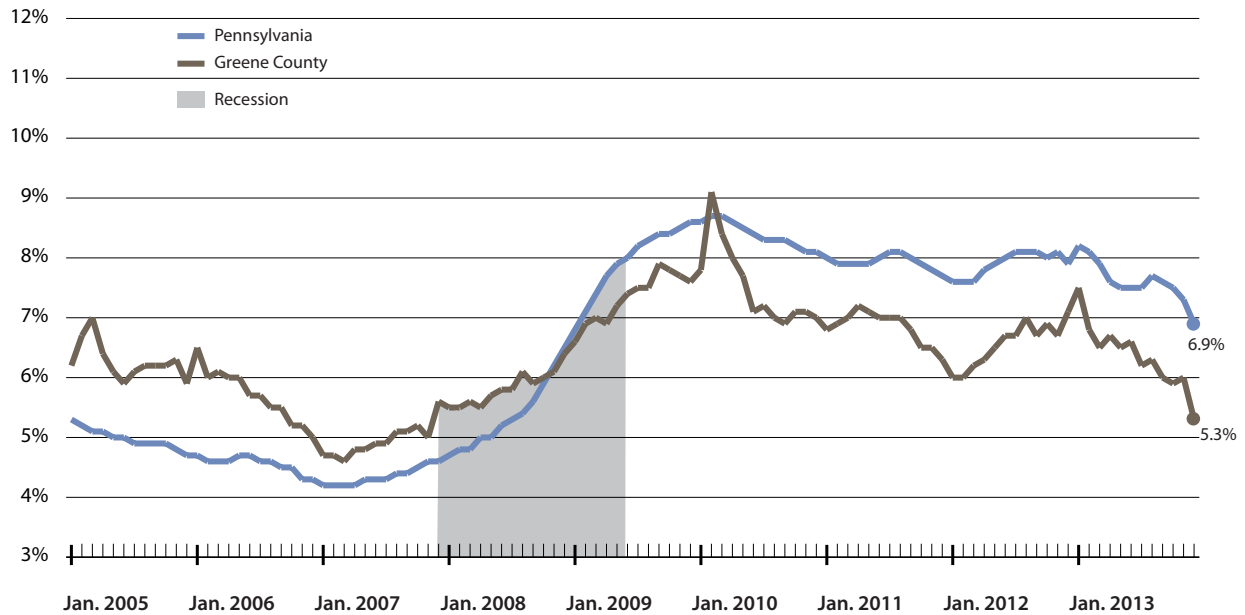
The jobs available to residents vary, Greene County officials say. Oil and gas industry jobs tended to be in trucking, pipelines, and service work such as maintenance, well-site security, and secretarial. Residents appreciate the pipeline work, one resident says, for its good pay and hours that allow parents to attend kids' school and sports activities (Authors' Interviews). The increase in jobs is a confidence-booster for local residents, reports one local human services staffer (Authors' Interviews).

Jobs on drilling rigs are higher-paying and tend to be filled by out-of state workers, although there have been regional efforts to train local workers for these positions (Schwartzel 2013). Industry representatives sometimes maintain that it is hard to find local workers who can pass drug tests, a claim we could not substantiate but one also heard in interviews in Ohio and West Virginia.

As gas drilling brought more jobs, some government agencies struggled to retain staff. The county Planning Commission and the Conservation District, in particular, have lost staff members who are knowledgeable about permits and environmental regulations to jobs with gas companies that pay better (Authors' Interviews).

From 2005 to the present, Greene County's unemployment rate first trended worse than the state's, then tracked upward during the recession starting in late 2007, and has remained below the state average since 2009. (See Figure 5.)

Figure 5. Unemployment in Greene County and Pennsylvania, 2005 to 2013



Source: Keystone Research Center based on Bureau of Labor Statistics (BLS) data.

C. Housing: High Costs, Low Standards

Previous research has shown that, when gas booms and highly paid workers come to town, rising rents and temporary housing shortages follow (Ecosystems Research Group 2009; Headwaters Economics 2008; Headwaters Economics 2009; Ooms and Tracewski 2011). In some locations, mobile home communities have grown to deal with housing shortages (Jacquet 2009). Conversely, recent research suggests that property values near drilling activity can fall, especially for homes with well water (Gopalakrishnan and Klaiber 2012; Muehlenbacks, Spiller and Timmins 2012). When housing costs rise, non-gas related employers such as hospitals and colleges may have trouble recruiting new workers, threatening a region's economic diversity (Headwaters Economics 2008; Headwaters Economics 2009).

In Greene County, out-of-state workers with cash in hand, or generous company per diems, have driven up rents for homes, apartments, and RV hook-ups, exacerbating a pre-existing shortage of affordable housing and making it harder for lower-income residents to find affordable housing.

Pre-existing Problem: Old Housing Stock

Heading into the gas boom, Greene County's housing stock was older and much of it was in poor condition. Quality housing was in short supply, and the county's 17% decline in rental units between 1990 and 2005-07 was the state's steepest (Mierzwa et al 2010). The influx of workers looking for short-term housing greatly accentuated the problem (Authors' Interviews). Low-income people were pushed into crisis, and drillers were challenged to find adequate housing.

While the increase in out-of-state workers drove much of the rising rents, coal is also partially responsible for further diminishing the housing stock. In recent years, the coal industry has been buying up properties in western Greene County to expand extraction processes. Two small villages in western Greene – the Village of Holbrook and the Village of Time – have been leveled, dramatically changing pockets of the landscape (Authors' Interviews; Al Jazeera America 2013).

The Owner-Occupied Housing Market: Tight and Tighter

Greene County's gas boom further squeezed an owner-occupied housing market made tight by a confluence of causes – a lack of development, property buyouts by CONSOL and other companies, and the quest for cheap housing by commuters to Washington County and Morgantown, West Virginia (Williamson et al 2011; Authors' Interviews).

One realtor attributed 25% to 30% of today's tight owner-occupied housing market to the gas boom. Another reported that a typical summertime real-estate listing might have 125 to 150 homes in the \$125,000 to \$250,000 price range, but the summer of 2011 saw only about 80 (Williamson et al 2011).

While not raised during our interviews, some research suggests that homebuyers in gas drilling areas increasingly have trouble obtaining loans from banks that refuse mortgages on homes with gas leases (Peters 2013; Drouin 2013).

Rent Prices: On the Rise

While rents in and after the Great Recession stagnated across Pennsylvania, they rose in Greene and Washington counties by 6% to 12%, with the largest increases at the higher end of the distribution. (See Table 3.)¹ Data from the U.S. Census Bureau's American Community Survey likely underestimate the growth in rents for two reasons. First, the data cover both new and long-term renters, and rent increases were likely most substantial in properties that turned over rather than those with continuing tenancies. In addition, the data cannot isolate Greene County from Washington County or drilling-intensive areas within counties. Since Washington County is more urban, and unconventional gas drilling is a smaller part of the overall economy, it is likely that drilling had more impact on rents in Greene County than in Washington County. Local residents interviewed in Greene County described rents that doubled or tripled, rising during the gas boom from \$300 or \$400 per month to \$1,000.

As rents rose in the region:

- Low-income renters in Greene and Washington counties saw their incomes fall, although by less than people in communities without drilling. Household incomes rose for middle- and high-income renters in Greene and Washington, even as the recession lowered incomes in the rest of Pennsylvania. (See Table 4.)
- The number of households in Greene and Washington counties paying 30% or more of income in rent – a measure of housing affordability – rose 14%. This increase, however, trailed rural and urban counties without drilling, within which the share of households paying 30% or more of their income in rent rose 20%. The increase in this share statewide reflected the decline in incomes during and immediately after the recession.
- New housing permits in Greene County fell in comparison to pre-drilling days by 22%. The recession slowed new housing construction even more in non-drilling areas (by 30%), but in Greene, the trend put further upward pressure on rents.

¹ Public use data from the U.S. Census Bureau's American Community Survey, upon which our analysis of rents is based, combines observations collected in Greene County with observations collected from Washington County.

Table 3. Change in rents in selected percentiles between 2005-2007 and 2009-2011 in Greene and Washington County				
County/region	2005-2007	2009-2011	Change	Percent Change
Median (50th percentile) rents				
Greene & Washington	\$550	\$596	\$46	8.4%
Pennsylvania, Rural*	\$691	\$690	-\$1	-0.2%
Pennsylvania, Urban*	\$853	\$848	-\$5	-0.6%
20th percentile rents				
Greene & Washington PA	\$380	\$406	\$26	6.9%
Pennsylvania, Rural*	\$477	\$470	-\$7	-1.5%
Pennsylvania, Urban*	\$588	\$581	-\$7	-1.2%
80th percentile rents				
Greene & Washington PA	\$759	\$852	\$93	12.2%
Pennsylvania, Rural*	\$954	\$945	-\$9	-0.9%
Pennsylvania, Urban*	\$1,159	\$1,172	\$13	1.2%
*The data presented here is for only rural and urban Pennsylvania counties that had zero wells drilled between 2002 and 2011.				
Source. Multi-State Shale Research Collaborative based on the American Community Survey microdata provided by Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. Integrated Public Use Microdata Series: Version 5.0 [Machine-readable database]. Minneapolis: University of Minnesota, 2010.				

Table 4. Change in household income (inflation-adjusted) of renters at selected percentiles between 2005-07 to 2009-11				
County/region	2005-2007	2009-2011	Change	Percent Change
Median (50th percentile) household income				
Greene & Washington PA	\$22,859	\$24,400	\$1,541	6.7%
Pennsylvania, Rural*	\$30,534	\$27,443	-\$3,091	-10.1%
Pennsylvania, Urban*	\$32,262	\$29,000	-\$3,262	-10.1%
20th percentile household income				
Greene & Washington PA	\$10,623	\$10,571	-\$52	-0.5%
Pennsylvania, Rural*	\$14,011	\$13,100	-\$911	-6.5%
Pennsylvania, Urban*	\$12,606	\$11,180	-\$1,426	-11.3%
80th percentile household income				
Greene & Washington PA	\$44,347	\$47,700	\$3,353	7.6%
Pennsylvania, Rural Non-Drilling Counties *	\$56,005	\$53,869	-\$2,136	-3.8%
Pennsylvania, Urban Non-Drilling Counties *	\$63,142	\$59,561	-\$3,581	-5.7%
Note. * The data presented here is for only rural and urban Pennsylvania counties that had zero wells drilled between 2002 and 2011.				
Source. Multi-State Shale Research Collaborative based on the American Community Survey microdata provided by Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. Integrated Public Use Microdata Series: Version 5.0 [Machine-readable database]. Minneapolis: University of Minnesota, 2010.				

Rising Rents: Elderly in Crisis, Homelessness, Families Divided

As drilling increased, more low-income residents in Greene County and Washington counties facing higher rents or potential eviction needed housing assistance, according to county human services personnel. Over roughly the same period, however – from 2006-2007 to 2012-2013² – available housing assistance declined due to decreased funding (Authors' Interviews).

When rents rise sharply, vulnerable populations such as low-income people, seniors, young people, and domestic violence victims have the hardest time paying rent or coming up with deposits to secure housing in the first place (Authors' Interviews).

Although seniors comprise 16% of Greene County residents, for example, they constituted 25% of the 323 people who approached the county human services office with housing crises in the first three months of 2013 (Authors' Interviews).

A local domestic violence organization reported that some clients have found it more difficult to leave abusive situations because it is so hard to find affordable housing (Authors' Interviews).

According to human service and school personnel, some Greene County residents had to move out of the county in search of affordable housing or live in houses so substandard they lacked running water. Landlords were renting unlivable properties for high prices (Authors' Interviews).

Even out-of-towners connected to the oil and gas industry needed help – creating so much demand for housing that social services provider Community Action decided to limit benefits to people who have been in Greene County for at least six months.

Homelessness on the Rise

According to service providers, homelessness rose in Greene County between 2009 and 2013 (Authors' Interviews). Providers noted that while it is rare to see the homeless sleeping on the streets of Greene County, individuals and families do live in cars, camp, or couch surf with friends and family.

In 2009-10, Greene County had the state's highest rate of homelessness assistance – 45 clients per 1,000 residents, compared to the state average of 7 per 1,000. That year, 1,733 individuals in Greene County received homeless assistance, including case management for housing problems, rental assistance, and emergency shelter (Center for Rural PA).

Greene County has no homeless shelters, forcing human services workers to send clients to shelters in nearby Washington, Pennsylvania, or Morgantown, West Virginia (Authors' Interviews). Shelters that took Greene County referrals in 2008 now are often booked to capacity (Authors' Interviews). One shelter in Washington County reports sheltering an average of 10 Greene County families and 25 individuals every year, and the county's shoestring-budget shelters can't always meet the need (Authors' Interviews, Mansfield 2013).³

“Within the past four years the number of homeless has increased...I had five new clients today alone.”
~Eric Braun,
Caseworker, Community
Action Southwest

“Housing was hard to find for women who left their abusive situation... For many of our clients, the lack of housing made it harder for people.”
~Cheryl McCready,
Domestic Violence Services
of Southwestern PA

² Homeless Assistance Program data for Greene County (which includes case management, rental assistance, and emergency shelter) show that the number of people served (adults and children) decreased from 2,755 in 2006-07 to 638 in 2012-13.

³ Plans are under way for a volunteer shelter in West Waynesburg.

Human Services: More Kids in Foster Care

As Karen Bennett, Director of Human Services in Greene County, reports, the ripple effect of rising housing costs reaches all other local human services – such as drug and alcohol, disability, and mental health services. But perhaps those most vulnerable to poverty and inadequate housing during a gas boom are children. Bennett knew of at least eight families in two years split up as parents went into shelters and kids went into foster care homes. Other children were removed from their homes because of substandard housing conditions (Authors’ Interviews; Williamson 2011).

Kids Count data spotlight the trend of children landing in foster care for housing-related reasons. (See Table 5.) In 2008-09, 15% of children in the Greene County foster care system were there because of inadequate housing. The next year, as gas drilling increased, the rate more than doubled and has remained between 30% and 40% since 2009-10.

The increased costs of foster care and the rising workload shouldered by Children and Youth Services put pressure on the county’s entire human services budget.

	Children in foster care	Children in foster care for reason of “inadequate housing”	Percent
4/1/08-3/31/09	79	12	15.2%
4/1/09-3/31/10	73	26	35.6%
4/1/10-3/31/11	71	24	33.8%
4/1/11-3/31/12	84	27	32.1%
4/1/12-3/31/13	89	36	40.4%

Source: Kids Count website

Hotels: No Room at the Inn

As a result of increased drilling and the influx of out-of-state workers to Greene County, hotel rooms are hard to find. Two new hotels were built, but a drilling company immediately rented one to house its workers for an entire year. That meant a loss to the county in revenue from its 3% hotel occupancy tax, which doesn’t apply for extended stays (Authors’ Interviews). Tourists to the area are forced to spend their lodging dollars outside the county because of this lack of available hotel rooms.

Hotels also have served as emergency shelters, but Greene County Human Services’ offer of three nights’ worth of emergency shelter funds sometimes goes unused because rooms are not available in the county. Even senior citizens displaced by a 2010 fire in their Waynesburg apartment building could not be housed at local hotels (Williamson 2011). A bad snowstorm that knocked out power and heat drove many residents to West Virginia hotels for temporary shelter (Authors’ Interviews).

RV Campsites: Unsavory and Unsafe

With the gas boom, some workers sought housing in RV parks, which expanded beyond capacity or emerged seemingly overnight, creating sewage and public safety problems. Existing RV parks that once parked six RVs were suddenly accommodating 30, and others were sited on land hastily converted for RV use. Some sites charged \$500 to \$900 per month but did not have sewage systems or safe electricity, and some were parked in flood zones (Authors’ Interviews). According to a local joke: “\$900 will get you a pond-side view.”

Some townships zone for RV parks, and the RV boom exposed out-of-date county zoning ordinances. The County Planning Commission is rewriting the Subdivision and Land Development Ordinance to tighten rules around the creation and expansion of RV parks (Authors' Interviews).

County Housing Response: Hampered by Infrastructure

While an increase in subsidized housing could address Greene County's crisis, the existing program is small, has not increased in 13 years, and is not slated for expansion. Only 30 Section 8 vouchers are given out countywide, and in 2013 several vouchers were lost due to a lack of housing meeting HUD standards (Authors' Interviews). By comparison, on a per capita basis, Butler County distributes eight vouchers for every one that Greene County releases. With limited vouchers, the waiting list is long and few spots open in a year. The Greene County Housing Authority director declined an extended interview, reporting that the county has not seen many impacts on housing (Authors' Interviews).

County government has responded to the housing crisis in several ways, but a lack of water and sewer infrastructure is a barrier. In 2012, County Commissioners reestablished a Redevelopment Authority. Its director and sole staff member, Dave Mirkovich, explored building new housing but found that existing water and sewage infrastructure could not support new developments.

Responding to the increased need for affordable housing, a portion of the funding from Pennsylvania's Marcellus Shale Impact Fee was allocated to the Pennsylvania Housing Affordability and Enhancement Fund (PHARE) to address housing problems in drilling counties – \$2.5 million in 2012 and \$5 million in subsequent years.

The county Redevelopment Authority decided to acquire, renovate, rent, and resell 13 blighted properties, acquiring PHARE funding of \$600,000 in 2013. An Ohio developer, Gateway Senior Housing, was approved for \$600,000 to construct 51 units of new affordable housing for senior citizens, including six fully accessible units (Authors' Interviews).

The county Department of Human Services opened six transitional-housing apartments for homeless people with behavioral health issues and has recently acquired PHARE funding to build four apartments for people with disabilities and low incomes. The department has also sought funding to help landlords convert properties into HUD housing, including some left worse for the wear by gas workers.

D. Traffic and Roads: High Damage, Heavy Burdens

When it comes to the costs of energy booms, road damage is typically the number one concern of local officials and residents. The impact of natural gas and oil extraction on traffic and roads, especially in rural areas, has been well documented. In Texas, Arkansas, and other states, the cost of road damage has been significant and often exceeds budgets (Campoy 2012; Oman 2010). Some communities have tied increased traffic accidents and fatalities to the traffic from shale development (Anderson and Theodori 2009). In Pennsylvania, local officials cited traffic, safety, and road damage as key concerns (Schaeffer 2011; Troxell 2011).

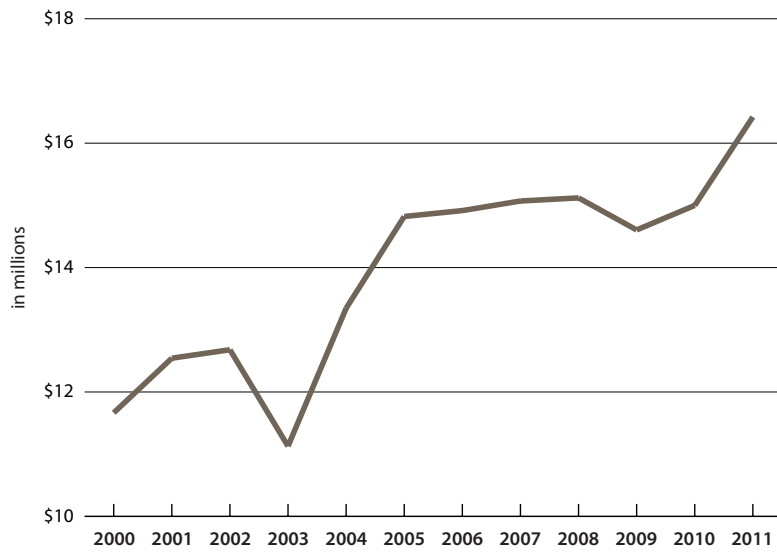
"I wish we had better prepared for drilling. You have impacts on infrastructure that wasn't anticipated. What was adequate before is not any longer."

~Chief Hawfield,
Waynesburg Borough
Police

Greene County has had similar experiences with damaged roads and collapsed bridges. Greene County's highway maintenance costs rose from \$11.7 million in 2000 to a high of \$16.4 million in 2011. (See Figure 6 below.)

In a drilling boom, construction vehicles, dump trucks, and concrete trucks come and go, carrying pipes, materials, sand, water, and chemicals. Chief Hawfield of the Waynesburg Police explained that what was adequate before, in terms of roads and infrastructure, is no longer with the increase in truck traffic. County Commissioners indicated that bridges have been damaged and collapsed because

Figure 6. State Highway Maintenance Costs, Greene County, PA 2000-2011



Source: Pennsylvania Department of Transportation.

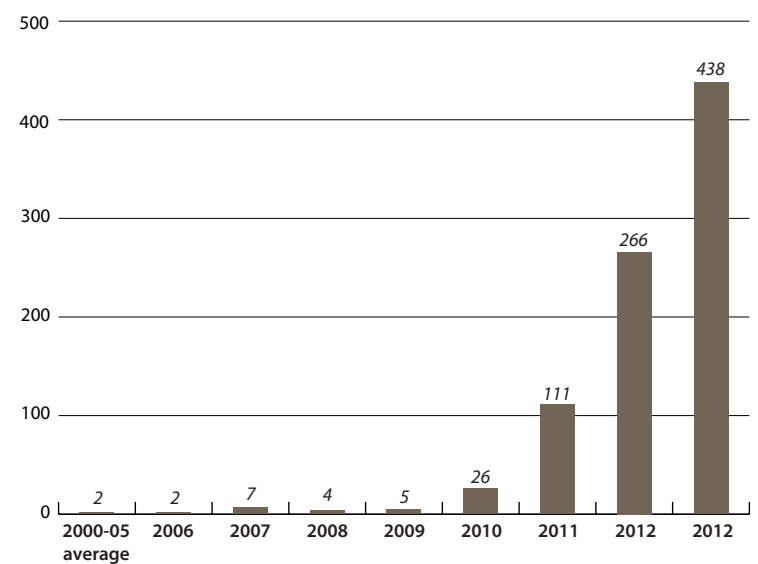
trucks ignored existing weight limits. At the time of our interviews, Waynesburg and Cumberland Township police did not have a weight machine to snare over-the-limit trucks. The Waynesburg Police Chief reported that the cost of such a machine is about \$10,000 but would easily pay for itself after several fines have been issued (Authors' Interviews).

The industry has done more over time to fix damaged roads in some drilling areas. In other instances, gas companies have not fully paid the cost of needed repairs, forcing officials to dip into county and local coffers. One county bridge collapsed with a truck stuck on it. The company paid about \$200,000 for the damage, but the county's cost to rebuild the bridge to PennDOT standards neared \$1 million. And

while it was easy in that instance to identify the company responsible, most cases are difficult to pin on a specific industry or firm.

The number of bonds that truck haulers buy to cover the costs of heavy use has risen dramatically in Greene County, from five in 2009 to 438 in 2013. Even this increase, however, does not set aside enough to cover repair costs. (See Figure 7.) PennDOT Deputy Secretary for Highway Administration Scott Christie testified that bonds cover only 10% to 20% of repair costs (Christie 2010). As a result, when users fail to make needed road repairs, bonds are not sufficient to help local governments carry the financial burden.

Figure 7. Road Bonds Issued, Greene County, PA 2000-2013



Source: Pennsylvania Department of Transportation.

Greene County has experienced a wide range of problems and costs associated with truck traffic:

- **Safety Concerns:** More trucks rumbling through the county seat of Waynesburg mean more noise and increasing safety concerns. Countywide, local officials say that trucks do not always adhere to speed limits and stop signs, endangering pedestrians and other drivers. Truck drivers “used to be safe drivers but increasingly they are not,” says the Waynesburg police chief. Cumberland Township police are getting more complaints about trucks going too fast on winding country roads. Both Cumberland and Waynesburg police noted an increase in accidents, mirrors knocked off cars, and fallen mailboxes.
- **More Traffic Fatalities:** Though Greene County traffic fatalities vary from five to 16 per year between 2000 and 2012, the 16 fatalities in 2012 were the most during that period (Pennsylvania Department of Transportation via FOIA request).

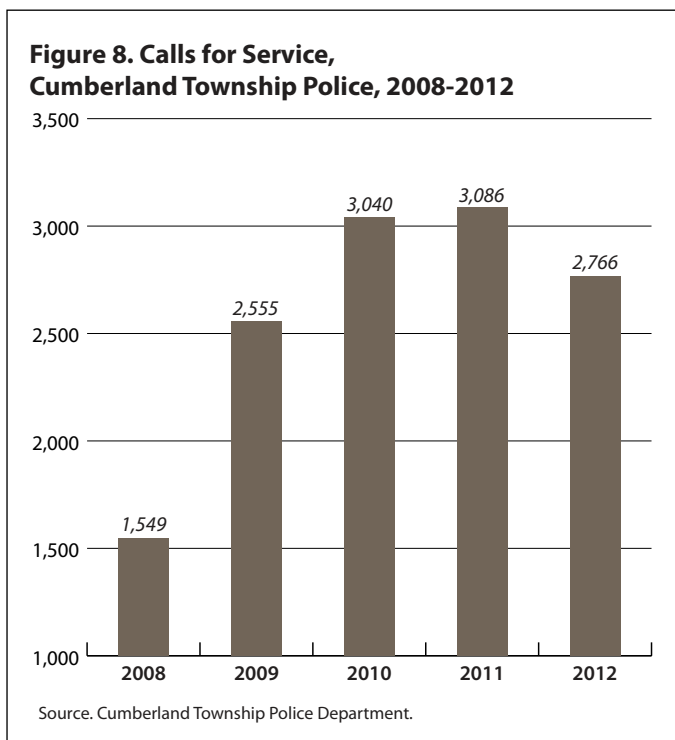
- **School Buses Stuck in Traffic:** Townships found that children were arriving at school and back home late because of truck traffic. They solved the problem by restricting truck traffic during school-bus hours.
- **Demands on Police Time:** In Waynesburg, police were pulled away from other duties to escort wide load tractor-trailers arriving in town without advanced notice. Police complained to PennDOT, which now requires trucking companies to seek police permission.

E. Emergency Services: Crime Rates Up

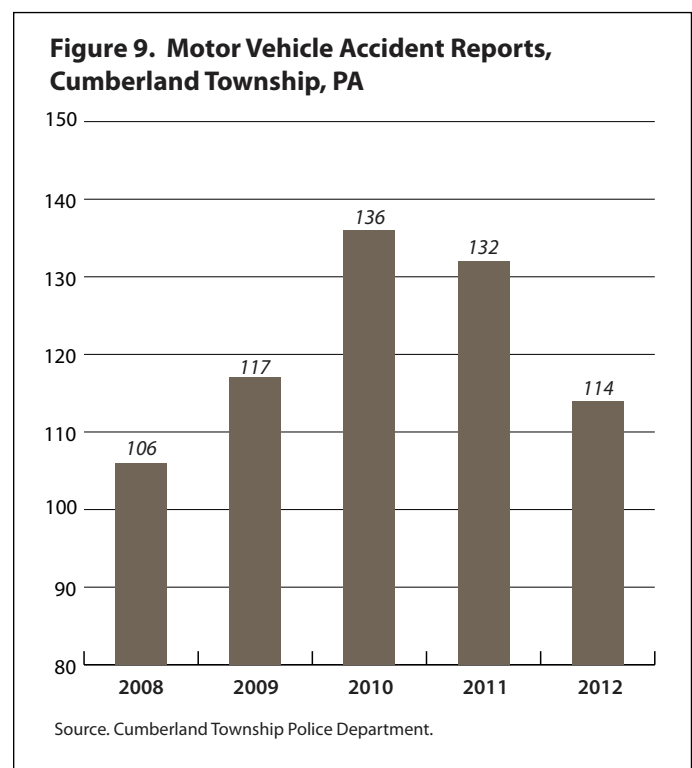
Previous research has shown that increased drilling and an influx of oil and gas workers can lead to rising crime and the need for additional law enforcement personnel (Murray and Ooms 2008; Ecosystems Research Group 2009; Headwaters Economics 2009).

In a study of seven of the heaviest drilling counties in Pennsylvania including Greene County, Kowalski and Zajac (2012) observed a decline in Pennsylvania State Police incidents/calls for service and arrests for Greene between 2006 to 2007 and 2008 to 2010, which they define as before and after drilling.

For this study, we obtained data from Cumberland Township, which had the greatest concentration of producing gas wells in the county in 2012. Overall call volume to police, which included calls for DUIs, theft, disturbances, disorderly conduct, sexual assault, and motor vehicle accidents, nearly doubled between 2008 and 2011, from 1,549 calls to 3,086 calls. Calls declined in 2012 but remain high compared to 2008. (See Figure 8.)



Disorderly conduct and motor vehicle accident calls in Cumberland Township increased when gas drilling hit its height. (See Figure 9.) Calls for disorderly conduct jumped from 32 in 2008 to 52 in 2011. Calls reporting motor vehicle accidents were at their highest in 2010 and 2011.



In interviews, Cumberland Township police also reported that increased drilling and the influx of young men working in the gas industry led to a rise in arrests for DUI, theft, bar fights, assaults, and prostitution. According to a press report, solar panels, scrap metal, and copper grounding wire have been stolen from a number of well sites in Washington and Greene counties (Observer-Reporter 2013).

Local sources maintained that Cumberland Township bar fights rose in 2010. Police were called to bars every weekend, sometimes when reported tensions between out-of-town gas drillers and locals boiled over (Authors' Interviews). With a drop in production (as drilling shifted in the county) came a drop in bar fights, said the Cumberland Township police chief. Prostitution also increased as "locals take advantage of the extra revenue" from the mostly single, male out-of-state workers coming through town (Authors' Interviews).

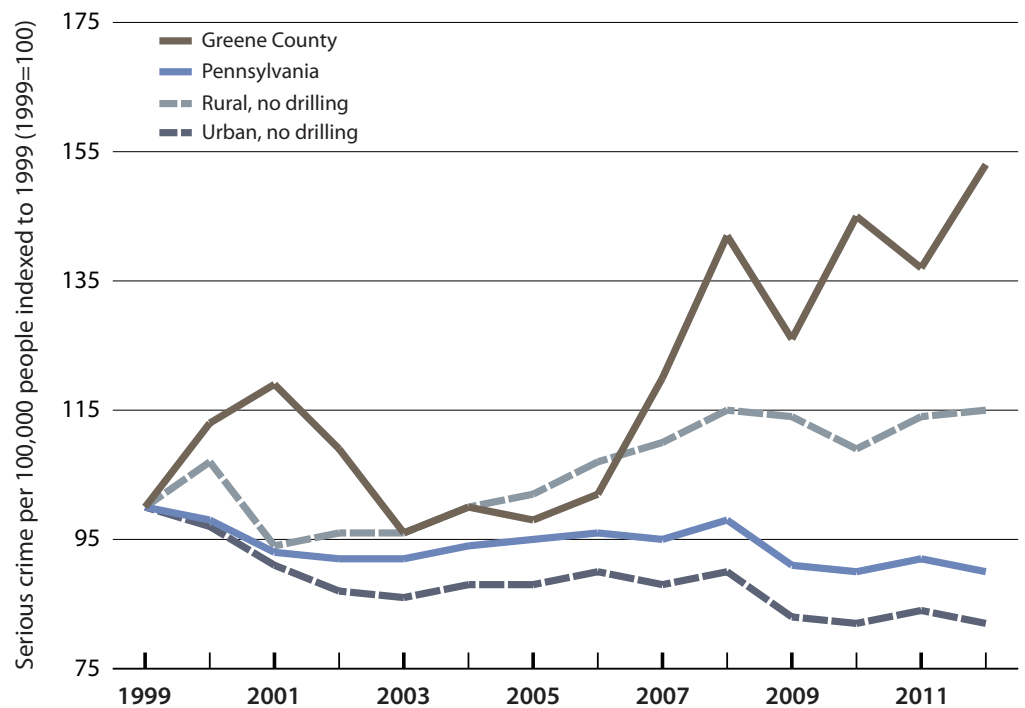
There were no reports of increased drug use, domestic violence, or sexual assaults in Cumberland Township, according to local police. A Waynesburg domestic violence non-profit corroborated the claim that domestic violence has not increased, saying that its call volume has not increased in the county. The organization did note that some drilling workers' girlfriends have sought services, including seeking shelter until they could get a ride back home (Authors' Interviews).

In Cumberland Township, home to the majority of the county's bars, DUIs were "drastically up," reported the police chief. Drunken driving rose only slightly in Waynesburg, the county seat. Shortly before drilling picked up, Waynesburg police said that they had implemented a successful crackdown on DUIs and that some Waynesburg bars had closed down (Authors' Interviews).

While Waynesburg and Cumberland Township have their own police departments, the rest of the county relies primarily on state police. Morris Township, second to Cumberland Township in number of wells, used Act 13 money to hire the Southwest Regional Police to deal with the rapid increase in truck traffic and speeding. The hired police focused mainly on improving road safety and report some improvement (Niedbala 2013).

To complement locally gathered data for this study, we assembled county-level data (covering both local police and state police) reported annually by the Pennsylvania State Police

Figure 10. Serious Crimes in Greene County and Pennsylvania, 1999-2012



Source. Multi-State Shale Collaborative based on Pennsylvania State Police and Bureau of Economic Analysis data. Note. The Pennsylvania State Police define serious crime to include murder, forcible rape, robbery, aggravated assault, burglary, larceny, motor vehicle theft, and arson. Crime per 100,000 people = offenses / population * 100,000

on serious crime.⁴ From 1999-00, long before unconventional oil and gas drilling began in Greene County, there were 1,585 crimes reported for every 100,000 residents. In the latest two year period, 2011-12, the number of serious crimes rose to 2,074 for every 100,000 residents. Between 1999-01 and 2010-12, the crime rate in Greene County grew by 31% while Pennsylvania's crime rate fell by 6%. (See Figure 10.)⁵ The rise in Greene's crime rate between these two periods was concentrated in two categories of property crime: burglary increased 25% (to 517 per 100,000 people), and larceny rose 51% (to 1,301 per 100,000 people).⁶ Among lesser offenses not included in the "serious crime" rate, the number of offenses for drug abuse and driving under the influence were also up in Greene County in the most recent three-year period.

F. Schools, Child Care, and Early Intervention: Unmet Need

During mineral booms, when emigrating workers bring their families with them, school enrollment can rise (Ecosystems Research Group 2009). Although Schafft and Glenna (2012) found no school enrollment increase in Marcellus Shale drilling regions, other studies have found impacts including higher dropout rates, more special-needs students, difficulty recruiting school staff due to high housing costs, and an increased need for ESL instruction (Ecosystems Research Group 2009; Headwaters Economics 2008; 2009; Schafft and Glenna 2012; White 2007).

Greene County's schools experienced some of the impacts documented by earlier research. Gas drilling had little impact on enrollment but drove away potential teachers and brought families likelier to need certain special education services.

Student Population: Slowing Down

Greene County school districts have seen some influx of new students from out-of-state drilling workers bringing their families with them, but not much. Some workers moved to the area without their families, while others brought their children and enrolled them in home-state cyber schools.

Overall student enrollment in public schools has steadily declined between 2004-05 (6,076 students) and 2012-13 (5,237 students), reflecting a broader trend in Pennsylvania (Pennsylvania Department of Education). County and school officials attribute some of the enrollment decline, especially in western Greene, to families leaving the area after coal companies bought their homes for demolition (Authors Interviews; Al Jazeera America 2013).

Difficulty Attracting School Staff

In the West Greene School District, the housing shortage has made it difficult to attract school staff. "People want to live close to where they work, especially with the cost of fuel," said Superintendent Thelma Szarell. "We have had people very enthusiastic about a job offer, and then they declined it later for a less desirable position closer to where they live" (Authors' Interviews).

4 The Pennsylvania State Police define serious crime to include murder, forcible rape, robbery, aggravated assault, burglary, larceny, motor vehicle theft, and arson. For more, see <http://ucr.psp.state.pa.us/UCR/Reporting/Annual/AnnualSumArrestUI.asp>, especially Table 2 of Appendix A.

5 In Pennsylvania, the crime rate per 100,000 people fell between 1999-2001 and 2010-2012 by 6% to 2,552. This trend was driven by a decline in crime rates in Pennsylvania urban areas where the crime rate fell over the same time period by 14% to 2,905 crimes per 100,000 people. It is of note that rural areas in Pennsylvania without drilling like Greene experienced a 12% increase in crime to 1,930 offenses per 100,000 people.

6 In Pennsylvania, the crime rate per 100,000 people for burglary climbed 9% to 444 from 1999-2001 to 2010-2012. The crime rate for larceny in Pennsylvania over the same period fell 1% to 1,607. A rural county is defined here as any county with less than 278 people per square mile.

High School Students Dropping Out

Companies connected to the oil and gas boom hired young men, 16 or 17 years old, who had not graduated from high school. This may have contributed to an increase in the Greene County dropout rate. (See Table 6.)⁷ The County’s Human Services Department has since come into contact with several 20-year-old men lacking high school diplomas, including a group of 15 needing help because their employer moved out of Greene County and they were being evicted.

	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Pennsylvania	1.8%	1.6%	1.5%	1.6%	2.0%
Greene County	1.6%	1.3%	1.9%	2.5%	2.6%

Source: PA Department of Education, <http://www.pde.state.pa.us/portal/server.pt/community/dropouts/7396>

Licensed Child Care Hard to Find

As hotels, grocery stores, and restaurants expand hours and more people get jobs, Child Care Information Services (CCIS) fielded many more inquiries about weekend or nighttime child care. However, few of the county’s registered daycare facilities provide weekend coverage or night hours. As one staffer reported, many child care providers often “are not open to parents with uneven schedules.” Therefore, many people needing odd-hour care can find only unlicensed care where standards may be lax or help from family and friends. In addition, Greene County human services personnel reported that families have lost child care subsidies because parents make more money from jobs related to the drilling industry (such as trucking), making child care less affordable because wage increases are not enough to cover the cost of unsubsidized child care. This “cliff effect” phenomenon is a common challenge with income-limited safety programs for which families lose eligibility if their incomes rise too much.

Drilling Families Seek Early Intervention

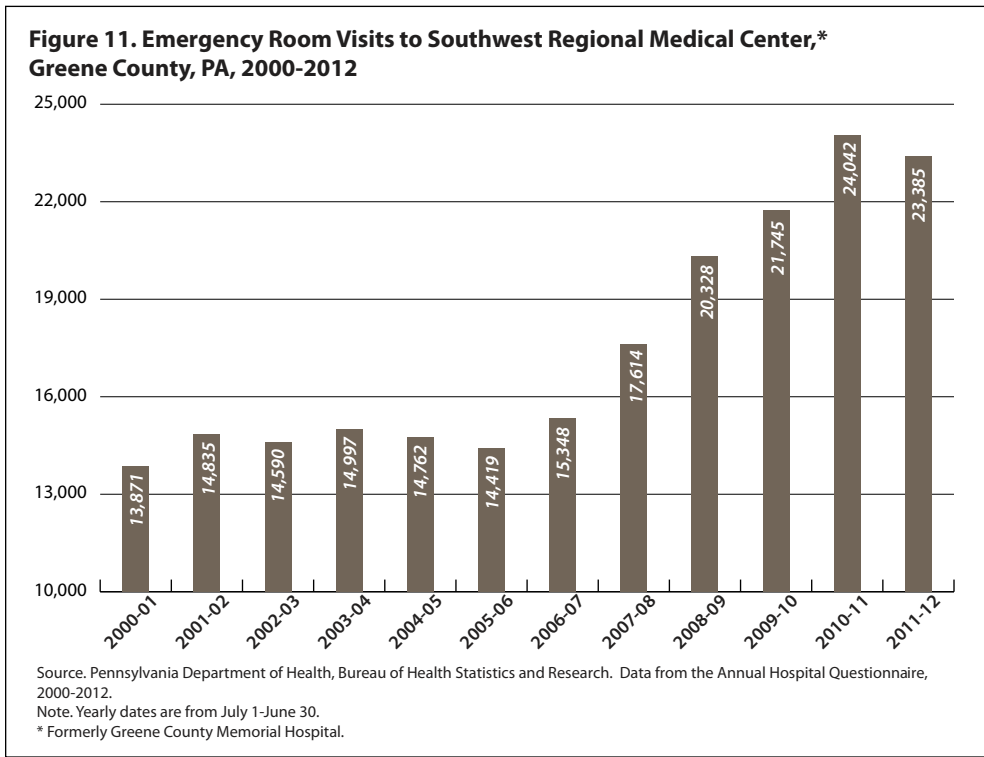
Social service staff in Greene County have observed that some drilling families need early intervention services for their children, although they did not provide an explanation for this. In a November 2012 assessment, Greene County Human Services found that drilling families accounted for one quarter of families receiving early intervention services from the county. The Tioga County case study also found an increase in the number of children requiring special education services after the boom.

G. Health Impact: Demand on Emergency Rooms Grew

Greene County’s Southwest Regional Medical Center (SRMC) saw a sharp rise in emergency room visits from 2005-2006 to 2010-2011 coinciding fairly closely with increased drilling. (See Figure 11.) An SRMC representative reported that this increase was not related to gas drilling and that there has not been a rise in the number of young men – the demographic employed most heavily as gas workers – using the ER. There was, however, an increase in hospital visits for physicals and occupational medical care related to drilling. SRMC credited most of the rise in ER use to a 2005 takeover by a for-profit corporation that attracted patients by enhancing inpatient services and the hospital’s image (Authors’ Interviews).

Another area health expert suggested this may not explain all of the increases, especially since 2008. The transition to new corporate ownership should have had the strongest impact in the first years after the change, while the continuing rise in ER visits since 2008 may be partly a drilling effect. Recent ER traffic, for example, could include more residents (not just gas workers) seeking attention for health issues related to shale gas extraction

⁷ The dropout rates in Table 10 are measured as dropouts as a percent of the total grade 7-12 population; measured as a share of the students in a single year, the rates would increase by roughly six times and so the increase since 2007-09 would be more on the order of 9% to 15%.



contamination or be related to loss of health care coverage during the recession (Authors' Interviews).

Residents, schoolchildren, and workers near oil and gas activities may be at increased risk for asthma, cancer, cardiovascular disease, and other disorders due to uncontrolled or high exposures to air pollutants, toxic chemicals, metals, radiation, noise, and light pollution, according to a 2008 review of studies on the health effects of gas drilling (Witter et al). In Greene County, environmental health experts report seeing health issues similar to those

reported consistently nationwide around unconventional natural gas drilling – headaches, abdominal pain, skin rashes, anxiety, asthma, sinus and throat irritation, muscle fatigue, nausea, dizziness, nosebleeds, depression, and respiratory problems (Walleigh 2012; Authors' Interviews).

The Harry Enstrom Chapter of the Izaak Walton League is a local conservation group that supports the economic development of mining and drilling but seeks to protect water and air from contamination. The group, with members from Greene, Washington, and Fayette counties, grew from 15 members to 137 in recent years, due to residents' concerns about gas drilling. The league trains people to test their water to establish baseline information before drilling and for possible contamination after drilling.

League members reported health concerns due to water contamination. Some members said their well water was once clean but is now undrinkable due to contamination or cracked well casings (Authors' Interviews).

Health effects from gas drilling could also have a financial impact on families, according to the Southwest Pennsylvania Environmental Health Project. Workers may have to use unpaid sick leave, possibly risking dismissal, to care for themselves or their sick kids and incur additional health-related costs. Some households must buy air filters and drinkable water (Authors' Interview). Some Izaak Walton League members reported significant costs from rebuilding damaged water wells, hauling water, buying safe water for livestock, and buying bottled water to drink.

VI.

Limited Revenue for Local Government

Marcellus Shale development has produced new tax revenue for state coffers but, because of Pennsylvania's particular tax structure, offers very little in the way of new revenue to local governments and communities that bear the brunt of drilling activity.

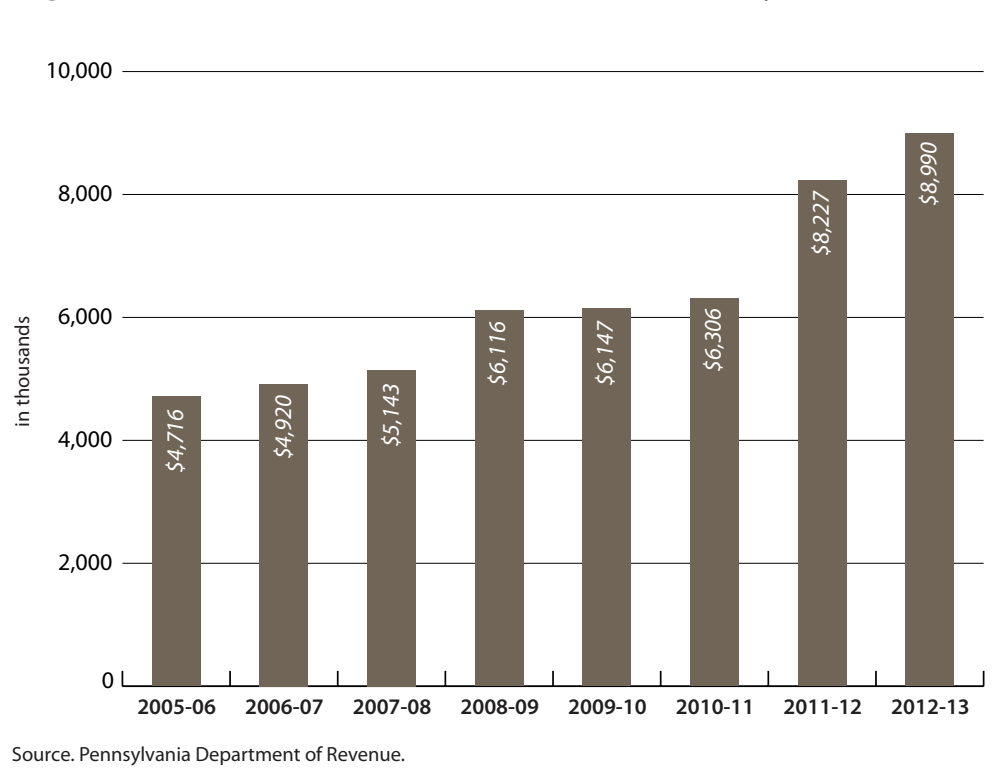
Total personal income tax (PIT) revenue from Greene County grew by almost 50% from 2005 through 2011, from \$15.4 million to \$23.1 million. The county's share of Pennsylvania's total PIT collections remained steady and small, just 0.2%, throughout the period.

Sales taxes generated in the county also grew between fiscal year 2005-06 and 2012-13. Growth continued slowly through the recession and first two years of recovery, then jumped by 30% in 2011-12. In contrast, statewide sales tax revenue fell each year between 2007-08 and 2010-11 before rebounding with 7% growth in 2011-12.

Pennsylvania has no county-level sales tax, so an increase in vehicle sales, drilling supplies, or food and alcohol will not affect county tax collections. Perhaps the biggest potential source of local tax revenue — property tax on drilling equipment and value of natural gas reserves — is no longer available, as a successful court challenge by the Pennsylvania Oil and Gas Association removed these products from the list of taxable items, although other minerals are still subject to the tax. The court case led to a significant revenue loss, particularly to school districts.

In Wetzel County, West Virginia, which like Greene County had a robust conventional gas industry prior to the development of shale, total property tax collections for school, county, and municipal governments almost tripled between 2005 and 2013, rising from \$10 million to \$27.5 million, largely as a result of increased assessments of gas inventories and property.

Figure 12. Sales and Use Tax Collections, Greene County, PA



Local governments in Pennsylvania see little income from higher rents and royalty payments, which are not subject to local earned income taxes.

County and municipal officials advocated for tax revenue to help offset local drilling costs and impacts. Act 13 of 2012 imposed a per well fee on all unconventional wells in the state, allocating 60% to local governments to be split between counties and municipalities hosting or adjacent to active drilling areas. Another 40% of the fee is allocated to transportation, environmental conservation programs, housing, water infrastructure, and other statewide needs.

Pennsylvania collected \$204 million for wells drilled through 2011, \$202 million in 2012, and \$224.5 million in 2013. The impact fee is expected to raise comparable amounts through the next 10 years.

Greene County has received \$3.13 million in Act 13 payments for wells put in service between 2008 and 2011, the state's sixth-highest allocation. Twenty-six municipalities in the county received an additional \$5.2 million in Act 13 payments. Cumberland Township received \$1.0 million, the second-largest municipal payment in the state. For 2012 Greene County received \$2.9 million and municipalities received an additional \$4.7 million (PA Public Utility Commission County and Municipal Disbursement 2011, 2012).

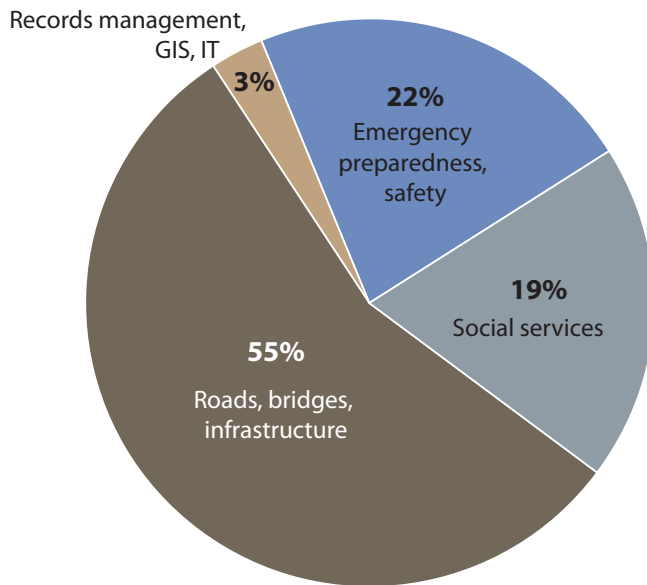
As Figure 13 documents, 55% of Greene County's impact fee money was spent on roads, bridges, and public infrastructure, 22% was spent on emergency services, 19% was spent on social services, and 3% was spent on records management. County commissioners used funding to address structural problems with facilities and properties, including fixing the courthouse roof, investing in a new Nathaniel Greene statue atop the county courthouse, updating an old water system, and improving local parks.

Some townships report using Act 13 money to replace township roads, to purchase equipment such as dump trucks and graters, and to fund local fire departments. Cumberland Township police used funds for additional police shifts and bought a new patrol car and an additional Taser.

The majority of Act 13 funds allocated to municipalities were unspent, going directly into reserve funds. Municipal officials seem reluctant, at the moment, to build Act 13 revenue into budgets as an ongoing revenue source. Greene

County commissioners, for example, did not budget for the revenue in the first year because they were unsure about the amount. As time goes on, counties and municipalities may become more willing to build this revenue into their general fund budgets.

Figure 13. Use of Act 13 Payments, Greene County, PA 2012



Source: Greene County's Unconventional Gas Well Fund Usage Report, 2012.

Greene County's experience with unconventional gas drilling has much in common with other high development communities but is also somewhat unique. The county has long been a poster child for the "resource curse," highly dependent on coal and gas extraction with higher poverty and lower income than the state as a whole. Still, the early years of unconventional gas drilling has benefited Greene County – perhaps more than any other county in the state – with rapid growth in employment and a boost in county income.

On the flip side is the swift and overwhelming impact of an extractive industry creating multiple, simultaneous impacts across communities, impacts not associated with conventional gas extraction. Both county and municipal governments lacked tools necessary to get a handle on, much less get out in front of, drilling-related impacts. Those tools are clearly lacking. The Pennsylvania Supreme Court decision invalidating Act 13's prohibition against local zoning controls offers an important opportunity for local governments to regain some control – by adopting, for example, local zoning ordinances making drilling a conditional rather than permitted use in residentially-zoned areas. Nearly 40% of the county's 26 municipalities lack zoning ordinances, so there is room for improvement.

Greene County holds many lessons for areas that are or will experience an increase in gas extraction in the coming years. Our recommendations:

Deeds and Permitting. Greene County is one of the few counties to keep detailed records of land leases that are published online. Leasing activity is the canary in the coalmine for future unconventional drilling. Counties should establish good leasing databases, and prepare regular reports for municipalities to help them anticipate and plan for future drilling activity.

Zoning and Land Use. Many states retain significant control over oil and gas operations at the state level, and keeping that control at the state, rather than local level, in Pennsylvania is a high priority for companies. Municipalities should attempt to keep a hand in siting authority. At a minimum, all municipalities should adopt local zoning ordinances and modify existing ordinances to gain some handle on the siting of wells within the confines of state law.

Planning and Communications. Communications between the industry and local officials is limited, especially when local governments have no permitting or siting authority. Counties should establish a local oil and gas commission early on to address the communications gap. This commission could include county commissioners and municipal officials, county agencies, landowner groups, industry, and members of the public.

Landowner Rights. Counties should encourage development of local landowner groups. The groups can educate landowners about leases and improve landowners' bargaining power with the industry. Legislation currently pending in the Pennsylvania General Assembly that would help to prevent companies from deducting costs from royalties should be passed.

Paying for Drilling-related Impacts. Coal companies pay local property taxes on the value of reserves, and natural gas companies should do the same. This is the most direct way to match impacts to the location in which they occur. It will also provide much needed funding to local school districts lost after a 2002 Pennsylvania Supreme Court case invalidated property taxes on natural gas reserves (Pennsylvania Independent Oil and Gas Association vs. Fayette County).

Enact a Severance Tax Similar to That in Effect in West Virginia. Pennsylvania is the only mineral-rich state that does not have a severance tax and is losing out on needed revenue. By 2019-20, a 4% natural gas severance tax could generate nearly three times as much money as the current impact fee. Funding could support better enforcement of environmental regulations, support economic development throughout the state, and provide additional funds to local governments coping with drilling-related impacts.

Road Repairs and Safety. Road damage from heavy trucks is one of the primary concerns of local officials. Costs are high for repair, enforcement, and traffic safety and should be borne by industry rather than local or state taxpayers.

- States should proactively post weight limits in areas where drilling is anticipated and provide funding for local governments to post local roads and bridges.
- Enforcement of speed and weight limits should be a high priority. Funding for state and local police is necessary to ensure timely and regular enforcement.
- Localities should invest in a weight machine, around \$10,000, to improve enforcement of weight limits. States could provide the funding, or funds could be allocated from a severance tax or impact fee.
- Heavy truck traffic should be limited to times outside of morning and afternoon pick-up and drop-off of local school students.
- Companies should be required to contact local police for permission in advance for wide-load trucks that require a police escort.

Housing Impacts. Rapidly escalating rents are a burden on low-income households, increase homelessness, and need to be addressed proactively.

- Probably the best temporary approach to housing is to allow the establishment of man-camps. Counties or localities should proactively identify appropriate sites, for example, existing RV parks, and work with owners and companies to expand those sites.
- Counties should use local funds or drilling fee income to establish a local housing voucher program to help low-income families stay in their homes.
- Pennsylvania's PHARE program, funded with Act 13 impact fee dollars and administered by the Pennsylvania Housing Finance Agency, is a good model for improving housing stock and addressing permanent housing solutions. Other states should adopt this model.

Human Services. In both Greene and Tioga counties, we found that drilling activity is particularly hard on the poor, who cannot pay for housing and have not benefitted from employment or royalty income. Drilling activity has brought with it increased demand for a range of social services, for the poor and for drilling families, yet human service funding has not been identified as a high priority use for impact fee dollars.

Table A1.1.A Employment (annual) by Sector in Greene County													
Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2005 to 2012	
												Change	Percent Change
Total, all industries	11,727	11,521	11,682	11,788	12,028	12,675	12,829	13,297	13,602	14,342	15,380	3,592	30.5%
Private	8,828	8,676	9,069	9,122	9,289	9,930	10,074	10,571	10,877	11,673	12,791	3,669	40.2%
Natural Resources and Mining	2,749	2,467	2,451	2,528	2,678	2,926	3,017	3,284	3,099	3,637	4,269	1,741	68.9%
• NAICS 212 Mining, except oil and gas	2,603	2,300	2,274	2,370	2,468	2,589	2,729	2,887	2,856	2,996	3,045	675	28.5%
• NAICS 213 Support activities for mining				159	135	184		257		200	496	1,057	922
Construction	254	200	241	415	504	635	657	613	689	890	1,214	799	192.5%
Manufacturing	682	609	622	607	471	527	448	363	387	385	379	-228	-37.6%
Trade, Transportation, and Utilities	2,102	2,112	2,250	2,083	2,032	1,988	2,033	2,260	2,386	2,568	2,630	547	26.3%
Information	85	78	81	90	85	83	90	86	76	78	71	-19	-21.1%
Financial Activities	292	302	334	343	334	319	329	388	490	382	438	95	27.7%
Professional and Business Services	225	407	569	511	447	495	552	546	519	562	576	65	12.7%
Education and Health Services	1,457	1,489	1,510	1,577	1,782	1,857	1,838	1,850	1,921	1,857	1,923	346	21.9%
Leisure and Hospitality	577	599	572	579	595	660	670	737	820	781	816	237	40.9%
Other Services	398	413	440	389	361	440	440	445	491	533	475	86	22.1%
Public	2,900	2,845	2,614	2,665	2,739	2,745	2,756	2,725	2,725	2,670	2,590	-75	-2.8%
Federal	119	136	137	138	135	137	139	144	149	128	126	-12	-8.7%
State	1,179	1,086	904	898	944	924	910	917	935	929	909	11	1.2%
Local	1,602	1,623	1,573	1,629	1,660	1,684	1,707	1,664	1,641	1,613	1,555	-74	-4.5%

*In most years, "NAICS 211 Oil and gas extraction" is not reported separately. Therefore we do not include it in this table. The last year this figure was reported separately, in 2010, there were 33 jobs in this detailed industry.

Source: Multi-State Shale Collaborative based on Quarterly Census of Employment and Wage data

The following persons were interviewed and/or provided us with information during our research in 2013 and 2014.

- **Cindy Bailey**, Editor/Publisher of *Greenespeak*
- **Karen Bennett**, Director of the Greene County Department of Human Services
- **Eric Braun**, Family Economic Success Caseworker at Community Action Southwest
- **Rebecca Capozza**, Staff at Domestic Violence Services of Southwestern PA (Greene County office)
- **Rebecca Cook**, Director of Safe Haven and the Family Shelter (Washington County)
- **Veronica Coptis**, Community Organizer at the Center for Coalfield Justice
- **Mary Ann Dispenza**, Case Management Coordinator at the Greene County Department of Human Services
- **Joy Eggleston**, Senior Public Affairs Officer at the Southwest Regional Medical Center
- **Timothy Hawfield**, Chief of the Waynesburg Borough Police
- **Jeremy Kelly**, Planning and Business Development Manager at the Greene County Planning Commission
- **Kyle Kooyers**, Americorps Vista, Greene County Outreach Vista, Greater Pittsburgh Community Foodbank
- **Jill Kriesky, Ph.D.**, Associate Director at the Southwest Pennsylvania Environmental Health Project
- **Cheryl McCready**, Satellite Office Coordinator at the Domestic Violence Services of Southwestern Pennsylvania
- **Craig Miller**, Chief of the Cumberland Township Police
- **Dave Mirkovich**, Executive Director of the Redevelopment Authority in Greene County
- **Chuck Morris**, Greene County Commissioner
- **Lloyd Richard**, Manager of the Carmichaels Borough Municipal Authority
- **Raina Rippel**, Director of the Southwest Pennsylvania Environmental Health Project
- **Amy Switalski**, Greene County Director of Housing and Family Resources at the Greene County Department of Human Services
- **Thelma Szarell**, Superintendent of the West Greene School District
- **Archie Trader**, Greene County Commissioner
- **Becky Whoolery**, Family Economic Success Associate Director at Community Action Southwest
- **Members of the Izaak Walton League of America**, Greene County Chapter

- Act 13: Public Utility Commission. (n.d.) "Impact Fees." PUC. Accessed on 1/3/14 at <https://www.act13-reporting.puc.pa.gov/Modules/PublicReporting/Overview.aspx>.
- Al Jazeera America. 2013. "In Pennsylvania town, fracking presents unclear future." Al Jazeera America, October 14, 2013. Accessed on 12/28/13 at <http://america.aljazeera.com/watch/shows/america-tonight/america-tonight-blog/2013/10/14/in-pennsylvania-frackingpresentsunclearfuturefortown.html>.
- Alter, T. R., & Ooms, T. 2010. "Baseline Socioeconomic Analysis for the Marcellus Shale Development in Pennsylvania." Department of Agricultural Economics and Rural Sociology and The Institute for Public Policy and Economic Development at Wilkes University. August 31, 2010. Accessed on 3/18/14 at <http://energy.wilkes.edu/PDFFiles/Economics/Marcellus%20Shale%20Study%20-%20ARC%2008.31.2010.pdf>.
- American Community Survey. Various years. "Poverty status in the past 12 months: 2007-2011, 5-Year Estimates" [data tables].
- Anderson, B., & Theodori, G. 2009. "Local Leaders' Perceptions of Energy Development in the Barnett Shale." *Southern Rural Sociological Association*, 2009.
- Bureau of Economic Analysis. Various years. "CA1-3 Personal income summary" [data tables]. <http://bea.gov/>
- Campoy, Ana. 2012. "Drilling Strains Rural Roads: Counties Struggle to Repair Damage from Heavy Trucks in Texas Energy Boom." *The Wall Street Journal*, July 26, 2012. Accessed on 3/13/14 at <http://online.wsj.com/news/articles/SB10000872396390444840104577551223860569402>.
- Cato, Jason. 2013. "Neighbors in rural Pennsylvania areas leery of proposed deep-mine projects." *TribLive*. 6/22/13. Accessed on 1/3/14 at <http://triblive.com/news/editorspicks/4096364-74/coal-mine-county#axzz2g6WKNDTT>.
- Center for Rural Pennsylvania. Various years. "County Profiles" [data tables]. <http://www.ruralpa2.org/>
- Christie, Scott. 2010. "Protecting Our Roads – House Transportation Committee." Testimony by Scott Christie, P.E. Deputy Secretary for Highway Administration. June 10, 2010.
- Cusick, Marie. 2013a. "Bradford County Landowners Accuse Chesapeake of Underpaying Royalties." *StateImpact Pennsylvania*: June 17, 2013. Accessed on 12/20/13 at <http://stateimpact.npr.org/pennsylvania/2013/06/17/landowners-dispute-chesapeake-royalty-payments-in-bradford-county/>.
- Cusick, Marie. 2013b. "Corbett Signs Controversial Bill Giving Drillers Power to Pool Leases." *StateImpact Pennsylvania*: NPR. July 9, 2013. Accessed on 1/3/14 at <http://stateimpact.npr.org/pennsylvania/2013/07/09/corbett-signs-controversial-bill-giving-drillers-power-to-pool-leases/>.
- Dahl, G., Price, C., & Kalish D. 2010. "Oil and Gas Regulation: A Guide for Local Governments." *Colorado Department of Local Affairs*. Accessed on 3/17/14 at <http://www.springsgov.com/units/boardscomm/OilGas/DOLA%20O&G%20Guide%20for%20Local%20Governments.pdf>.
- Delaware Riverkeeper Network. 2012. "Pennsylvania Municipality Support for Legal Challenge to Act 13 Growing: Sixty Seven Municipalities Go on Record Opposing Municipal Preemption." Press Release: Delaware Riverkeeper Network. 7/19/12. Accessed on 1/3/14 at <http://www.delawareriverkeeper.org/resources/PressReleases/press%20release%207.18.12.pdf>.
- Drouin, Roger. "How the Fracking Boom Could Lead to a Housing Bust." *The Atlantic: Cities: Place Matters*. August 19, 2013. Accessed on 12/10/13 at <http://www.theatlanticcities.com/politics/2013/08/how-fracking-boom-could-lead-housing-bust/6588/>.
- Ecosystems Research Group. 2008. "Sublette County Socioeconomic Impact Study: Phase I Final Report." Sublette County Commissioners.

Ecosystems Research Group. 2009. "Sublette County Socioeconomic Impact Study: Phase II Final Report." Sublette County Commissioners.

Ferris, Steve. 2011. "Carmichaels water contaminated again." *Greene County Messenger*, June 17, 2011. Accessed on 1/20/14 at http://www.heraldstandard.com/gcm/news/local_news/carmichaels-water-contaminated-again/article_10136fd8-003f-55bf-b570-3e887fd3b344.html.

Ferris, Steve. 2013. "Marcellus well drilling slowing down." *Shale Reporter*, February 24, 2013.

Greene County, PA. (n.d. a) "A Rich Heritage...History of Greene County, Pennsylvania" Accessed on 1/3/14 at <http://www.co.greene.pa.us/secured/gc2/history/GC-history.htm>.

Greene County, PA. (n.d. b) "Oil and Gas Drilling Information: Greene County Conservation District." Accessed on 1/3/14 at <http://www.co.greene.pa.us/secured/gc2/depts/ed/conserv/oil-gas.htm>.

Gopalakrishnan, S., & Klaiber, H. A. 2012. "Is The Shale Boom a Bust for Nearby Residents? Evidence from Housing Values in Pennsylvania." *Ohio State University Department of Agricultural, Environmental, and Development Economics*, December 2012.

Hargreaves, Steve. 2012. "Natural gas hit 10-year low." *CNN Money*. 3/9/12. Accessed on 1/4/14 at <http://money.cnn.com/2012/03/09/markets/natural-gas-prices/index.htm>.

Hartle, A. S. F. 2012. Holding the Deed, could leasing agreements generate additional revenue for your school? *Pennsylvania School Boards Association Bulletin*, August.

Headwaters Economics. 2008. "Impacts of Energy Development in Colorado: With a Case Study of Mesa and Garfield Counties." *Headwaters Economics*: Bozeman, Montana, November 2008.

Headwaters Economics. 2009. "Impacts of Energy Development in Wyoming: With a Case Study of Sweetwater County." *Headwaters Economics*: Bozeman Montana, March 2009.

Jacquet, J. 2005. "Index Crimes, Arrests, and Incidents in Sublette County 1995 to 2004." *Sublette County, Wyoming*, Dec. 2005.

Jacquet, J. 2009. "Energy Boomtowns & Natural Gas: Implications for Marcellus Shale Local Governments & Rural Communities". *Northeast Regional Center for Rural Development*, 2009.

Kane, Tom. 2008. "Drilling Debate Divisive." *The River Reporter*, April 17, 2008.

Kelsey, Timothy W., Alex Metcalf and Rodrigo Salcedo. 2012. "Marcellus Shale: Land Ownership, Local Voice, and the Distribution of Lease and Royalty Dollars." *Penn State: Center for Economic and Community Development. CECD Research Paper Series*.

Kelsey, Timothy W., Martin Shields, James R. Ladlee, Melissa Ward in cooperation with Tracy L. Brundage, Jeffrey F. Lorson, Larry L. Michael and Thomas B. Murphy. 2011. "Economic Impacts of Marcellus Shale in Pennsylvania: Employment and Income in 2009." *Marcellus Shale Education and Training Center: Pennsylvania College of Technology and Penn State Extension*.

Kowalski, L., & Zajac, G. A Preliminary Examination of Marcellus Shale Drilling Activity and Crime Trends in Pennsylvania. *Pennsylvania State University, Justice Center for Research* 9 Jan. 2012.

Lustgarten, Abraham. 2013. "Unfair Share: How Oil and Gas Drillers Avoid Paying Royalties." *Propublica*, August 13, 2013. Accessed on 12/20/13 at <http://www.propublica.org/article/unfair-share-how-oil-and-gas-drillers-avoid-paying-royalties>.

Mansfield, Karen. 2013. "Emergency housing in short supply." *Observer Reporter*. April 21, 2013.

Mauro, Frank, Michael Wood, Michele Mattingly, Mark Price, Stephen Herzenberg, Sharon Ward. 2013. "Exaggerating the Employment Impacts of Shale Drilling: How and Why." *Multi-State Shale Research Collaborative*. November 2013.

McGill, Andrew. (n.d.) "Falling Prices, Moving Rigs: An interactive look at the natural gas industry's move across the Marcellus region." Pipeline; Pittsburgh Post-Gazette. Accessed on 1/4/14 at <http://newsinteractive.post-gazette.com/rigmap/>.

McKenzie, Lisa M., Roxana Z. Witter, Lee S. Newman, John L. Adgate. 2012. "Human health risk assessment of air emissions from development of natural gas resources." Elsevier: Science of the Total Environment. Accessed on 1/8/14 at <http://cogcc.state.co.us/library/setbackstakeholdergroup/Presentations/Health%20Risk%20Assessment%20of%20Air%20Emissions%20From%20Unconventional%20Natural%20Gas%20-%20HMcKenzie2012.pdf>.

Mierzwa, Erin, Kathryn P. Nelson and Harriet Newburger. 2010. "Affordability and Availability of Rental Housing in Pennsylvania." Federal Reserve Bank of Philadelphia. March 2010.

Miller, Barbara. 2013. "Location, Location, Location: why the homeless may end up in Washington." Observer Reporter. May 10, 2013.

Mufson, S. 2012. "In North Dakota, the gritty side of an oil boom." *Washington Post*, July 18, 2012. Accessed on 3/17/14 at http://www.washingtonpost.com/business/economy/in-north-dakota-the-gritty-side-of-an-oil-boom/2012/07/18/gJQAZk5ZuW_print.html.

Muehlenbachs, L., Spiller, E., & Timmins, C. 2012. Shale Gas Development and Property Values: Differences Across Drinking Water Sources. *National Bureau of Economic Research Working paper 18390*.

Murray, S., & Ooms, T. 2008. The Impact of Marcellus Shale in Northeastern Pennsylvania with an Emphasis on Charities, Crime, and Poverty. Joint Urban Studies Center. May.

Niedbala, Bob. 2013. "New police presence making a difference in Morris Township." Observer-Reporter. September 28, 2013. Accessed on 12/12/13 at <http://www.observer-reporter.com/article/20130928/NEWS02/130929306#.UqipL11RaBx>.

Observer-Reporter. 2013. "Copper stolen from Range Resources drilling sites." Observer-Reporter. October 11, 2013. Accessed on 12/12/13 at http://www.observer-reporter.com/article/20131011/NEWS01/131019858/-1/NEWS#.Uqji_11RaBx.

Oman, Noel E. 2010. "Bad roads sprout in Fayetteville Shale: State directs gas-severance-tax revenue to repairs put at \$218.7 million." *Arkansas Democrat-Gazette*, June 3, 2010.

Ooms, T., & Tracewski, S. 2011. Impact on Housing in Appalachian Pennsylvania as a Result of Marcellus Shale. *The Institute for Public Policy and Economic Development*, November.

PA Budget and Policy Center. 2013. "Pa.'s Marcellus Impact Fee Comes Up Short." Policy Brief, PBPC. June 18, 2013. Accessed 12/12/13 at <http://pennbpc.org/pa-marcellus-impact-fee-comes-short>.

Pennsylvania Department of Environmental Protection. Various years. DEP Permits Issued Detailed Report. [data tables]. http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/Permits_Issued_Detail

Pennsylvania Department of Environmental Protection. Various years. DEP SPUD reports. [data tables]. http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/Spud_External_Data

Pennsylvania Department of Environmental Protection. Various years. DEP Oil and Gas Reporting. [data tables]. <https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/Welcome/Welcome.aspx>

Pennsylvania Housing Finance Agency. 2012. "Pennsylvania Housing Availability and Affordability Report." PHFA. September 2012.

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

Peters, Andy. 2013. "Fracking Boom Gives Banks Mortgage Headaches." *American Banker*. November 12, 2013. Accessed on 12-10-13 at http://www.americanbanker.com/issues/178_218/fracking-boom-gives-banks-mortgage-headaches-1063561-1.html?zkPrintable=1&nopagination=1.

- Price, Mark and Stephen Herzenberg. 2013. "The State of Working Pennsylvania 2013." Keystone Research Center, Harrisburg, PA.
- Redifer, J., Jouflas, G., Chase, T., & Morris S. 2007. Socioeconomic Impacts of Growth. *Mesa State College Natural Resource and Land Policy Institute*.
- Rodgers, M., Fogle, N., Kelsey, T.W., Lembeck, S., Pifer, R., Whitmer, W., & Wulfhorst, P. 2008. "Marcellus Shale: What Local Government Officials Need to Know." *Pennsylvania State University, College of Agricultural Sciences, Agricultural Research and Cooperative Extension*.
- Schafft, K. A., & Glenna, L.L. 2012. "Marcellus Shale Gas Development: What Does It Mean for Pennsylvania Schools?" *Pennsylvania State University, College of Agricultural Sciences, Cooperative Extension*.
- Schwartzel, Erich. 2013. "ShaleNET: Government-funded program helps job-seekers find work in energy industry." Pittsburgh Post-Gazette. 2/10/13. Accessed on 1/4/14 at <http://www.post-gazette.com/businessnews/2013/02/10/ShaleNET-Government-funded-program-helps-job-seekers-find-work-in-energy-industry/stories/201302100338>.
- Shrum, Rick. 2013. "Coal debate heats up in southwestern Pa." The Sunday Dispatch, 9/7/13. Accessed on 1/3/14 at <http://psdispatch.com/news/news-state/814576/Coal-debate-heats-up-in-southwestern-Pa..>
- State Impact. (n.d. a) "What's the Difference Between Wet and Dry Natural Gas." State Impact, NPR. Accessed on 1/3/14 at <http://stateimpact.npr.org/pennsylvania/tag/natural-gas-prices/>.
- State Impact. (n.d. b) "What the impact fee law, Act 13, means for Pennsylvania." State Impact, NPR. Accessed on 1/3/14 at <http://stateimpact.npr.org/pennsylvania/tag/impact-fee/>.
- Stevens, Jon. 2013. "Elderly at risk for homelessness." Observer Reporter. April 20, 2013.
- Walleigh, Leslie A. 2012. "Health Concerns from Unconventional Gas Extraction." SWPA-EHP, Washington County, PA. 7-20-12 (powerpoint).
- Weider, B. 2011. Schools Fill Budget Holes With Fracking Revenues. *Pew Charitable Trusts*, August 30, 2011.
- White, Phil. 2007. "Boom hits Wyo court system: Officials in counties with rapid energy development see dramatic caseload increases." Star-Tribune, August 13, 2007. Accessed on 3/13/14 at http://trib.com/news/top_story/boom-hits-wyo-court-system/article_8b260430-78a1-5da0-8ebc-01beaba2d195.html.
- Williamson, Jonathan, Bonita Kolb. 2011. "Marcellus Natural Gas Developments Effect on Housing in Pennsylvania." Center for the Study of Community and the Economy, Lycoming College. September 31, 2011.
- Witter, R., Stinson, K., Sackett, H., Putter, S., Kinney, G. et al. 2008. "Potential exposure-related human health effects of oil and gas development: A white paper." September 15, 2008. Accessed on 1/7/14 at http://docs.nrdc.org/health/files/hea_08091702a.pdf.
- Wood, Michael and Sharon Ward. 2009. "Responsible Growth: Protecting the Public Interest with a Natural Gas Severance Tax." Pennsylvania Budget and Policy Center. April 2009.
- Yerace, Tom. 2012. "Amid natural gas drilling boom, conventional wells hold edge." TribLive. Accessed on 12/15/13 at <http://triblive.com/neighborhoods/yourallekiskivalley/2912294-87/gas-wells-brown-weaver-natural-marcellus-companies-conventional-business-lot#axzz2CfRXAjyx>.
- Zwick, Kevin. 2014. "Capitolwire: House panel approves gas royalty payment changes." Capitolwire, March 17, 2014.

