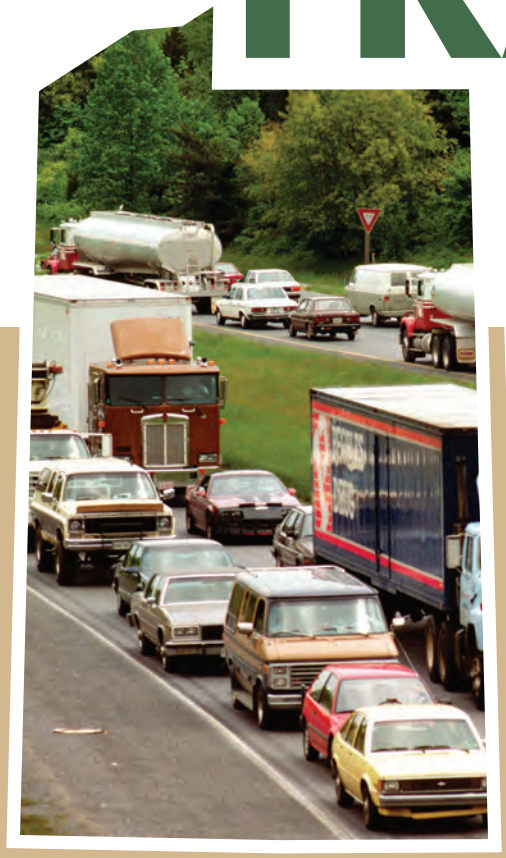
# The Social Costs of FRACKING




## A PENNSYLVANIA CASE STUDY

food&waterwatch

## About Food & Water Watch

Food & Water Watch works to ensure the food, water and fish we consume is safe, accessible and sustainable. So we can all enjoy and trust in what we eat and drink, we help people take charge of where their food comes from, keep clean, affordable, public tap water flowing freely to our homes, protect the environmental quality of oceans, force government to do its job protecting citizens, and educate about the importance of keeping shared resources under public control.

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## A PENNSYLVANIA CASE STUDY

## Executive Summary

Pennsylvania's natural gas boom has brought thousands of new gas wells, a number of transient workers and a host of social problems. Food & Water Watch found that traffic accidents, civic disturbances and public health problems in rural Pennsylvania counties have increased since the shale rush began in 2005, diminishing the quality of life for residents of once-bucolic communities.

Economic downturns like the Great Recession are often associated with negative outcomes, but these social and public health costs increased more in rural counties with the new shale gas wells than in rural counties without shale gas drilling. These negative social impacts were especially pronounced in the counties with the highest density of shale gas wells.

The oil and gas industry has surged over the past decade by employing new techniques and technologies that combine horizontal drilling and hydraulic fracturing (or "fracking") to extract gas from shale and other underground rock formations. Fracking injects large quantities of water, sand and toxic chemicals under high pressure to release gas tightly held in rock layers.[1] Fracking has expanded rapidly in areas across the country, but Pennsylvania has been at the epicenter of the nation's fracking boom, with nearly 5,000 shale gas wells drilled between 2005 and 2011.[2]

The fracking boom has brought heavy trucks crowding rural roads and out-of-state workers flooding small towns, often overwhelming local housing, police and public health capacities. The influx of transient workers with disposable income and little to do in their off hours is a recipe for trouble in small-town America, where alcohol-related crimes, traffic accidents, emergency room visits and sexually transmitted infection have all been on the rise.

Much of the national discussion about fracking has focused on the obvious environmental risks, while the social costs of fracking have been largely ignored. This study is the first detailed, long-term analysis of the social costs of fracking borne by rural Pennsylvania communities. Key findings include:

- **Fracking is associated with more heavy-truck crashes:** Heavy-truck crashes rose 7.2 percent in heavily fracked rural Pennsylvania counties (with at least one well for every 15 square miles) but fell 12.4 in unfracked rural counties after fracking began in 2005.

FRACKING RIG IN MORELAND TOWNSHIP, PA.
PHOTO © CC-BY-SA RUHRFISH; WIKIMEDIA COMMONS

- **Fracking is associated with more social disorder arrests:** Disorderly conduct arrests increased by 17.1 percent in heavily fracked rural counties, compared to 12.7 percent in unfracked rural counties.
- **Fracking is associated with more cases of sexually transmitted infections:** After fracking, the average increase in chlamydia and gonorrhea cases was 62 percent greater in heavily fracked rural counties than in unfracked rural counties.

The shale oil and gas boom generates tangible social costs that undermine the quality of life in rural communities. Communities and states must take these real costs into account when they consider approving controversial new oil and gas fracking.

These fracking-associated social costs further demonstrate the shortsighted investment and expansion of dirty fossil fuels. The United States can transition off of fossil fuels, but this will require remaking the U.S. energy system around proven clean energy solutions: conservation, efficiency and renewables. This energy transformation would underpin broad-based and sustained economic growth; circumvent the environmental, social and public health costs of extracting and burning fossil fuels; and usher in an era of true U.S. energy security, independence and resilience.

## Introduction

Over the past decade, the oil and gas industry has experienced a renaissance that has been a boon to energy companies[3] but has altered the quality of life for the rural communities where most new gas wells have been drilled.[4] Nationally, the number of new oil and gas wells drilled annually increased 73 percent, from 30,900 in 2003 to 53,600 in 2008, but then receded to 39,100 in 2011, according to data compiled by ProPublica.[5] These natural gas and oil wells use new techniques and technologies combining horizontal drilling and hydraulic fracturing, or "fracking," to release oil and gas tightly held in rock formations.

Much of the public debate has focused on the demonstrable environmental risks from the fracking process, which involves injecting large quantities of water, sand and toxic chemicals under high pressure to crack the rock and release oil and gas.[6] Methane, fracking fluids and wastewater can pollute water supplies and imperil the livelihoods of farmers, who rely on clean water.[7] Increased truck traffic and drilling emissions reduce air quality,[8] and methane leaks contribute to global warming,[9] while the proliferation of natural gas derricks destroys pristine landscapes (as well as related tourism and recreation industries).[10]

Although the energy industry has promoted fracking as fostering economic development, job creation and energy independence,[11] the employment benefits have been significantly overhyped, sometimes overestimating the job-creating benefits of fracking ninefold.[12]

But policymakers have largely ignored the significant social impacts on rural communities: declining quality of life and increased stress on the social fabric of small towns. Energy booms create intense pressures on local communities. The flood of out-of-state workers with few local social ties, plenty of money to spend and little to do can overwhelm the limited capacity to meet the growing needs and new challenges.[13] The *Associated Press* summarized the problem:

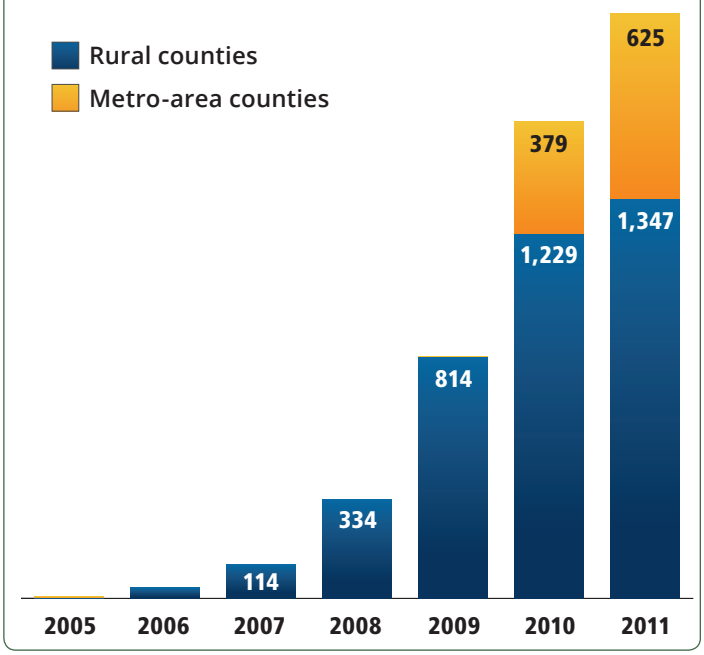
> *In a modern-day echo of the raucous Old West, small towns enjoying a boom in oil and gas drilling are seeing a sharp increase in drunken driving, bar fights and other hell-raising, blamed largely on an influx of young men who find themselves with lots of money in their pockets and nothing to do after they get off work.*[14]

Pennsylvania's part of the Marcellus Shale formation has been ground-zero of the fracking boom. Pennsylvania declared itself "the nation's drilling epicenter," and an article in the *Villanova Environmental Law Journal* observed that Pennsylvania's Marcellus Shale play has "created frenzy among natural gas drilling similar to the Gold Rush."[15]

The Marcellus Shale is one of the largest shale gas reserves in the continental United States. More than a third of it is in Pennsylvania.[16] The first new Marcellus well was drilled by Range Resources in 2003, and commercial production began in 2005.[17] Over the next six years, the number of new fracking wells drilled each year increased nearly 250 times, from eight wells in 2005 to 1,972 in 2011.[18] Of the nearly 5,000 new shale gas wells drilled between 2005 and 2011, four out of five (79.3 percent) were located in rural counties; the rest were in counties that have metropolitan areas.[19] (See Figure 1.)

The swift proliferation of fracking in Pennsylvania was accompanied by a host of social costs as workers flooded small towns in the Marcellus Shale. Food & Water Watch analyzed a decade of annual, county-level gas drilling, traffic accident, crime and public health data from before and after fracking was commercialized in Pennsylvania in 2005 and found that fracking was associated with increased social costs in rural Pennsylvania counties, and the counties with the highest density of fracking wells experienced the greatest impacts.

**Figure 1.** New Shale Gas Wells Drilled in Pennsylvania, 2005–2011




**SOURCE:** FOOD & WATER WATCH ANALYSIS OF PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION WELL DATA

Food & Water Watch's findings provide concrete evidence of the widespread media reporting that fracking contributes to increased traffic accidents, crime and sexually transmitted infections. The results also are consistent with the academic literature demonstrating the negative community impacts from the oil and coal boomtowns that sprang up in the wake of the 1970s energy crisis. Food & Water Watch's new analysis adds context to the fracking debate and is the first detailed and longitudinal examination of the social cost of fracking on rural communities.

## The Social Costs of Fracking Boomtowns

The fracking boom has transformed some rural communities into modern versions of Wild West mining towns. New workers rush to the discovery of new oil, gas or mineral deposits, creating a quick population bulge in small, rural communities that have a limited capacity to meet the growing needs and challenges.[20] Energy boomtowns often face rising levels of crime, substance abuse, mental illness and suicide, housing shortages, price inflation, divorce, school overcrowding and overextended public services.[21]

After the 1970s energy crisis, the high price of oil spurred an energy exploration boom that launched hundreds of new oil, coal and other projects.[22] The subsequent decade of expanding energy extraction across the Rocky Mountain and Northern Plain states also brought widespread disruptions to rural communities. Extensive academic research documented the significant social costs to communities.[23]

Energy booms can disrupt the fabric of society. A 1977 study of North Dakota and Wyoming coal boomtowns found that energy exploration changed the way of life in small towns.[24] Similarly, a 1974 study of the impacts of coal-related development on two Montana towns found, "The residents' sense of community in Forsyth and Colstrip is definitely breaking down...."[25] "Gillette Syndrome," named after a well-known coal town in Wyoming, became the epithet for, as described in a book about energy boomtowns, "the depression, divorce, alcoholism, and delinquency that beset communities on the energy frontier."[26]

The flood of new energy workers can exceed the available housing stock in rural areas. Local rents and housing prices can rise and workers may be forced to live in overcrowded and squalid conditions that further stress the community. In the 1970s, a coal mining company established trailer courts to accommodate coal workers in Colstrip, Mont.[27] In Gillette, coal miners and their families lived in "squatter colonies" of mobile homes that frequently lacked sufficient water and sanitation infrastructure.[28]

Today, fracking has exerted similar pressures on rural areas, including those in Pennsylvania. Almost all fracking jobs occur during the drilling phase and are filled, at least initially, by out-of-state employees or workers that relocate to the gas towns, which fuels population growth.[29] In North Dakota, the influx of young male fracking workers, many of whom retain their primary homes elsewhere and live in *man camps*, has created an unsafe atmosphere for women and given the state the nation's third-highest single male-to-female ratio.[30] In Pennsylvania, housing shortages are doubling and tripling local rents, forcing lower-income workers who had previously been self-sufficient to turn to public assistance for help covering the higher cost of living.[31] Food & Water Watch found that fracking undermined the quality of life in Pennsylvania's rural communities.

## The High Social Cost of Fracking in Rural Pennsylvania Counties: Analysis and Findings

Food & Water Watch found that shale gas drilling was associated with higher levels of traffic accidents, arrests for civil disturbances and sexually transmitted infections in rural Pennsylvania counties. Moreover, this trend was strongest in counties with the highest density of fracking wells. These findings suggest that drilling and fracking can impose real social costs on rural communities (traffic accidents, crime and public health problems) and that the most heavily fracked counties bear the greatest social costs.

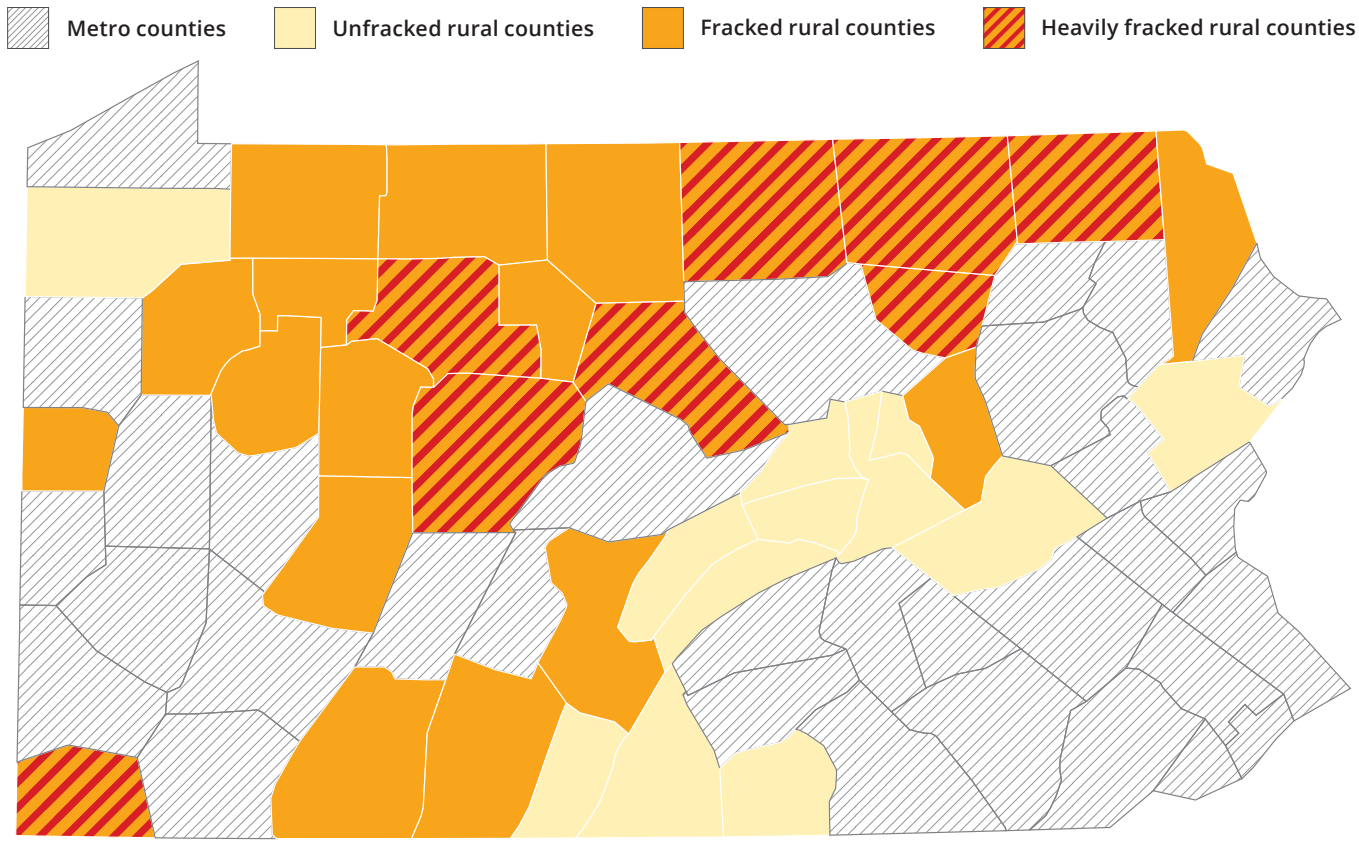
The study examined a decade of annual, county-level data for traffic accidents (heavy-truck accidents), civic disturbances (disorderly conduct arrests) and public health cases (the total number of gonorrhea and chlamydia cases) over two periods: before fracking (2000 to 2005) and after the commercialization of fracking in Pennsylvania (2005 to 2010). The study looked at Pennsylvania's 35 rural counties and compared the 12 counties where no fracking occurred to the 23 counties with fracking. Additionally, the analysis examined the top-third most-fracked counties; these eight most heavily fracked counties had at least one well for every 15 square miles.[32] (See Figure 2.)

For each social indicator, the analysis compared the prevalence (for example, the average annual *number* of heavy-truck crashes) and the average *year-to-year* change (e.g., the average annual percent increase or decrease in the number of heavy-truck crashes) from the before-fracking period to the after-fracking period. These measurements demonstrate trends for each social indicator before and after fracking began in Pennsylvania.

### *Truck crashes rise in Pennsylvania rural fracked counties; steepest jumps and trends in most heavily fracked counties*

Energy booms bring dramatically increased road congestion and heavy-truck traffic because of the need to deliver equipment, supplies and workers to drilling sites. Nationally, the number of automobile accidents has been declining steadily since 2005,[33] and in Pennsylvania, the

**Figure 2.** Fracking in Rural Pennsylvania Counties




**SOURCE:** FOOD & WATER WATCH ANALYSIS OF DATA FROM U.S. CENSUS BUREAU'S STATE AND COUNTY QUICKFACTS DATABASE AND PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION. INTERACTIVE REPORTS, WELLS DRILLED BY COUNTY.

number of all crashes and the number of heavy-truck crashes have generally been declining since 2000.[34] Food & Water Watch found that for rural Pennsylvania counties, fracking is associated with a curtailment of this trend — a slowing of the decrease in heavy-truck crashes — while rural Pennsylvania counties with the highest density of fracking actually saw an increase in heavy-truck crashes in the post-fracking period. The decrease in the average annual number of total vehicle crashes was 39 percent larger in unfracked rural counties than in heavily fracked counties.[35]

Food & Water Watch found that the rural Pennsylvania counties with the highest density of fracking had the largest increase in heavy-truck crashes after fracking began in 2005. After fracking began, the average annual change in truck accidents trended upward in the counties with fracking wells (after trending down before fracking started) and continued to decline in unfracked counties after fracking began.

The surging traffic from energy booms strains the capacity of rural roadways and contributes to rising truck and automobile accidents.[36] Each fracking well requires thousands of truck trips to deliver hazardous fracking fluid and materials and to haul away fracking wastewater, significantly increasing local truck traffic.[37] The growth in truck traffic has led to more heavy-vehicle accidents (some of which spilled fracking wastewater into surface water) and added to costly wear and tear on rural roads.[38]

The increased fracking traffic on previously uncongested roads brings big-city traffic jams to rural Pennsylvania communities. Marcellus Shale region school officials have identified fracking-related traffic congestion as a socio-economic challenge.[39] The boroughs of Wellsboro and Mansfield in Tioga County (where there was one fracking well for every two square miles by 2011) have issued more traffic citations and reported more road congestion.[40] The Waynesburg Area Chamber of Commerce executive director in Greene County (one well per square mile) reported that the fracking industry's heavy trucks have knocked rear-view mirrors off the sides of parked cars.[41]

Fracking-related traffic congestion and accidents pose significant hazards to local residents. In Bradford County (one well per square mile), increased traffic has delayed the response times of emergency vehicles.[42] In some fracked Pennsylvania counties, the number of 911 calls has increased significantly, often with reports of truck accidents (up 46 percent from 2009 to 2010 in McKean County and up 49 percent from 2007 to 2010 in Tioga County).[43]

**Heavy-truck crashes increased 7 percent in heavily fracked rural Pennsylvania counties but declined 12 percent in unfracked rural counties once fracking began:** The average annual number of heavy-truck crashes increased 7.2 percent in heavily fracked counties (with at least one well for every 15 square miles), rising from an average of 284 crashes a year in the pre-fracking period (2000 to 2005) to an average of 304 crashes in the post-fracking period (2005 to 2010). In contrast, heavy-truck crashes fell 12.4 percent in unfracked rural counties and fell 1.3 percent in all fracked counties (including the heavily fracked counties).[44] (See Figure 3.)

**Post-fracking, heavy-truck crashes grew by an average of 9 percent a year in heavily fracked rural Pennsylvania counties but fell by an average of 3 percent a year in unfracked rural counties:** Between 2000 and 2005, the number of heavy-truck crashes (crashes per million vehicle miles) fell by an average of 0.4 percent a year in rural counties that would later host fracking and declined by 1.6 percent a year in what would later be heavily fracked rural counties. Fracking appears to have contributed to a reversal of that trend.

During the post-fracking period, heavy-truck crashes increased by an average of 1.2 percent annually in all fracked counties and by 8.8 percent in heavily fracked counties. In unfracked counties, heavy-truck crashes continued to decline with an average decrease of 3.1 percent a year. (See Figure 4.)

## *Social disorder crimes increased in rural Pennsylvania counties with the highest densities of fracking*

The large influx of transient fracking workers can lead to higher levels of social disorder, especially substance abuse and alcohol-related crimes. The socially isolated workers have ample incomes and little to occupy their time in rural communities. One 23-year-old transient worker residing in Pennsylvania admitted: "We definitely do drink a lot. I ain't going to lie."[45] Food & Water Watch found that the counties with the highest density of fracking wells (at least 15 wells per square mile) had a greater increase in disorderly conduct arrests than rural unfracked counties once fracking began in 2005.

Academic research documented that during the 1970s, transient energy workers contributed to sharply increased crime and alcohol-related disturbances. Crime increased alarmingly across boomtowns of the western states — from Colorado to Utah to North Dakota.[46] In Rock Springs, Wyo., police calls jumped fivefold and alcohol-related crimes quadrupled between 1969 and 1974.[47] A 1976 report explained that in Gillette, Wyo., "The jail became a holding pen to restrain drunks and protect wives from their husbands."[48]

Today's fracking frontier communities face similar sharp increases in crime and disorder that diminish quality of life.[49] The Pennsylvania State Police linked increased

**Figure 3.** Post-Fracking Change in the Average Number of Heavy-Truck Crashes

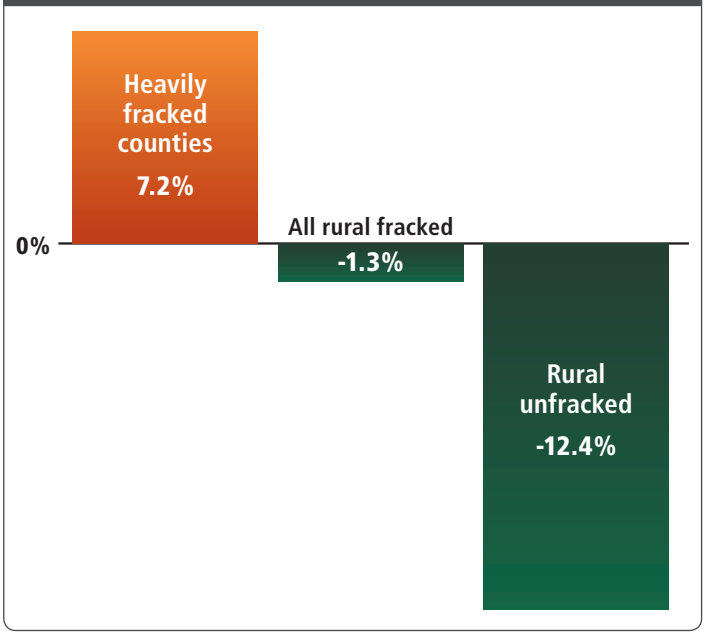
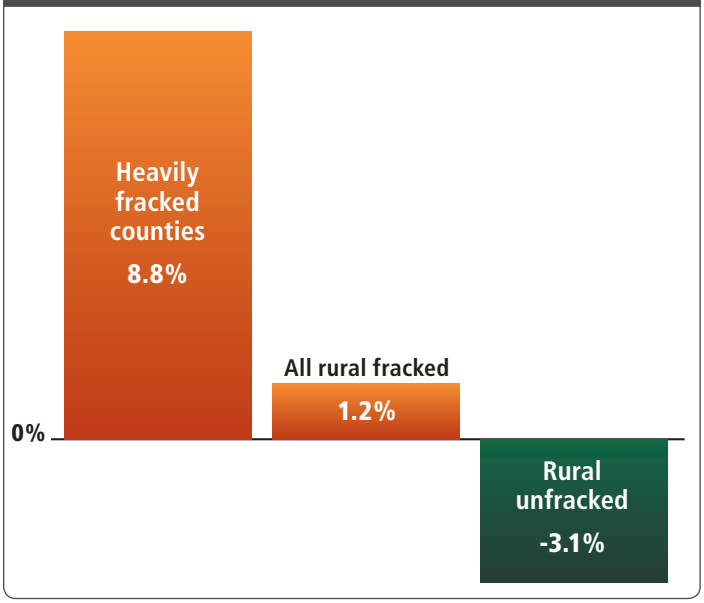



**Figure 4.** Average Annual Change in Heavy-Truck Crashes, 2005–2010
(CRASHES PER MILLION VEHICLE MILES TRAVELED)




**SOURCE, FIGURES 3 AND 4:** FOOD & WATER WATCH ANALYSIS OF PENNSYLVANIA DEPARTMENT OF TRANSPORTATION DATA.

crime to natural gas workers, which burdens state and local police departments.[50] The police chief in Wellsboro, Pa., attributed significant increases in alcohol-related crime, including public intoxication, bar-room brawls and drunk driving, to shale gas industry workers.[51] For example, the average annual number of public intoxication arrests rose 11.9 percent in the post-fracking period in heavily fracked rural counties and 8.7 percent in all fracked rural counties.[52] The most-fracked Pennsylvania communities have experienced steep upticks in drunken driving, traffic violations and bar fights.[53]

**Disorderly conduct arrests rose a third more steeply in heavily fracked rural counties after fracking began than in unfracked rural counties:** The average annual number of disorderly conduct arrests in the most heavily fracked counties rose 17.1 percent, from 1,336 prior to commercial fracking (2000 to 2005) to an average of 1,564 per year after fracking. (See Figure 5.) This increase is one-third higher than the 12.7 percent increase in the average annual number of disorderly conduct arrests in unfracked rural counties.

**The average annual increase in disorderly conduct arrests was three times higher in heavily fracked rural Pennsylvania counties after fracking began than in unfracked rural counties:** From 2005 to 2010, disorderly conduct arrests grew by an average of 6.9 percent a year in the most heavily fracked counties, reversing an average annual 3.7 percent decline seen between 2000 and 2005. This increase was more than three times faster than the 2.1 percent average annual increase in unfracked rural counties from 2005 to 2010 (up from a 0.4 percent annual increase from 2000 to 2005). (See Figure 6.) In all fracked rural counties, disorderly conduct arrests declined by an average of 1.7 percent annually from 2000 to 2005, but it declined by only 0.9 percent a year from 2005 to 2010.

## *Sexually transmitted infections rose fastest in rural Pennsylvania counties where fracking began*

Energy booms can contribute to public health problems as transient workers overwhelm the capacity of rural hospitals and health systems are inundated with new, often-uninsured patients and public health problems, including an increase in the incidence of occupational injuries, traffic accidents, mental illness, substance abuse and sexually transmitted infections (STIs).[54]

Fracking is associated with increased cases of sexually transmitted infections and assault. In oil boomtowns in North Dakota, doctors are treating more chlamydia cases, sexual and domestic assault rates have increased, and many local women have reported feeling unsafe.[55] Pennsylvania's gas boom has been linked to a rise in sexually transmitted infections.[56] In Bradford County (one fracking well for every square mile), a hospital attributed an increase in STIs to the Marcellus Shale industry.[57]

**Figure 5.** Post-Fracking Change in Average Disorderly Conduct Arrests

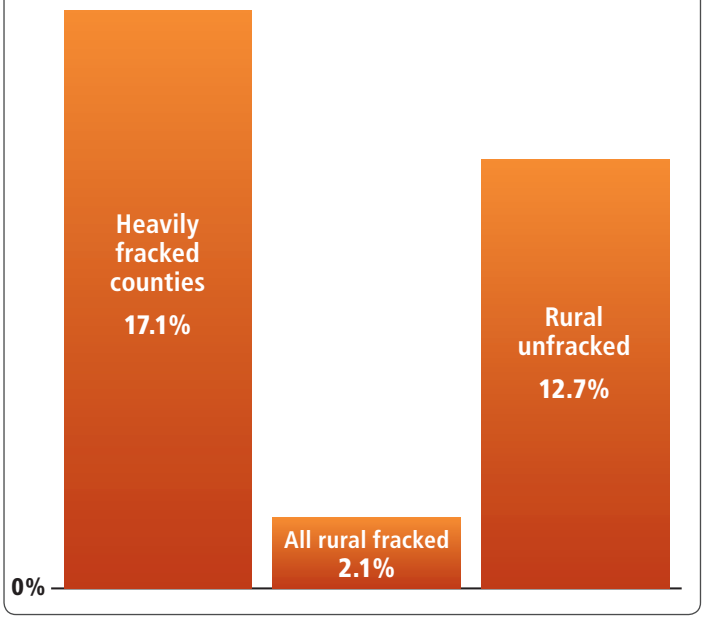
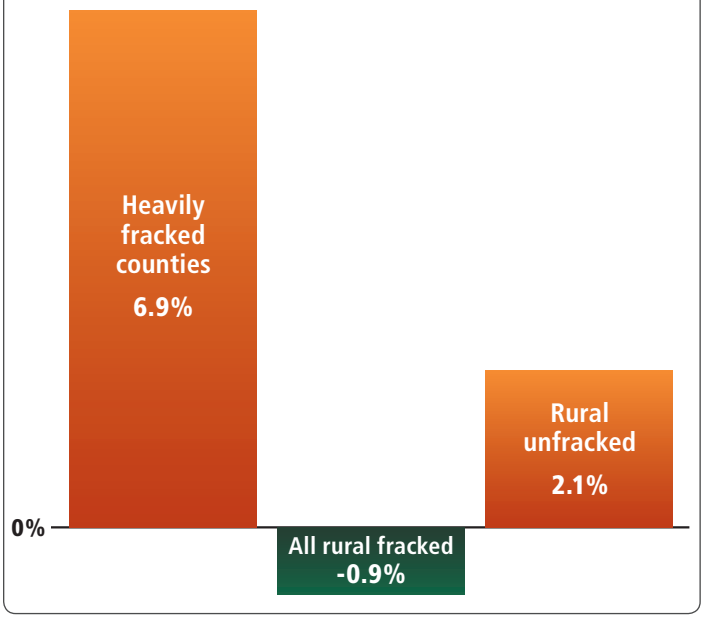



**Figure 6.** Average Annual Change in Disorderly Conduct Arrests, 2005–2010




SOURCE, FIGURES 5 AND 6: FOOD & WATER WATCH ANALYSIS OF PENNSYLVANIA STATE POLICE REPORTING DATABASE, UNIFORM CRIME REPORTING SYSTEM.

**The increase in the average annual number of cases of sexually transmitted infections was greater in heavily fracked rural counties than in unfracked rural counties:** The average annual number of gonorrhea and chlamydia cases increased by nearly a third (32.4 percent) in the most heavily fracked rural Pennsylvania counties once fracking began — 62 percent more than the 20.1 percent increase in rural unfracked counties. (See Figure 7.)

**During the post-fracking period, the number of cases of sexually transmitted infections increased twice as fast in heavily fracked counties as in unfracked counties:** After fracking began, the number of chlamydia and gonorrhea cases increased by an average of 8.0 percent a year in the most heavily fracked rural counties, more than twice the 3.8 percent a year average increase in unfracked rural counties. (See Figure 8.) All fracked rural counties had an average annual increase of 4.6 percent.

The average annual growth in STI cases was much greater for all rural counties during the pre-fracking period (2000 to 2005), but unfracked counties saw the STI growth rate plunge by more than two-thirds during the second half of the decade (2005 to 2010) — dropping from 12.4 percent a year to 3.8 percent a year. Heavily fracked counties, however, saw only a slight decrease in the STI growth rate — from 9.8 percent pre-fracking to 8.0 percent post-fracking.

## Conclusions and Recommendations

The expansion of drilling and fracking is associated with significant quality-of-life and public health problems in rural Pennsylvania communities. These findings are consistent with a wealth of academic literature demonstrating the negative social consequences of rapidly developing energy boomtowns. It also supports extensive anecdotal evidence from community leaders and media reports that the rise in fracking has also delivered tangible harms to rural life.

But more research is needed to better understand the long-term public health impacts of the fracking industry. According to a September 2012 U.S. Government Accountability Office report, "Oil and gas development, whether conventional or shale oil and gas, pose inherent environmental and public health risks, but the extent of these risks associated with shale oil and gas development is unknown, in part, because the studies GAO reviewed

**Figure 7.** Post-Fracking Change in Average Number of Chlamydia and Gonorrhea Cases

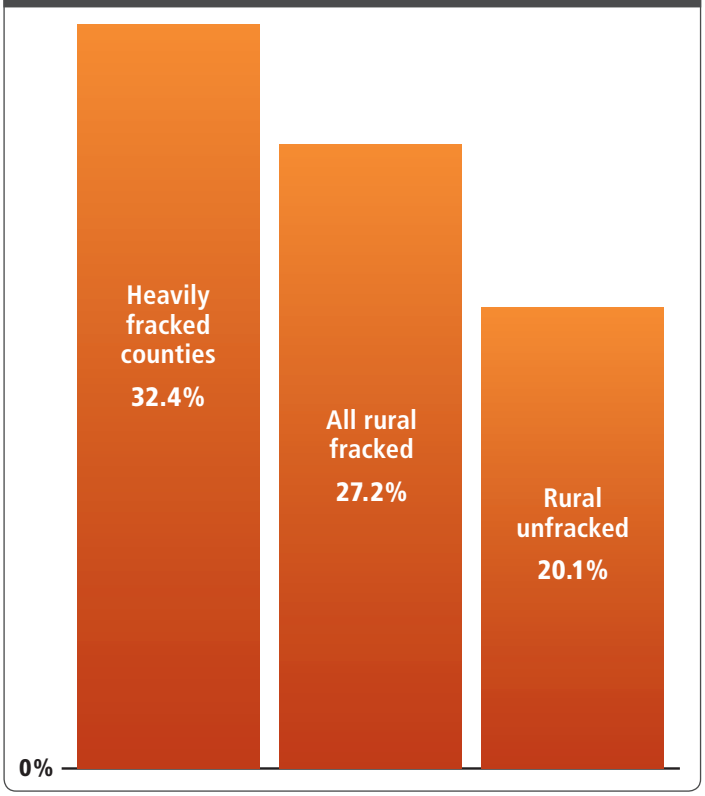
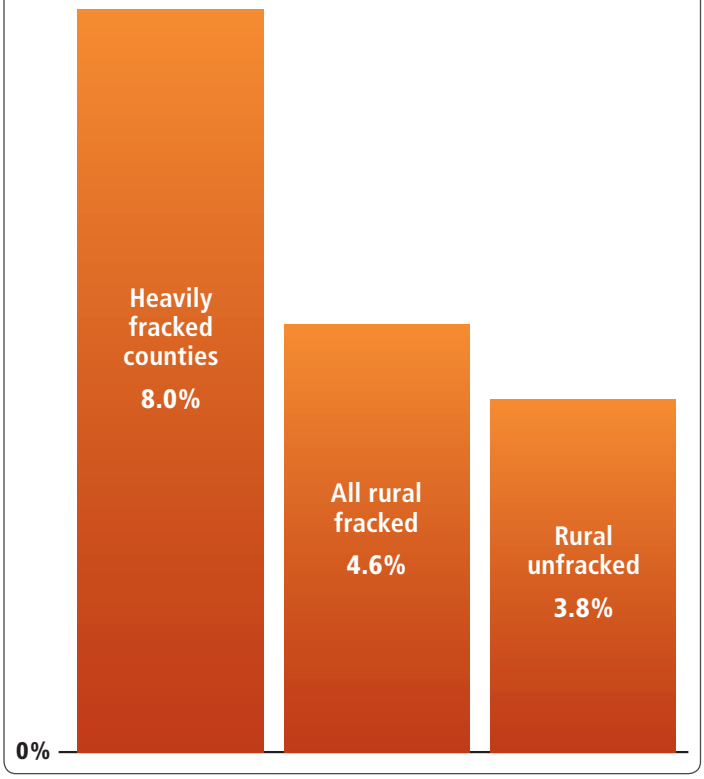



**Figure 8.** Average Annual Change in Chlamydia and Gonorrhea Cases, 2005–2010




**SOURCE, FIGURES 7 AND 8:** FOOD & WATER WATCH ANALYSIS OF PENNSYLVANIA DEPARTMENT OF HEALTH STATISTICS AND RESEARCH DATA.

do not generally take into account the potential long-term, cumulative effects."[58] Similarly, in January 2012, the Director of the National Center for Environmental Health at the U.S. Centers for Disease Control and Prevention in Atlanta told the *Associated Press*, "More research is needed for us to understand public health impacts from natural gas drilling and new gas drilling technologies."[59]

Proponents tout fracking as a panacea for energy independence and job creation, but the social costs identified in this study have real economic impacts on rural communities as well. Traffic accidents and public disorder arrests associated with fracking cost counties and municipalities with already-stretched finances. Responding to fracking-related emergencies also diverts first responders from other emergencies.

Local economies can also bear significant economic costs. For example, if heavy-truck accidents had continued to decline at the pre-fracking rate, heavily fracked Pennsylvania counties would have avoided significant costs. A typical heavy-truck accident in Pennsylvania traffic has an estimated economic cost of $216,229 related to deaths, injuries and property damage. In heavily fracked counties, if the number of heavy-truck accidents (per million vehicle miles traveled) had continued to fall at its pre-fracking average of 1.6 percent a year, instead of increasing by an average of 8.8 percent a year after 2005, there would have been 131 fewer heavy-truck accidents between 2006 and 2010. The additional heavy-truck accidents represent an estimated $28 million economic burden on those heavily fracked counties.[60]

These considerable social costs — and the associated economic costs — only add to the mounting evidence against the long-term environmental and economic viability of fracking. Communities and states must take these real costs into account when they consider approving controversial new oil and gas fracking.

It is long past time to move away from dirty fossil fuels and to invest in clean, renewable energy. But the deep-pocketed fossil fuel industry — with its increasingly intensive extraction methods, entrenched infrastructure and lack of investment in energy conservation to slow demand for its product — is trying to derail the necessary transformation. Now is the time for the United States to declare independence from the oil and gas industry. Food & Water Watch recommends:

- Investing in independent research devoid of industry funding or affiliation to honestly assess the costs and benefits of fracking, and that weighs the purported economic gains against the social and environmental costs;
- Enacting aggressive policies to reduce energy demand, including substantial investments in public transportation, community planning and the deployment of energy efficiency solutions;
- Establishing ambitious renewable energy programs for deploying and incentivizing existing technologies, such as wind and solar power, to increase the clean energy supply;
- Modernizing the electric grid with smart grid solutions, catering to distributed renewable power generation and promoting conservation;
- Investing in development to help the clean technology industry overcome barriers to the next generation of clean energy solutions; and
- Implementing a national ban on fracking.

FRACKING NEAR AGRICULTURAL FIELD, UPPER =FAIRFIELD TOWNSHIP, PA. PHOTO © CC-BY-SA RUHRFISH; WIKIMEDIA COMMONS

## Methodology and Data

Food & Water Watch analyzed a decade of socioeconomic-indicator data from rural Pennsylvania counties and compared these indicators before and after hydraulic fracturing (fracking) was commercialized in the state in 2005. Counties were classified as rural if they were outside any standard metropolitan statistical area, as determined by the U.S. Census Bureau and Office of Management and Budget. Primary county-level data were obtained from governmental agencies. All of the data were annual, county-level data for years from 2000 to 2010. The socioeconomic indicators were determined based on trends identified through a literature review and modern anecdotal evidence. They included heavy-truck crashes, disorderly conduct arrests, and gonorrhea and chlamydia cases.

Pennsylvania was selected because of its recent, rapid adoption of fracking and the higher rural population density than other states where fracking is occurring, which provided more-robust data. Rural counties were selected to avoid background noise associated with other industries and urban populations and to more effectively observe the fracking-related changes over other economic and demographic changes.

Food & Water Watch performed two basic trend analyses that compared the periods before and after fracking was commercialized. First, the study examined the average annual number of cases or accident rates before and after fracking (2000 to 2005 and 2005 to 2010). This division yields two equal six-year periods that overlap in a single year that represents the transition year (only eight wells were drilled in 2005). Second, the study compares the average annual year-to-year rate of change before and after fracking (from 2000/2001 to 2004/2005 and 2005/2006 to 2009/2010), which yields two equal periods with five annual change periods.

**Measurement of "frackedness":** The most-fracked rural counties in Pennsylvania were determined by unconventional well density, based on the 2005–2011 sum of unconventional wells from the Pennsylvania Department of Environmental Protection's Interactive Reports, Wells Drilled By County between 2005 and 2011, and the area (square miles) of each county from the U.S. Census Bureau's State and County QuickFacts database. The rural Pennsylvania counties were divided into three groups: unfracked rural counties (12 counties) without any fracked wells, all fracked counties with any fracked wells (23 counties) and heavily fracked counties (eight counties). The heavily fracked counties had the top-third highest density of unconventional wells, with at least one well for every 15 square miles. For comparison purposes, eight counties had one well for every 15 to 75 square miles, and seven counties had less than one well for every 175 square miles. (There were no counties with well density between one well per 76 square miles and one well per 174 square miles.)

Commercial fracking began in Pennsylvania in 2005, immediately before a significant economic recession. Many negative socioeconomic indicators are associated with weak economic conditions, rising unemployment, increased poverty rates and other concurrent negative economic trends. The studied post-fracking period (2005–2010) includes several years that were impacted by the economic downturn. Unfracked rural counties were included as a control group in an attempt to distinguish the impacts of fracking from this background noise in rural fracked communities.

**Traffic accident data:** All heavy-truck accident data are from the Pennsylvania Department of Transportation (PennDOT). Reportable crashes include those with injuries, fatalities or towing a vehicle away from the scene. Heavy-truck accident data are of vehicles with a gross vehicle weight rating of more than 26,000 pounds. The crash rate was the number of crashes per million vehicle miles traveled, which controls for the total traffic volume.

**Crime data:** All disorderly conduct arrest data are from the Pennsylvania State Police reporting database, Uniform Crime Reporting System. Arrest numbers were analyzed, but the arrest rate (per 1,000 people) yielded similar results.

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