

# Shale Development in Pennsylvania

## Pennsylvania Transfer of Wealth Study

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### Background and Introduction

The Center for Rural Entrepreneurship has been retained by the [Center for Rural Pennsylvania](#) to update the Commonwealth's **Transfer of Wealth Opportunity (TOW)** analysis. Related to this project, the Center has prepared a [series](#) of mini-reports focusing on unique factors that impact community TOW opportunities. This mini-report addresses **Shale Energy Development**.

### Question and Additional Information

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### Shale Development in Pennsylvania

Gas-bearing shale underlies a large portion of western and northeastern Pennsylvania. The twin technologies of horizontal drilling and hydraulic fracturing allowed development of the Marcellus shale formation, beginning in earnest in 2008. A total of 8,924 unconventional wells have been drilled since then through February 2015. The map on the following page shows the location of these wells. There are two nodes of activity, one in the southwest corner centered on Washington and Greene counties, and the other in the northeast tier of counties, including Tioga, Bradford, Susquehanna, and Lycoming.

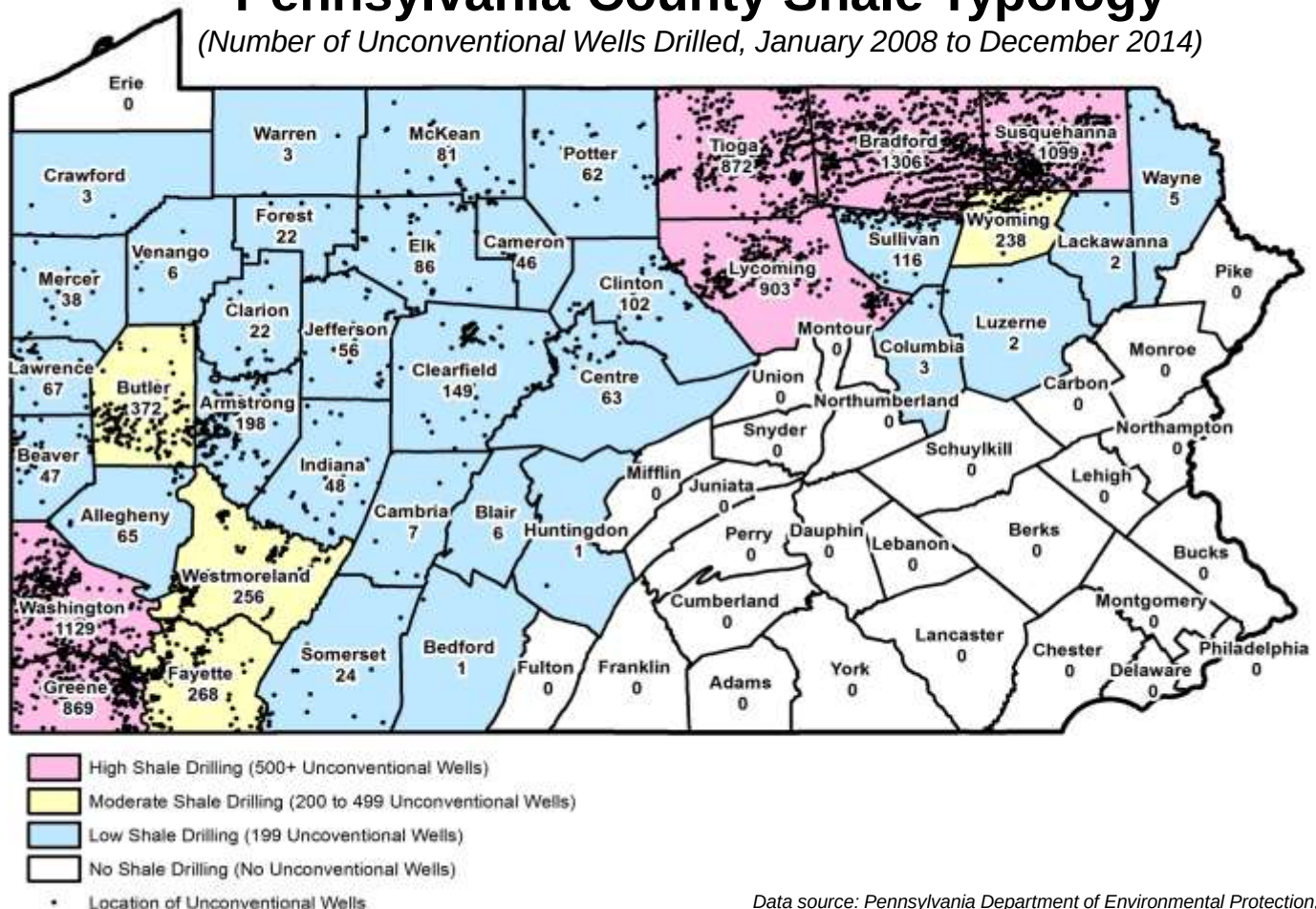
Drilling peaked in 2011 and a sharp drop in the price of natural gas has led to a series of local downturns in drilling, depending on shale productivity and local cost factors. Drilling has continued in a small sweet spot in Susquehanna County, and especially in the southwest corner where “wet gas” is produced that contains valuable distillate liquids in addition to the gas. In addition, the southwest corner also contains portions of the Utica shale formation, a second possible “pay zone.”

It may be useful to contrast the development of the Marcellus Shale with the Bakken Shale of North Dakota. The development of the Bakken caused a massive immigration of oil and pipeline workers, which in turn created housing and retail service challenges. Pennsylvania is blessed with a higher population density, even in its rural areas, such that there was little, if any, population change associated with shale development. Over time, the local workforce has filled all but the most specialized jobs. A shortage of hotel rooms in the northern counties has been addressed with many new facilities, so that tourism directors view shale development as a positive force in providing more accommodations for visitors. Environmental concerns include water quality, pipeline fracturing of forest and wildlife habitat, and noise. Infrastructure strains such as busy roads and housing shortages have been less evident than in the sparsely populated Bakken, and are now being addressed, in part,

by the statewide well impact fee. The “crowding out” of vulnerable populations like the elderly and homeless remains a concern.

## Pennsylvania County Shale Typology

(Number of Unconventional Wells Drilled, January 2008 to December 2014)



Data source: Pennsylvania Department of Environmental Protection, Oil and Gas Reports, SPUD Data Report

### How does Shale Affect Wealth?

Whether measured by sales tax collections, home values, rent and royalty income, or realty transfer tax collections, the high and medium shale counties have outperformed Pennsylvania state averages. Economic indicators are masked by the general downturn of the Great Recession. In some cases, shale counties were flat or slightly negative, while the entire state declined even more. The majority of the income increases came as lease and royalty income. For example, lease and royalty income in Bradford County increased by \$143.5 million between 2007 and 2010. From 2007 – 2011, the change in rents and royalty income was 108% for Pennsylvania, but 300% for the top shale counties. However, it is difficult to ascertain who owns the mineral rights to a given piece of land. In one study, the share of mineral rights owned by county residents varied from 77.6% in Washington County to 48.4% in Lycoming County. The rest of the royalty income can be assumed to leak out of the economy to non-resident owners or corporations. Where mineral rights are intact with the land, the streams of royalty income should be capitalized into higher property values, another source of wealth

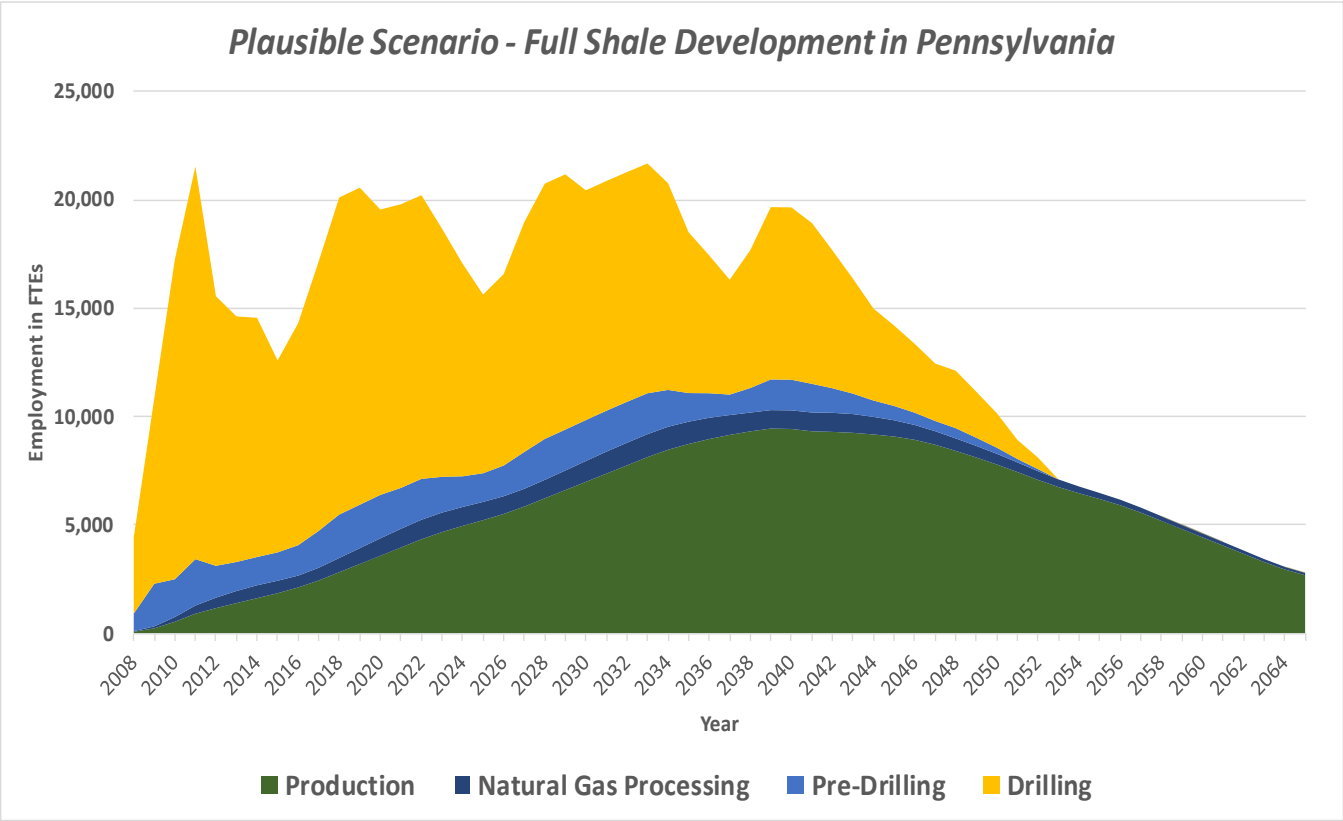
creation. Wealth also comes in the form of higher housing values in communities where gas workers have driven up rents. From 2007 – 2013, realty transfer tax collections fell by 18.7% in the Commonwealth, but rose 3.1% in the top Marcellus shale counties.

Regional hubs of drilling activity have emerged in Williamsport (Lycoming County) and Canonsburg (Washington County). These communities have transportation access and are big enough to accommodate workers in the service yards, warehouses, and office space needed for industry regional headquarters. The development served to help revitalize the greater Pittsburgh region, as well. Lycoming, Washington, and to a lesser extent, Allegheny counties are likely to capture more residents, economic activity, and wealth over time than the other shale counties.

### **What might the future of shale development look like?**

Studies point out that the Marcellus is still in the drilling phase which requires more employment. However, the eventual full build-out of the Marcellus and Utica formations in Pennsylvania may require as many as 60,000 wells. Though drilling has currently slowed due to low natural gas prices, full development is likely over the 50 year period of the Transfer of Wealth (TOW) study. Given that the highest number of wells drilled in a single year is less than 2,000, the drilling phase may well last 30 years or more. Periods of low gas prices merely serve to push development farther into the future. Once drilled, wells may produce for 30 to 50 years, though production declines quickly over the first five years.

The graph below represents a hypothetical, but plausible, full development scenario for Pennsylvania shale. It projects drilling to rise and fall with natural gas prices over time, but that eventually 60,000 wells will be required to fully develop the geological resource. The timing and depth of the drilling slowdowns is completely hypothetical. The total number of wells is conservative (even with the inclusion of Utica formation wells) and only allows for 30 years of productive life for each well. The four colors represent different phases of development. Light blue represents the planning and permitting jobs required in the pre-drilling phase; yellow represents drilling phase jobs; green represents long-term production jobs; dark blue represents gas processing jobs needed to separate distillates from “wet gas.”



This plausible development scenario must allow for technological improvements in this fast-changing industry. The scenario factored in a 20% improvement in labor efficiency in 2015, based on the labor requirements shown in the table below. This initial improvement in labor efficiency was followed by 10% improvements again in 2020, 2025, and 2030. We also assumed an average of 4 wells per pad in 2010 - 2015, 5 wells per pad in 2016-2020, and, after 2020, an average of 6 wells drilled per pad. Production labor is only 0.19 FTE per well but it grows cumulatively with wells drilled for a conservative 30 year well life. Forty percent of the wells were assumed to be drilled in the 10 wet-gas counties of southwest Pennsylvania, which is based on the cumulative proportion of wells drilled through February 2015. An additional 0.2 FTEs per year is required to process wet gas for the first five years of each well. Because processing varies with gas volume, and not the number of wells, the processing labor drops to 0.02 FTE per well per year in Years 6-30.

Note that even the drilling phase jobs are expected to last for thirty more years. The long-term gas production jobs are between 8-10,000 FTEs for a period of 17 years starting in 2033. Fifty years from now, there may still be 3,000 jobs in the Pennsylvania gas industry. The scenario graph shows that there may be 15,000 well-paying jobs for residents to have a career in the gas industry within the Commonwealth. Survey data in 2010 indicated that 65-75% of these jobs are going to Pennsylvania residents, and this proportion should grow as training programs produce more graduates. Many of the economic benefits are likely to accrue to the hub cities of Williamsport and Canonsburg, absent active recruiting of workers and quality of life positioning by smaller towns. In addition, significant wealth will come from the flow of lease and royalty payments to mineral rights



owners. In one study of four of the strongest shale counties, the proportion of mineral rights owned by county residents varied from 48% to 78%.

The average Expected Ultimate Recovery (EUR) from a Marcellus well will be 3.5 billion cubic feet of natural gas. That means 3.5 million thousand cubic feet at a long-term average wellhead natural gas price of \$4.73 per thousand cubic feet equals \$16.5 million in gross revenue over the life of a well, and that does not include natural gas liquids from wet gas.

In total, the Marcellus and Utica shale formations would produce 207 billion thousand cubic feet of natural gas, worth an estimated \$981 billion dollars over the next fifty years. Royalties paid to mineral right holders over the next five decades are estimated to be \$147.1 billion at 15% lease rates. A CRP report estimated that county residents in four of the most productive shale counties owned some 62% of the mineral rights on average. Applying a 60% ownership assumption, this means that shale county residents may be receiving as much as \$88.3 billion in royalty payments over the next 50 years as the Marcellus becomes fully developed.

| FTE by Phase and Type of Well                                                                                            |              |                         |
|--------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------|
| Phase                                                                                                                    | Single Well  | Additional Wells on Pad |
| Pre-drilling <sup>1, 2</sup>                                                                                             | 2.41         | 0.65                    |
| Drilling <sup>1, 2, 3</sup>                                                                                              | 10.49        | 8.81                    |
| Production <sup>1, 2</sup>                                                                                               | 0.19         | 0.19                    |
| Natural Gas Processing <sup>2</sup>                                                                                      | 0.20         | 0.20                    |
| <b>Dry Gas Total</b>                                                                                                     | <b>13.09</b> | <b>9.65</b>             |
| <b>High-BTU Gas Total</b>                                                                                                | <b>13.29</b> | <b>9.85</b>             |
| <sup>1</sup> Dry Gas Calculation<br><sup>2</sup> High-BTU Gas Calculation<br><sup>3</sup> Includes Pipeline Construction |              |                         |

Source: Pennsylvania Statewide Marcellus Shale Workforce Needs Assessment, MSETC, June 2011

## Supporting Research and Sources

The sources for this analysis are the Center for Rural Pennsylvania, <http://www.rural.palegislature.us/documents/reports/The-Marcellus-Shale-Impacts-Study.pdf> and the Marcellus Shale Education and Training Center, [http://pasbdc.org/uploads/media\\_items/pennsylvania-statewide-marcellus-shale-workforce-needs-assesment-june-2011.original.pdf](http://pasbdc.org/uploads/media_items/pennsylvania-statewide-marcellus-shale-workforce-needs-assesment-june-2011.original.pdf).



The Center promotes and sustains the vitality of Pennsylvania's rural and small communities by sponsoring research projects to identify policy options for legislative and executive branch consideration and action; collecting data on trends and conditions to understand the diversity of rural Pennsylvania; publishing information and research results to inform and educate audiences about the diverse people and communities of rural Pennsylvania; and participating in local, state and national forums on rural issues to present and learn from best practices.

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