Ohio's
Natural Gas and Crude Oil Exploration and Production Industry and the Emerging Utica Gas Formation

Economic Impact Study

September 2011

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& Associates

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OHIO OIL & GAS ENERGY EDUCATION PROGRAM
OOGEEP.org

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Acknowledgement

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I. EXECUTIVE SUMMARY

The Ohio Oil and Gas Energy Education Program engaged Kleinhenz & Associates to estimate the economic impacts of planned industry spending for the development of the Utica shale gas formation and update its 2008 study that examined the economic contribution and benefits of the natural gas and crude oil industry to the State of Ohio.

Ohio producers provided the state with 78 billion cubic feet of natural gas and 4.7 million barrels of crude oil in 2010. Ohio remains in the top half of natural gas and crude oil producing states and ranks sixth in number of producing gas wells. Since 1860, Ohio has produced over 8.5 trillion cubic feet of natural gas and 1.14 billion barrels of crude oil, worth approximately $124.4 billion at 2010 average wellhead prices.

Kleinhenz & Associates used a multifaceted approach to complete this study that included the use of a regional economic model and extensive efforts to gather data from a literature review, primary and secondary data collection, interviews and analysis.

This report evaluates the value of Ohio's natural gas and crude oil industry by examining the following:

- The current natural gas and crude oil industry and the potential Utica shale development impacts on the state of Ohio regarding:
    - Jobs
    - Income
    - Tax revenues
    - Gross state product

- Beneficial effects of Ohio-produced natural gas in terms of:
    - Price-reducing impact
    - Avoided interstate pipeline costs
    - Price volatility reduction
    - Security of supply

- Royalties and free natural gas provided to mineral interest owners from Ohio natural gas and crude oil producers

- Taxes paid by the industry

- Reinvestment of revenues made by the industry as outlays for exploration and development expenditures.

Findings

This report shows that the Ohio Natural Gas and Crude Oil Industry currently offers many benefits to Ohioans. It also illustrates that the projected impact from capital investments for the Utica shale development holds significant impacts on the Ohio economy. Specific contributions and benefits that the industry provides to Ohio are presented across the following:

Economic Impact of Ohio's Natural Gas and Crude Oil Industry 2010

- Ohio's natural gas and crude oil industry supports more than 4,490 direct jobs which contributes to a total of 12,950 Ohio jobs due to the leasing, royalties, exploration, drilling, production and pipeline construction activities in various geological formations within Ohio.

- The industry, via its expenditures, is directly and indirectly responsible for $988 million annually in gross state product and statewide output or sales of $1.7 billion per year.

- The industry, via its multipliers, is responsible for $793 million per year in personal income in the state of Ohio.

Economic Impact of the Development of the Utica Formation

- More than 204,000 jobs will be created or supported by 2015 due to exploration, leasing, drilling and connector pipeline construction for the Utica Shale reserve.

- With the substantial pace of development, economic output will increase by over $22 billion and wages by $12 billion by 2015.

- In the year 2015, local government wage tax revenues amount to $240 million. This estimate excludes the severance or ad valorem taxes levied upon producers of crude oil and natural gas.

Economic Impact of New Wells Drilled in 2010

- In addition to spending its revenues in 2010 on operation and maintenance, royalty obligations and taxes, the industry re-invested approximately $238 million in exploration and development.

- The value of that re-investment to Ohio – the well-drilling activities in Ohio – that is the portion excluding operation, maintenance and overhead, was modeled. The re-investment portion of the industry accounts for 2,249 jobs and $135 million per year in gross state product.

Local Natural Gas and Crude Oil Supply Benefits

- Ohio keeps $718 million per year in-state when it can buy locally produced natural gas and crude oil.

- Value of local production is significant because it is deliverable in times of scarcity. Ohio consumers need the commodity, not a hedge on the commodity, during peak times of demand. Research found that there was a security or un-interruptability of supply premium imbedded in interstate pipeline transport costs. Secondary research found the "quantity risk premium" paid by buyers of natural gas during times of great demand to be on the order of 3% per dollar of movement of expected spot price.

- Ohio consumers save $9.2 million per year due to the price-reducing impact the state's supply of natural gas has on the national equilibrium price of natural gas. Ohio's supply of natural gas to the national market is small but significant enough to affect price.

- Ohioans save $30 million per year in avoided interstate pipeline transportation costs. This avoided cost is due to Ohio production not requiring interstate pipeline transmission. This research does not attempt to allocate benefits to particular market participants; rather, the gathering system and Ohio production are viewed as an inseparable entity. Benefits are distributed in the competitive marketplace of DTI (Dominion Transmission, Inc.) and other hubs.

- Local production provides an important "storage-like" benefit of reduced price volatility or peak shaving. DTI vied with Chicago in offering the lowest variance in pricing during the winter from 2000 to 2010. DTI was found to have the lowest mean price in four out of 11 years analyzed and the lowest variance in price in six out of the 11 years analyzed. The reduced price fluctuations benefited millions of Ohio natural gas users – residential, commercial and industrial.

- In the past 10 years, Ohio natural gas and crude oil producers generated royalty payments totaling $1 billion. In 2010, royalties amounted to $90 million. Mineral interest owners, typically landowners, receive the royalty payment.

- Ohio natural gas and crude oil producers provided free natural gas to mineral interest owners, typically landowners, worth $61 million, in 2010.

- In 2010, Ohio natural gas and crude oil producers paid an estimated $32.7 million in federal, state and local taxes.

II. INTRODUCTION

The natural gas and crude oil industry in Ohio is mature and enjoys a well-developed infrastructure that provides locally produced natural gas and crude oil to Ohioans. The industry helped establish Ohio as an industrial base in the 1860s and continues to contribute to the economy. Since 1860, Ohio has produced over 8.5 trillion cubic feet of natural gas and 1.14 billion barrels of crude oil, worth approximately $124.4 billion using 2010 average wellhead prices for over $125 billion in 2006 dollars.[1]

Ohio producers provided the state with 78,122 million cubic feet of natural gas and 4.8 million barrels of crude oil in 2010. This amounted to a market value of $718 million worth of natural gas and crude oil, the lowest since 2003.[2]

Ohio remains in the top half of natural gas producing states, and ranks ninth in the number of gas wells drilled and fourth in number of total productive wells with 222,204 to date.[3] Approximately 64,378 natural gas and crude oil wells are currently in operation and are distributed among 5,664 registered well owners (4,200 are domestic owners).[4] Natural gas and crude oil have been produced in most of Ohio's 88 counties since the industry's launch, though much of the current activity occurs in the eastern half of the state. Many wells produce both natural gas and crude oil.

Clinton sandstone wells were the most actively drilled, accounting for 53% of all wells drilled. Cuyahoga County was the most active in 2010, with 37 wells drilled.

Many of Ohio's reserves originate in "marginal wells," wells that produce less than 10 barrels of crude oil or less than 60 thousand cubic feet of natural gas per day. Ohio has the fourth highest number of marginal natural gas wells and has the fourth highest number of marginal crude oil wells in the nation. According to national statistics provided by the Interstate Oil and Gas Compact Commission (IOGCC) in 2008, marginal wells (sometimes called stripper wells) account for 19% of natural gas and 20% of crude oil produced in the U.S.[5]

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[1] Summary of Ohio Oil and Gas Activities Ohio Department of Natural Resources Division of Mineral Resource Management, 2010.

[2] Summary of Ohio Oil and Gas Activities Ohio Department of Natural Resources Division of Mineral Resource Management, 2010.

[3] U.S. Energy Information Administration (EIA) http://www.eia.gov/oil_gas/natural_gas/data_publications /natural_gas_annual/nga.html and Summary of Ohio Oil and Gas Activities Ohio Department of Natural Resources Division of Mineral Resource Management, 2010.

[4] Summary of Ohio Oil and Gas Activities Ohio Department of Natural Resources Division of Mineral Resource Management, 2010.

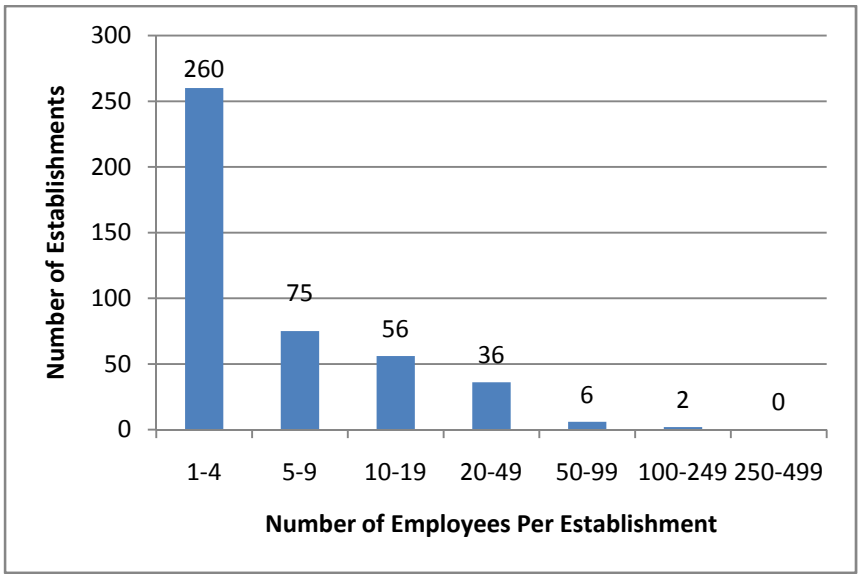
[5] Marginal Wells: Fuel For Economic Growth 2009 Report, Interstate Oil and Gas Compact Commission.

According to the U.S. Census Bureau's County Business Patterns Report (CBP), there are an estimated 435 natural gas and crude oil establishments in Ohio.[6] Since there is a certain amount of under coverage in employment estimates reported in the CBP report,[7]the Industry and wage data from the Quarterly Census of Employment and Wages[8] (QCEW) is used to measure the economic impact of the Industry to the State of Ohio. According to the QCEW, there were 4,490 employees for the year 2010. (See Table 20 on page 28.)

Table 1: Number of Ohio Natural Gas and Crude Oil Industry Establishments, 2009

Industry Code	Industry Code Description	Total Number of Establishments[9]
21111	Oil and Gas Extraction	203
213111	Drilling Oil and Gas Wells	78
213112	Support Activities for Oil and Gas Operations	154
	Total	435

Figure 1: Ohio Natural Gas and Crude Oil Industry Number of Establishments by Employment Size, 2009



[6] U.S. Census, County Business Patterns, 2009.

[7] U.S. Census, County Business Patterns for Ohio, 2009 reported only 3,365 employed in Industry Sectors 21111, 213111 and 213112 which underestimates employment due to tabulation and survey methods.

[8] The employment estimate is based on the Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) program which publishes a quarterly count of employment and wages reported by employers covering 98 percent of U.S. jobs, available at the county, MSA, state and national levels by industry.

[9] An establishment is defined as a business or industrial unit at a single location that distributes goods or performs services. It is not necessarily identical to a company or enterprise, which may consist of several establishments.

In spite of greater access to resources, costs of exploring, drilling and producing energy have been increasing. Drilling and production firms innovate and invest in high-technology equipment and software to improve productivity. Firms also invest in the classic hardware of "steel, pumps and motors" needed to lift the natural gas and crude oil out of the ground. As older wells deplete or depressurize and become uneconomical, new wells must constantly be drilled.

The Ohio Oil and Gas industry, however, is at a pivot point. The industry is changing rapidly in the face of potential development of the Utica shale formation. Prior to 2011, the oil and gas industry focused on development of the Clinton sandstone formation. This report provides insight into the industry's impact upon Ohio economy based upon development of the Clinton formation in 2010 as well as the industry's potential near term impact of investments in Ohio to explore and develop the Utica formation. The estimation of investments and their projected impacts developed in this report depend upon the continued viability of the Utica formation. The viability is largely a function of price and technology. Market price of natural gas, crude oil, and natural gas liquids must be adequate to encourage investment. Continued technical success employing horizontal drilling and stimulation technologies must be achieved at a cost-efficient level. The supply chain of labor and equipment must grow at a pace with the development of the formation. Lastly, ultimate demand for the products of the Utica shale must be evident. To the extent that Ohio firms will use these chemicals, natural gas, its liquids, and oil, industries will benefit from reduced costs of inputs and be more competitive.

This study provides evidence and analysis of how natural gas development stimulates the economy and provides estimates of the benefits to Ohioans of having and maintaining a natural gas and crude oil industry within the state. For example, the disruption of the Louisiana-supplied natural gas during Hurricane Katrina offered a glimpse of the benefits of Ohio-supplied natural gas. That is, there was no disruption in supply to Ohio. Natural gas supplied from Ohio:

a) is less disruptable during times of peak demand
b) is sold on a price-leveling "first of the month index"
c) reduces natural gas price locally as well as nationwide
d) faces minimal interstate pipeline capacity constraints
e) supports or creates thousands of jobs and millions of dollars in annual revenue for the state.

The next section provides an overview of the methodology undertaken to estimate the economic benefits of Ohio-produced natural gas and crude oil. The subsequent section presents the projected economic impacts from capital investments for the Utica shale development. It includes an analysis of leasing and royalty payments and taxes paid by Ohio oil and gas Industry from the Utica formation. This section also presents the economic impacts of the industry with respect to jobs, income, and gross state product and new wells drilled and the value of 2010 wells drilled. The third section examines the value of natural gas to Ohio consumers in terms of price reductions, avoided interstate pipeline charges, security benefits,

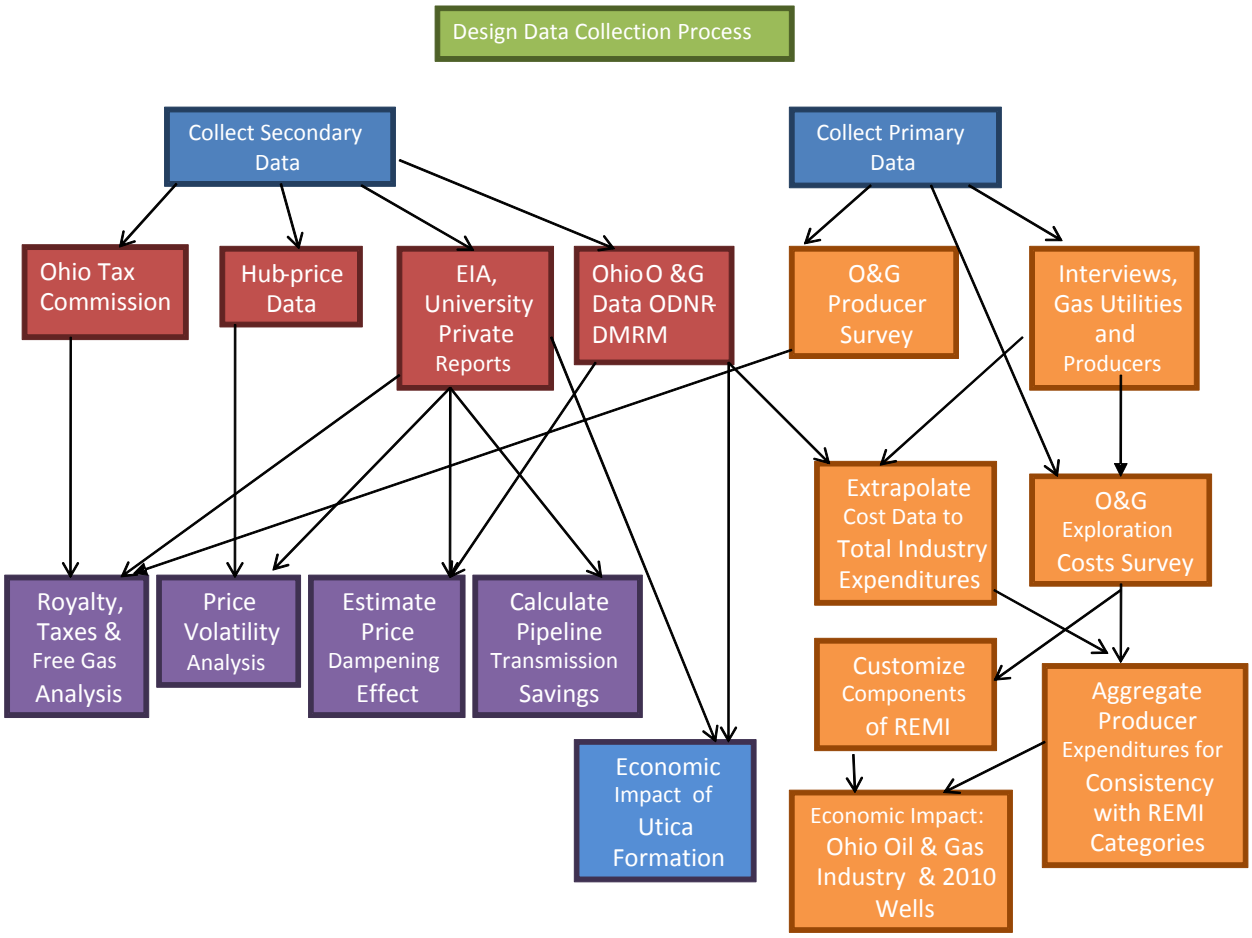
and price volatility benefits of local natural gas. The fourth section analyzes the distribution of the natural gas and crude oil industry outlays. The final sections review capital reinvestments the industry makes to the state's benefit, taxes paid by the industry and the benefits of gas reserves.

III. METHODOLOGY

In this study, Kleinhenz & Associates completed several investigations requiring a multifaceted approach that included the use of a regional economic model, a literature review, primary and secondary data collection, interviews, surveys and analysis. Like our previous report, this study estimates the direct, indirect and induced economic impacts by sector using the model developed by Regional Economic Models, Inc. (REMI). Public data available from the Energy Information Agency (EIA) as well as data and research conducted by the Department of Energy, the Government Accounting Office, and various universities were employed. In addition, key industry players in the market were interviewed. This comprehensive approach provides perspective and insights to the questions posed and are valid to address the value of local Ohio production of natural gas and crude oil.

A full accounting of each methodology is provided in subsequent sections of this document. Often, research findings from a survey or a source were relevant to more than one task. The diagram in Figure 2 relates the overall methods. Other research and analytical approaches, beyond the scope of this research, would also be valid and would shed a different light on the issues addressed. Further research taking a transactional- or basis-oriented approach would be of great interest. Mapping out the impact that various trading hubs and their commensurate natural gas demand and supply have on the regional price of natural gas could very well reveal the impact of DTI Southpoint and DTI Appalachia hubs. Another approach, not undertaken in this analysis, would be more cost-accounting research tracing the various seasonal purchases, transport and expenditures made by Ohio utilities from various sources.

Figure 2: Research Design: Project Flow Chart



IV. ECONOMIC IMPACTS OF THE NATURAL GAS AND CRUDE OIL INDUSTRY ON THE OHIO ECONOMY

To estimate the economic value of the existing natural gas and crude oil industry on the State of Ohio's economy and specifically the impact of wells drilled in 2010, Kleinhenz & Associates used an econometric model which employs a dynamic input/output framework that tracks how a dollar of investment flows through the economy over time. The economic modeling framework that best captures these flows is called an input-output model and most often applied to assess the economic outcomes of job creation or reduction.

Fundamentally, expenditures by natural gas and crude oil industry firms affect the Ohio economy directly through the purchases of labor, materials and services in the state and indirectly as those purchases generate spending by suppliers from related sectors of the economy. Induced economic impacts result as household income changes (created by direct and indirect effects on wages) lead to further consumer spending throughout the state economy. This cycle continues until spending eventually leaks out of the region as a result of taxes, savings or purchase of goods or services from outside the state.

An econometric model developed by Regional Economic Models, Inc. (REMI) was used to measure the combination of direct, indirect and induced effects critical for this analysis.[10] It is an empirical representation of the Ohio economy and its intersectorial linkages enable the user to trace the effects of a change in the demand for goods and services due to an expansion or contraction of a firm or industry. As a dynamic representation of the economy, the model takes into account inter-regional trade flows, intraregional trade flows, and the pressures of competition on demand for capital and labor. Such competition impacts the costs of both labor and capital, the mix of resources used by industry (production function) and, in the long run, the amount of regional goods and services purchased and produced. Based on many equations, the REMI model makes the correlation between input of goods and services (capital, labor and technology) and output. For example, producing 1 mcf of natural gas may require 10 workers, thousands of dollars of materials, and a particular set of equipment (representing technology and capital investment). If any of the three ingredients – labor, materials or equipment – becomes scarce or unavailable, the final output would be negatively affected.

The amount of intraregional trade depends on the proportion of the total demand for a good or commodity by all users in the study area captured by each industry. The local market share of total demand depends on relative production costs, the estimated price elasticity of demand, and the effective distance between the study area and each of the other regions. An increase or decrease in the local share will depend on price and quantity produced compared with competitors in the market. The change in share of a specific area in any region depends on changes in its delivered price and the quantity it produces compared with the same factors for competitors in that market. The share of local and external markets thus drives the exports

[10] The Northeast Ohio REMI Model was used in this analysis and includes all Ohio counties. The model has its own base forecast and requires individual inputs of economic activity.

from and imports to the home economy. The economic model represents the major interindustry linkages among private industries aggregated into 70 major industrial sectors, including three public sectors (state and local, federal and military). The model combines county data to create regions or spatial units of analysis.

A baseline projection of the Ohio economy is embedded in the model and serves as the baseline forecast that is used to estimate the impacts of economic change or shock. The baseline forecast establishes economic and labor conditions based on a series of assumptions and how they are affected by trends forecasted at the national level. The national trends are reflected in the baseline based on the state's industry mix and competitive conditions. For purposes of this study, all impacts are compared to the baseline forecast. This underlying feature is what makes the model dynamic, meaning that it is able to show how the Ohio economy will react over time.

For modeling purposes, specific economic sectors using the North American industrial classification system (NAICS) codes affected by the oil and gas industry expenditures were required. These sectors are defined by the U.S. Office of Management and Budget and include:

> **NAICS 213** industries in the support activities for mining subsector group establishments primarily providing support services, on a contract or fee basis, required for the mining and quarrying of minerals and for the extraction of oil and gas. Establishments performing exploration (except geophysical surveying and mapping) for minerals, on a contract or fee basis, are included in this subsector. Exploration includes traditional prospecting methods, such as taking core samples and making geological observations at prospective sites.
>
> **NAICS 2111** The activities performed on a contract or fee basis by establishments in the Support Activities for Mining subsector are also often performed in-house by mining operators. These activities include: taking core samples, making geological observations at prospective sites, excavating slush pits and cellars, and such oil and gas operations as spudding in, drilling in, redrilling, directional drilling, well surveying; running, cutting, and pulling casings, tubes and rods; cementing wells, shooting wells; perforating well casings; acidizing and chemically treating wells; and cleaning out, bailing and swabbing wells.

Measuring Economic Impacts: Indicators

In the following tables, estimates for the various measures from each of the simulations are analyzed and reported as differences from the control forecast. Economic impacts are reported for five elements:

1. Employment changes
2. Change in gross regional product (GRP)

3. Changes to income
4. Output
5. Local income taxes

- Employment – A Bureau of Economic Analysis (BEA) concept based on place of work including full-time and part-time employees, as well as seasonal employees. It is important to note that these jobs are simply "jobs" as they are counted and weight equally full- and part-time positions. These jobs are distributed across a number of industries and so, in any given industry, a "job" may represent a summation of positions across a number of industries in which each industry has less than one complete or full-time-equivalent (FTE) position.

- Gross Regional Product (GRP) – An economic measure of the value-added that labor contributes to the final product or service. This measure is used more often than output as it does not include the value of "intermediate goods" or inputs into estimating the economic impact. For example, if a $25,000 auto is comprised of $15,000 in parts (intermediate goods) and $10,000 in labor to assemble the parts into a complete car, then the $10,000 in GRP is what the state uses to measure its input or contribution into the value of the vehicle (output).

- Personal Income – This measure consists of total increases in payroll costs paid by local industries, plus income from self-employment, other property income and transfer payments.

- Output – This indicator is also estimated by the model as a measure of economic impact. Output is analogous to sales and is a measure of the total value of both the inputs to labor as well as the value of inputs from materials.

- Local Income Taxes –This measure is estimated by multiplying the personal income figure generated by the model by an average tax rate. This is a median approximation and does not take into account those areas with higher rates nor does it take into account the workers and companies from townships that are not able to levy a tax.

Economic Impact of the Development of the Utica Formation

Recognizing that the development of natural gas from the Utica formation involves a sequence of activities, Kleinhenz & Associates sought the assistance of a committee of industry experts to provide input on the various stages of the development process. This included activities before and after drilling that are related to measuring the economic impact. The committee provided a forecast of the likely number of Utica formation wells drilled, expenditures and production estimates for the years 2011 to 2015. In addition, experts advised as to midstream investments required and Ohio counties most likely to benefit from early investments. Other industry executives were interviewed about the general status of the industry and for specific costs for labor and materials for natural gas exploration, development and production. The data gathered from meetings and from interviews are used to develop assumptions and inputs into the REMI model. When estimates are made, they are conservative and are based on standard economic practices and the advice of experts. This study does not include historical or projected spending to upgrade or expand natural gas transmission pipelines, although it is recognized that Utica Shale development will result in significant new construction activity in that sector. Midstream investments that include lateral gathering pipeline systems are captured in our study. This report does not include expenditures for any "downstream" activities such as expansion of interstate natural gas transmission, increased natural gas compression capability, natural gas distribution or new businesses that may be created in Ohio due to development of the Utica formation.

Our results on economic benefits of the development of the Utica formation are presented in three parts:

1) Economic impacts of planned drilling and completing 3,922 horizontal wells in Ohio
2) Economic impacts of consumer spending associated from lease and royalty payments
3) Direct taxes paid by Ohio crude oil and natural gas producers

Economic Impacts of Planned Drilling

Data Requirements and Assumptions

The REMI model allocates planned expenditures associated with Utica shale by historical spending patterns as estimated for the industry within Ohio. As such, the Ohio natural gas industry's production function incorporates activities by Ohio firms as well as by firms outside Ohio. Recognizing that the Utica play incorporates new technology, i.e., horizontal drilling, enhanced well stimulation, and perhaps a greater degree of computer modeling, the increased usage of service companies is assumed. These skills and services may not be available within

Ohio to a sufficient degree. Such importing of horizontal well technology and expertise has been witnessed regarding the Marcellus shale and other shale plays around the country.

A fully completed well and production gathering lateral pipeline was estimated to be $10 million based upon industry information. Based on past performance of other drilling activities, a 98% completion rate was adopted assuming that the Utica wells are as successful as the horizontal well trials in the nearby Marcellus formation. Exploration, development and production expenditures were subdivided between dry hole (33%) and completion (67%) activities per expected well.

To project future drilling activity for Utica development in Ohio, the committee projected that over 4,000 wells would be drilled by 2015 – 3,922 of those as ultimately completed. This projection was based on the Marcellus Gas development in Pennsylvania. Using industry expert input, it was further assumed that only 75% of wells drilled each year would be completed due to the scarcity of well servicing capacity. In the second year after drilling, it was assumed that 75% of the uncompleted wells would be completed, etc.

In addition to drilling and completion, production gathering lateral pipelines must be built to link the new well to the nearest branch of the gathering system. Such pipelines can range from one to seven miles in length and cost on average $2,051,280 per pad. In this study, 10 wells per pad are assumed.[11] While references for more than 20 wells per pad are evident, there are several uncertainties in this new drilling activity. Experts noted that they expect a time lag between drilling of the first hole and the drilling of subsequent wells on the same pad. The geology of each site is another key factor which will determine the length of the horizontal bore and, in turn, determine the economics of how fast a pad might be filled in with wells. Uncertainty exists about the need for companies to drill the first well to secure the lease and then come back to drill in-fill wells later. Yet another concern belies the activities of the midstream firms that might construct liquid separator plants. With more liquid content, the midstream firms may need to build larger diameter pipes closer to larger pads or build out a network of larger pipes to a region with multiple pads. The more the midstream firms build out the region, the less the distance from the wellhead to the large diameter gathering pipe.

With drilling and completion expenditures of $9.7 million and a production gathering lateral pipeline of $200,000, investment approximates $10 million per completed well. In addition, nearly $3 million per never-completed dry hole will also be spent.

Not all of this spending is expected to occur within Ohio given that some supplies are imported from other regions and land income recipients may spend money outside the state. A sizeable well support industry has developed in Pennsylvania, for example, as corporations from the world oil and gas service businesses have established operations in Pennsylvania.

[11] Estimate provided by executive of firm that builds lateral pipelines in Ohio.

To allow for this importation, it is assumed that 10% of initial expenditures are to be made to firms outside of Ohio. This assumption is supported by various recent studies. The Pennsylvania Marcellus Shale study[12] using firm accounting records found that 95 percent of expenditures in 2009 occurred within the state of Pennsylvania. A second Pennsylvania study[13] focusing on occupational demand associated with the growth of Marcellus Shale development reported that between 70 and 80 percent of the labor in 2007 was first imported into Pennsylvania. Yet by 2010, only 29 percent of the new hires were from out of Pennsylvania. The authors emphasized that there is much variability across the many support industries and across companies.

In our simulations, the bulk of the economic impacts occur in the later years, when presumably labor content is tilted more locally to the state of Ohio. The Ohio infrastructure and industry supply chain, arguably will grow in response to the Marcellus development occurring in Pennsylvania. As the Marcellus shale play in Pennsylvania became apparent, labor and investment were assumed to have been drawn from other shale plays in the U.S. such as Barnett and Eagle Ford in Texas. Thus, Ohio's oil and gas industry benefits from nearby Pennsylvania's initial demand for labor and investment and it is assumed that Ohio will be more self sufficient than Pennsylvania was at the same time of its development. Finally, the investment of Ohio's oil and gas industry due to the nearby Marcellus play is expected to be a springboard of rapid investment in Ohio's near-term Utica formation development. The model's default expenditure patterns, moreover, allow for more purchases to be made along industry lines rather than along geographic lines once expenditures are made. In this manner, we do not force the Utica expenditures to only be spent within Ohio; rather, the model allocates expenditures according to regional purchase factors.

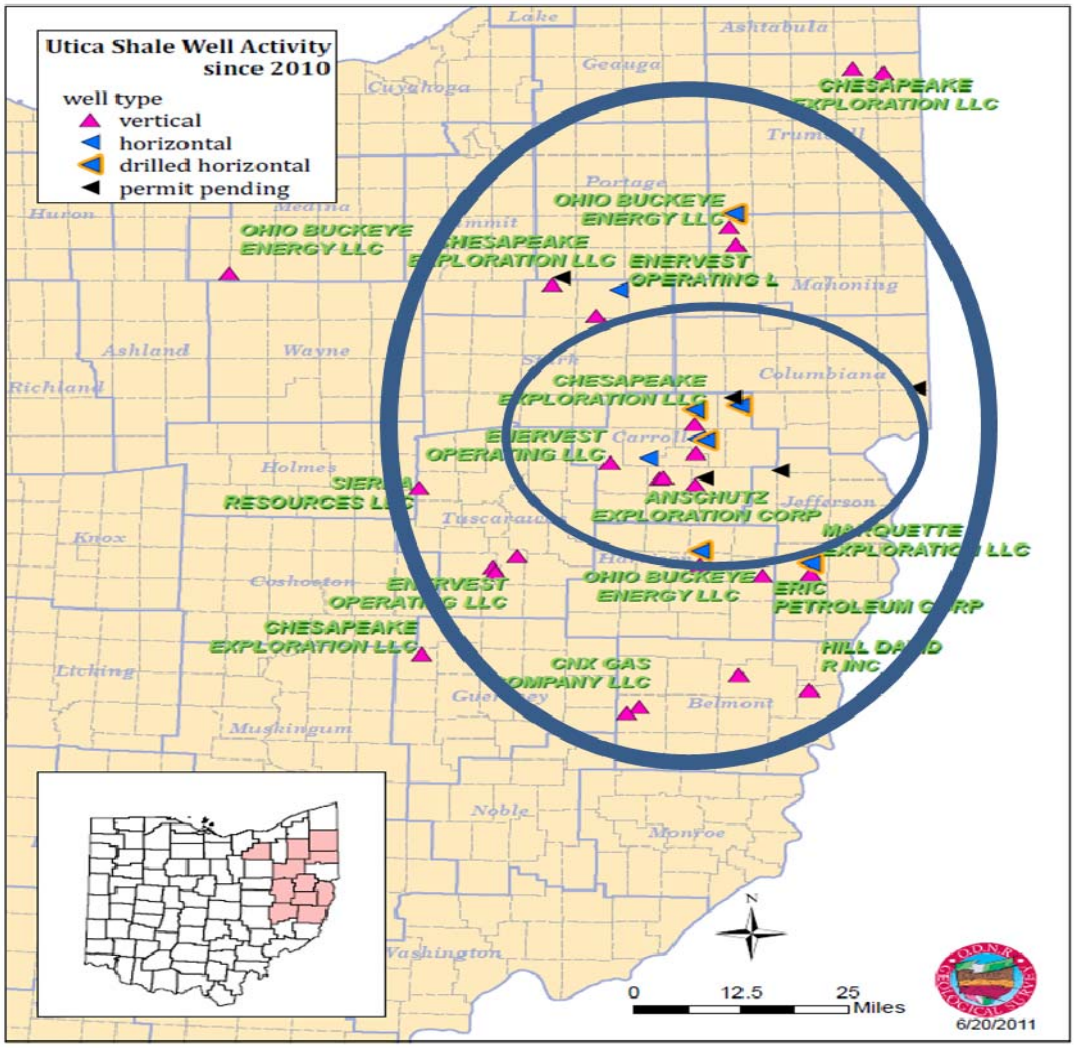
The economic impacts of the Utica shale industry in Ohio are a direct function of drilling activity. The collective opinion of our study committee is that if the Utica play is proven successful, a great deal of activity would then occur over the next decade. For modeling purposes, initial well expenditures were assumed, to occur in 11 counties. [14]

[12] Considine, et al., 2011, p. 11.

[13] Pennsylvania Marcellus Shale Economic Impact Study, Pennsylvania Statewide Workforce Needs Assessment, prepared by the Marcellus Shale Education and Training Center, June 2011, p. 20-21.

[14] **Year 1: S**tark, Carroll, Columbiana, Jefferson. **Year 2**: Portage, Trumbull, Mahoning, Tuscarawas, Harrison, Guernsey, Belmont.

Figure 3: Counties with Initial Utica Development



Direct Utica gas exploration and development expenditures amount to $246 million in 2011 and are estimated to ramp up to $14 billion by 2015. Over the next five years, oil and gas producers are projected to spend over $34 billion. This amount does not include lease or royalty payments made to land or mineral rights owners. These are discussed and modeled in the next section.

Table 2: Utica Well Growth and Expenditures in Ohio, 2011 – 2015

Wells	2011	2012	2013	2014	2015	5 Year Total
Drilled	27	161	785	1,386	1,644	4,003
Completed	20	123	608	1,171	1,501	3,423
Dry hole Expenditure	$99	$565	$2,651	$4,561	$4,909	$12,785
Completion Expenditure	$147	$877	$4,160	$7,820	$9,104	$22,108
Total Expenditures ($million)	$246	$1,442	$6,811	$12,381	$14,013	$34,893

Results

Table 3 summarizes the potential economic impacts on the state of Ohio associated with the emergence of the Utica gas play (not including royalities and lease expenditures). 203,138 jobs across all industries are projected to be created or supported in Ohio by 2015. Sales (Output) in Ohio will increase by over $22 billion and wages by nearly $12 billion. All figures are calculated at the 2010 price level.

A more meaningful estimate of the economic impact is Gross Regional Product that subtracts interindustry purchases from gross purchases and measures the value of labor and capital. Using this measure, the Utica gas expenditures for exploration and development will add $12.2 billion to the economy of Ohio. By 2015, local wage tax revenues amount to $239 million.

Table 3: Economic Impacts of Utica Expenditures in Ohio
(not including impacts from royalty and lease expenditures)

Measure	2011	2012	2013	2014	2015
Employment	3,794	21,469	102,052	177,006	203,138
Gross Regional Product (2010$)	$180,490,801	$1,090,454,086	$5,382,507,950	$9,972,385,040	$12,265,597,116
Wages by Place of Work	$153,076,171	$955,291,749	$4,907,806,396	$9,412,658,692	$11,990,570,072
Output (2010$)	$336,442,364	$2,028,308,975	$9,987,537,682	$18,429,639,625	$22,583,274,738
Local Wage Tax (@2%)	$3,061,523	$19,105,835	$98,156,128	$188,253,174	$239,811,401

Benefits displayed above are calculated by the model at the industry level and summed. Direct expenditures made by the oil and gas industry wind their way through the Ohio economy and generate economic impacts across a variety of industry sectors. Specific industry benefits are noted below. Sectors with largest employment impacts include support activities for mining, retail trade, and professional and technical services.

Table 4: Net Employment Impacts by Selected Sectors Due to Utica Well Development

Category	2011	2012	2013	2014	2015
Support activities for mining	2,473	13,521	63,118	105,709	117,204
Retail trade	166	1,007	4,948	8,990	10,743
Professional and technical services	149	885	4,299	7,675	8,988
Administrative and support services	107	625	3,023	5,365	6,236
Ambulatory health care services	106	634	3,215	5,911	7,060
Construction	98	660	3,235	6,673	9,077
Food services and drinking places	71	434	2,156	3,994	4,940
Wholesale trade	54	321	1,539	2,722	3,162
Real estate	43	259	1,287	2,307	2,670
Personal and laundry services	33	201	1,010	1,834	2,158

Economic Impacts of Royalty and Lease Payments

In this section, the economic contributions of royalty and lease payments for Utica shale wells to the Ohio economy are presented. Natural gas development affects the economy through land payments. Natural gas companies negotiate leases with landowners to access land for development. These agreements often provide an upfront payment or bonus to oil and gas rights owner after signing the lease and then production royalty payments during the life of the agreement if production is established. Royalty payments are paid by the natural gas and crude oil producer to the owner of the mineral interest, usually the landowner. Private owners, corporations, municipalities, nonprofit organizations, and federal and state landowners could lease their mineral interest to producers. Payments are a percentage of the proceeds garnered from the well.

Estimation of Royalty Payments

Expected Ultimate Recovery (EUR) is the amount of oil and gas expected to be economically recovered from a reservoir or field by the end of its producing life. EUR estimates for the development of Utica formation are based upon early reports of reserves in the Marcellus. The industry experts on the study committee recommended an assumed estimate of an EUR of 5 bcf per well for Ohio. Publicly available EUR estimates ranged from 3.7 to 9.9 bcf and support the producers' estimate. According to Anadarko Petroleum, ultimate recovery (EUR) on Marcellus shale wells will be at the high end of the 4 billion to 6 billion cubic foot range.[15] CONSOL Energy reported, "We have seen outstanding results in the last five Marcellus shale wells. The estimated ultimate recoveries of these wells range from 5.5 bcf to 9.9 bcf."[16] In June 2010, Ultra Petroleum (UPL) estimated the EUR to be more conservative, or 3.75 bcf. For the higher-pressured Centre County area, Ultra estimated an EUR of 5 bcf.[17] Atlas estimated average anticipated EURs of 6 bcf wells. Finally, in a July 2011 press release, Range Resources estimated EUR for wells completed in 2009 and 2010 to average 5.7 bcf per well.[18]

How much of the EUR will be produced in the first five years? The consensus view of our study committee is that 40% of the EUR will be produced within the first five years and approximately 80% within the first 10 years. Furthermore, the first year's decline is deemed to be between 70 and 83% of initial daily production. These figures are based upon other shale production rates

[15] March 30, 2011 Anadarko news release, shale.typepad.com.
[16] CONSOL Energy (CNX) conference call, July 29, 2010.
[17] Source: Seeking alpha.com ULTRA news release. June 4, 2010.
[18] http://marcellusdrilling.com/2011/07/range-resources-natural-gas-liquids-and-higher-commodity-gas-prices-equal-a-very-good-quarter/

as well as upon early Marcellus production rates. In a July 2011 press release, Range Resources estimated the 5.7 bcfe type curve reflects that 40% of the EUR is produced within the first five years of production.[19]

In an analysis of production rates by Brandon Baylor of other U.S. shale formations,[20] first year production was shown to decline and estimated 73% within the Barnett shale formation. Annual production decline rates were estimated for one well in the Haynesville formation for the first 10 years which 80% of all recovery takes place. The first year's decline rate was estimated to be 82%; the second year 45%; and the third year, 30%. Chesapeake Energy predicts that 55% of production for its Marcellus wells will be produced within the first 10 years and approximately 40% in the first five years. The initial production rate is projected to be 4 mmcfe/d and EUR is predicted to be 4.2 bcfe. In the first year, 17% of EUR was expected to be produced. In the second year, an additional 9% will be produced and in years three and four another 10%. Years five and six are to add another 7% of production out of the EUR.

The basis for this study's estimate of expected royalty and tax payments utilizes an analysis submitted by James Knobloch Petroleum Consultants and shows a similar decline rate as discussed above.

Utica well production assumptions are as follows:

1) 5,000,000 mcf expected ultimate recovery (5 bcf)
2) Production from wells drilled in 2011 will occur in 2012, thus royalty and tax payments commence in 2012

3) Annual per well production rate as percent of EUR:

Year	EUR
2012	17%
2013	9%
2014	6%
2015	5%
2016	4%

4) Mcf price based upon an industry price assumption of $4.50 multiplied by a 1.2 factor to account for the liquids expected in the production
5) Royalties of 15% and payments lag drilling by a year
6) County property tax of 0.051%
7) Projected completed wells to be drilled as presented in Table 2 above.

[19] http://marcellusdrilling.com/2011/07/range-resources-natural-gas-liquids-and-higher-commodity-gas-prices-equal-a-very-good-quarter/

[20] Baylor, Brandon. Marcellus Shale Decline Analysis, Paul Fulton Scholarship Paper, Marietta College (undated, circa 2010).

Table 5: Royalty Payments for a Sample Utica Well Drilled in 2011

Year of Production	Mcf per well	15%	Price/Mcf	Royalty Payment
2012	874,533	131,180	$5.40	$708,372
2013	433,955	65,093	$5.40	$351,504
2014	315,394	47,309	$5.40	$255,469
2015	239,421	35,913	$5.40	$193,931

Multiplying the single well tax estimates by the appropriate number of wells in production yields totals for the expected drilling activity within the Ohio Utica play.

Table 6: Estimate Royalty Payments, All Ohio Utica Wells 2011 –2015

Year	Wells Drilled	Wells in Production	Gross Gas Production	Royalty Payment
2011	27	0	0	$0
2012	161	20	17,053,411	$13,813,263
2013	785	143	116,357,749	$94,249,776
2014	1386	751	591,406,043	$479,038,895
2015	1644	1,923	1,269,345,132	$1,028,169,557
Sum	4003	2,837	1,994,162,335	$1,615,271,491

Royalty payments lag drilling by a year in this calculation and most likely will not occur until the first wells are producing natural gas. Calculations based upon assumed annual drilling and production rates reveal that royalty payments in 2012 will be $13 million and grow to $1 billion by 2015 as many more wells are brought online.

Estimation of Lease Payments

Annual lease payments are projected to be $1.5 billion over the next five years as exploration firms lock in their claims. This forecast is based on the payment experience in Pennsylvania regarding the Marcellus shale formation and current leasing activity of several large exploration companies in Ohio.

Table 7 displays the combined estimates of royalty and lease payments associated with the projected Utica drilling. Research literature shows that recipients of such windfall payments such as oil and mineral lease payments do not spend 100% of the payments within the first year. Several studies were reviewed to arrive at an acceptable expenditure amount to be used as an input into the model. Authors of these studies took into account the size of the windfall relative to normal earnings, the type of windfall (cash versus property value), the age of the recipient, expenditures made on durable versus nondurable goods and other factors. The body

of literature appears to point to a marginal propensity to consume (MPC) of windfall income of between 4 and 10%.[21]

Table 7: Estimates of Royalty and Lease Payments and Expenditures by Consumers

Year	From Royalties	From Leases
2011	$0	105,000,000
2012	$966,928	105,000,000
2013	$6,597,484	105,000,000
2014	$33,532,723	105,000,000
2015	$71,971,869	105,000,000

For this study we use a modest assumption of 7% MPC out of windfall income to be spent by households due to Utica leasing and drilling activities. Since the holders of mineral interests that receive royalty payments can take on many legal forms, and as such, the value of state and local revenues from these payments are not incorporated into the study. Given these assumptions, as shown in Table 8, for every $1 million of Ohio-based expenditures associated with receipt of these payments, approximately eight additional jobs are created or supported and nearly $670 thousand is added to the state's economy.

Table 8: Economic Impacts of $1 Million of Consumer Expenditures

Economic Impact Measure	Impact Per Million $
Employment	8
Gross Regional Product (2010$)	$469,334
Wages by Place of Work	$305,180
Output (2010$)	$670,469

In Table 9 the estimated impacts due to royalty payments are provided. These are the product of the royalty payments made as presented in Table 6, the 7% marginal propensity to consume,

[21] Dr. Loren C. Scott & Associates (April 2010) *Economic Impact of the Haynesville Shale on the Louisiana Economy*, who used a study by Yash Mehra, Federal Reserve Bank of Richmond Quarterly Review, Spring 2001. (As cited in a study commissioned by America's Natural Gas Alliance: Center for Community and Business Research, The University of Texas at San Antonio, Institute for Economic Development, Economic Impact of the Eagle Ford Shale, February 2011.
Imbens et al., Estimating the Effect of Unearned Income on Labor Earnings, Savings, and Consumption: Evidence from a Survey of Lottery Players, The American Economic Review, Vol. 91, No. 4 (Sep. 2001), pp. 778-794.
Christopher D. Carroll, NBER Final Draft, A Theory of the Consumption Function, With and Without Liquidity Constraints
(Expanded Version), July 6, 2001.
Abdel-Ghany et al., Windfall Income and the Permanent Income Hypothesis: New Evidence, Journal of Consumer Affairs, Vol.17, No. 2, pp 262-276, 1983.

and the economic benefits per million of consumer expenditure from Table 8 divided by $1 million.

Table 9: Economic Impacts of Utica Royalty Payments

Measure	2011	2012	2013	2014	2015
Employment	0	8	52	262	562
Gross Regional Product (2010$)	$0	$453,812	$3,096,424	$15,738,047	$33,778,846
Wages by Place of Work	$0	$295,087	$2,013,420	$10,233,516	$21,964,375
Output (2010$)	$0	$648,296	$4,423,411	$22,482,662	$48,254,930

In Table 10 the estimated impacts due to lease payments are provided. These are the product of the lease payments presented in Table 7 and the economic benefits per million of consumer expenditure from Table 8 divided by $1 million.

Table 10: Economic Impacts of Utica Lease Payments

Measure	2011	2012	2013	2014	2015
Employment	820	820	820	820	820
Gross Regional Product (2010$)	$49,280,072	$49,280,072	$49,280,072	$49,280,072	$49,280,072
Wages by Place of Work	$32,043,900	$32,043,900	$32,043,900	$32,043,900	$32,043,900
Output (2010$)	$70,399,278	$70,399,278	$70,399,278	$70,399,278	$70,399,278

Using these estimates, the future economic impact of expenditures from combined royalty and lease payments between 2011 and 2015 are calculated and are summarized in Table 11. During the first year, 2011, the Utica gas industry could generate or support 820 more jobs and result in additional sales of $70 million to the Ohio economy. By 2015, the projected impacts grow even larger with over 1,300 Ohio jobs and $118 million in additional output. These estimates do not account for any local, state, or federal state or local taxes being paid by the royalty or lease recipient. Moreover, only 7% of the windfall portion of payments received is used in calculating economic impacts. It is also recognized that the second year of a consumer's expenditure is not incorporated into the calculations of economic impact. The wide degree of savings and tax uncertainty would make results of such a calculation unclear.

Table 11: Estimated Combined Economic Impact of Royalty and Lease Payments 2011-2015

Measure	2011	2012	2013	2014	2015
Employment	820	828	872	1,082	1,383
Gross Regional Product (2010$)	$49,280,072	$49,733,884	$52,376,495	$65,018,119	$83,058,918
Wages by Place of Work	$32,043,900	$32,338,987	$34,057,320	$42,277,416	$54,008,275
Output (2010$)	$70,399,278	$71,047,574	$74,822,689	$92,881,940	$118,654,208

The higher economic output and greater employment associated with expenditures associated with royalty and lease payments by the Utica gas industry generate additional tax revenues for state and local governments. These impacts are reported in Table 12. For every $1 million of Ohio-based consumer expenditures from royalty and lease payments, total state and local tax revenues increase by $45,700.

Table 12: Public Revenue Impacts of Consumer Expenditures from Royalty and Lease Payments

	Impact	Impact from Royalty Payments		Impact from Lease Payments
Public Revenue Estimates	Per Million $	2012	2015	Yearly
State Income Tax (@3% ATR)	$9,165	$8,862	$659,600	$962,293
CAT: Self Supply	$1,312	$1,269	$94,423	$137,754
CAT: Imports	$405	$392	$29,144	$42,519
Sales: B2B	$2,950	$2,852	$212,294	$309,716
Sales: Consumer	$25,799	$24,946	$1,856,823	$2,708,925
Total State Revenue Estimates	$39,631	$38,320	$2,852,284	$4,161,207
Local Wage Tax (@2%)	$6,104	$5,902	$439,287	$640,878
Total Public Revenue Estimates	$45,735	$44,222	$3,291,572	$4,802,085

Summary Results: Economic Impact of Utica Formation

The capital investments for the development of the Utica formation will have significant impacts on the economy of Ohio. Our estimate suggests that producing Utica natural gas requires significant expenditures for exploration, leasing, drilling and pipeline construction. As displayed in Table 13, 204,520 jobs are projected to be created or supported in Ohio by 2015. Sales (Output) in Ohio will increase by over $22 billion and wages by $12 billion. Revenues to government from a local wage tax of 2% are estimated to amount to $240 million by 2015.

Table 13: Combined Economic Impacts of Spending on Utica Gas Formation (From Well Exploration and Development, Midstream, Royalty, and Lease Expenditures)

Measure	2011	2012	2013	2014	2015
Employment	4,614	22,297	102,924	178,088	204,520
Gross Regional Product (2010$)	$229,770,873	$1,140,187,970	$5,434,884,446	$10,037,403,159	$12,348,656,034
Wages by Place of Work	$185,120,071	$987,630,736	$4,941,863,716	$9,454,936,109	$12,044,578,347
Output (2010$)	$406,841,643	$2,099,356,549	$10,062,360,372	$18,522,521,565	$22,701,928,946
Local Wage Tax Revenues(@2%)	$3,708,303	$21,166,713	$100,297,006	$190,754,052	$240,891,566

In general, the findings from our analysis are consistent (although no exact comparisons can be made because of modeling and assumptions used) on a per dollar expended basis compared to the recent study published by Pennsylvania State University documenting the development of the Marcellus Shale and its economic impacts on the Commonwealth of Pennsylvania.[22] Our study shows slightly more of an employment impact per $1 million of expenditures than reported in the Pennsylvania Study. For Ohio, we estimate a range of 13 to 18 jobs per $1 million of expenditure. This compares favorably to Pennsylvania's 13 jobs per $1 million of expenditures. Gross Regional Product (GRP) projections per $1 million of expenditures are also comparable. In Ohio, on average, approximately $830,000 is generated compared to Pennsylvania's $1 million of GRP per $1 million of expenditure. Lastly, Ohio results show a 2011 output of $1.58 million per $1 million of expenditures while Pennsylvania results indicate a $1.97 million output increase due to $1 million expenditure.

Estimation of Direct Taxes Paid by Ohio Oil and Gas Industry from Utica Formation

The estimated total taxes collected from Ohio's Utica formation from natural gas and crude oil firms are estimated to be $5.4 million in 2012. After the ramp-up of shale drilling activity, tax revenues increase to more than $540 million in 2016. This projection is summarized in Table 19 and includes various taxes paid by the industry, severance taxes, property taxes, commercial activity taxes, and finally income taxes. The following provides an explanation of how these estimates are calculated.

Severance Tax

The State of Ohio imposes a severance tax on natural gas and oil production. At these large levels of production, we use the industry experts' recommended rate of $0.03 per taxable mcf.

Table 14: Severance Taxes For a Sample Utica Well

Year of Production	Taxable Mcf	Severance Taxes
2012	743,354	$22,301
2013	368,862	$11,066
2014	268,085	$8,043
2015	203,508	$6,105
2016	184,392	$5,532

[22] Considine et al., The Pennsylvania Marcellus Natural Gas Industry: Status, Economic Impacts and Future Potential, The Pennsylvania State University, July 20, 2011.

Property Tax

Ohio natural gas and crude oil producers pay property taxes. For the property valuation, a discounted cash flow method is used whereby the future net income from production is estimated and the present value of that net income stream is calculated. Specific information on this calculation is provided on the Ohio Oil and Gas Association's (OOGA) website and available from the Ohio Department of Taxation. From OOGA website (August 2011):

2010 Uniform Valuation of Oil and Gas Deposits Release:

> *The Ohio Department of Taxation has released their 2010 uniform formula for the valuation of oil and gas deposits in Ohio. In 2005, House Bill 66 exempted producers from the tangible personal property tax. Since then, OOGA, the Department of Taxation and state legislators have worked to find a fair and equitable formula to replace this tax. Per 2006's budget bill (HB 699), this new formula was codified for the valuation of these reserves.*

The 2010 formula is as follows:

Crude Oil	Taxable Value
Average Daily Production: more than 1 barrel	$4,640 per barrel
Average Daily Production: less than 1 barrel	$2,780 per barrel

Natural Gas	Taxable Value
Average Daily Production: more than 8 mcf	$450 per mcf
Average Daily Production: less than 8mcf	$225 per mcf

Source: http://www.ooga.org/industry-studies-links/tax-information

Assuming that Utica wells produce at the maximum taxable rates for the first five years, then a single well will be valued at between $267,000 and $1 million. Property taxes will amount to between $15,000 and $54,000 per year per Utica well.

Table 15: Property (Ad Valorem) Tax Paid for a Sample Utica Well

Year of Production	Mcf per well	Daily Mcf	Valuation @$450/mcf	Taxed @.051%
2012	874,534	2,396	$1,078,192	$54,988
2013	433,955	1,189	$535,014	$27,286
2014	315,394	864	$388,842	$19,831
2015	239,421	656	$295,177	$15,054

Commercial Activities Tax

The Commercial Activity Tax (CAT) paid by natural gas and crude oil producers is similar to taxes paid by other Ohio businesses. In Ohio, the Commercial Activity Tax (CAT) is a tax of 0.0026% on a firm's gross receipts.

Table 16: Estimated Commercial Activity Tax

Year	Gross Gas Production	Price/Mcf	Gross Receipts	Commercial Activity Tax
2011	0	$5.40	$0	$0
2012	17,053,411	$5.40	$92,088,418	$239,430
2013	116,357,749	$5.40	$628,331,843	$1,633,663
2014	591,406,043	$5.40	$3,193,592,634	$8,303,341
2015	1,269,345,132	$5.40	$6,854,463,711	$17,821,606

Income Taxes

The EIA publishes Performance Profiles of Major Energy Producers (the Majors) which is a comprehensive annual financial review and analysis of the domestic and worldwide activities and operations of 29 major U.S.-based energy-producing companies. EIA examines a company's operations on a consolidated corporate level, by individual lines of business, by major functions within each line of business, and by various geographic regions. These Major producers reported 3% income tax expense. Multiplying Taxable mcf (production net of royalty gas) by the price per mcf yields a gross revenue for Utica wells. Three percent of that revenue is estimated to be allotted to income tax payments.

Table 17: Estimated Income Tax

(Estimate based upon 3% of total revenues, Majors Analysis)

Year	Taxable Production	Income Tax @ 3% of Taxable Revenue	Federal Income Tax	State and Local Income Taxes
2011	-	$0	$0	$0
2012	14,495,399	$2,348,255	$1,878,604	$469,651
2013	98,904,086	$16,022,462	$12,817,970	$3,204,492
2014	502,695,137	$81,436,612	$65,149,290	$16,287,322
2015	1,078,943,362	$174,788,825	$139,831,060	$34,957,765

Summary Results: Taxes Paid by Ohio Oil and Gas Industry

Table 18 displays the estimated taxes to be paid per single well. Multiplying the single well tax estimates by the appropriate number of wells in production yields totals as displayed in Table 19 for the expected drilling activity within the Ohio Utica play.

Table 18: Summary of Estimated Taxes, Single Utica Well

Year of Production	Property	Severance Taxes	Commercial Activity Tax	Federal Income	State and Local Income	Total Taxes
2012	$54,988	$22,301	$12,278	$96,339	$24,085	$209,990
2013	$27,286	$11,066	$6,093	$47,805	$11,951	$104,200
2014	$19,831	$8,043	$4,428	$34,744	$8,686	$75,731
2015	$15,054	$6,105	$3,361	$26,375	$6,594	$57,489

Table 19: Summary of Tax Payments, Ohio Utica Wells 2011 – 2015

Year	Severance Taxes	Commercial Activity Tax	Ad Valorem Tax	Federal Income Tax	State and Local Income Taxes	Total
2011	$0	$0	$0	$0	$0	$0
2012	$434,862	$239,430	$1,072,262	$1,878,604	$469,651	$4,094,809
2013	$2,967,123	$1,633,663	$7,316,193	$12,817,970	$3,204,492	$27,939,440
2014	$15,080,854	$8,303,341	$37,185,668	$65,149,290	$16,287,322	$142,006,475
2015	$32,368,301	$17,821,606	$79,812,249	$139,831,060	$34,957,765	$304,790,980
Total	$50,851,140	$27,998,039	$125,386,371	$219,676,923	$54,919,231	$478,831,704

The Economic Impact of the Ohio Natural Gas and Crude Oil Industry

Like our previous report, the methodology to estimate the economic impact of the existing natural gas and crude oil industry was conducted as a "counterfactual study." The purpose of this methodology is to examine the possible changes on the Ohio economy that may result if the economic data of the natural gas and crude oil industry were removed. So what would happen in the state's economy if the natural gas and crude oil industry did not operate? To get a statewide perspective of the importance of the industry to the state of Ohio's economy, a simulation was created which allows the entire industry to be removed completely from the state. This approach eliminates all the economic activity – the supply chain, both interindustry and households. The reduction in economic activity due to interindustry (indirect effects) and households (induced effects) is essential to understanding what production of natural gas and crude oil means to the economy and output of the state of Ohio.

Modeling Methodology and Assumptions

The approach used to assess the economic value of the Ohio natural gas and crude oil industry to Ohio's economy employs accepted economic principles. The baseline estimate of natural gas and crude oil jobs and wages for the State of Ohio in 2010 from the U.S. Bureau of Labor Statistics' Quarterly Census of Employment and Wages approximates 4,490.

Table 20: Baseline Estimate of Ohio Natural Gas and Crude Oil Employment and Wages

Industry Code	Industry Code Description	Jobs[23]	Average Annual Wages
21111	Oil and Gas Extraction	2757	$88,335
213111	Drilling Oil and Gas Wells	554	$38,920
213112	Support Activities	1180	$55,531

While the state's average wage for the industry was applied to all regional components in the model, each region has different wage estimates and total wage bills. The total wage bill was used to re-estimate employment in each region based on dividing the wage bill for that region by the average wage for the state. Based on the marginal product of labor, which is tied to average wage within the model, each region had an estimate of output within the REMI model. Using employment, it was possible to estimate the output attributable to each worker.

[23] U.S. Bureau of Labor Statistics 2010 Quarterly Census of Employment and Wages (QCEW).

Summary Results: Economic Impact of Ohio Oil and Gas Industry

Table 21 contains the impact estimates of various measures of the natural gas and crude oil industry on Ohio. As a counterfactual, all impact estimates are reported as a negative or loss to the state. For example, if the natural gas and crude oil extraction industry disappeared from the state in 2010, 12,954 workers are impacted and the state would not have produced slightly less than $1.0 billion in Gross State Product. Personal income would decrease by $792.6 million, generating a loss of local personal income tax revenue of $15.9 million.

Table 21: Summary Impact Estimates of Natural Gas and Crude Oil Extraction on State of Ohio, 2010

Measure	Amount
Employment (Jobs)	-12,954
Gross Regional Product	-$988,441,924
Personal Income	-$792,556,763
Output	-$1,654,588,420
Local Wage Taxes @ 2%	-$15,851,135

Table 22 shows additional detail on the total economic impacts in other industry sectors that are affected by the natural gas and crude oil industry in Ohio. This table contains estimates of impacts to employment, gross state product (value added, output [sales]) and personal income. While this table only contains industries with employment of 10 or greater, nearly all of the 70 industry sectors reported in REMI were affected by the natural gas and crude oil industry.

Aside from the impacts of the target industries, oil and gas extraction and support activities for mining, construction and retail trade are the industries with the largest employment impacts. Construction supports all sectors of the economy and is impacted only as the industry ramps down due to changes in demand, but also suppliers and households are affected by the change in the natural gas and crude oil industry. Similarly, the retail trade sector is adversely affected by employment changes in the natural gas and crude oil industry as well as its suppliers and households supplying goods and services to workers.

Table 22: Net Impacts of Selected Sectors from Loss of Natural Gas and Crude Oil Industry, 2010[24]

	Sector	Jobs	Output	Wages
1	Oil and gas extraction	-2759	-$519,275,888	-$269,690,812
2	Construction	-2004	-$200,493,887	-$96,838,951
3	Support activities for mining	-1741	-$301,947,907	-$174,961,090
4	Retail trade	-977	-$69,800,225	-$30,082,703
5	Ambulatory health care services	-582	-$60,799,152	-$36,956,787
6	Professional and technical services	-559	-$59,877,254	-$38,175,583
7	Administrative and support services	-444	-$24,845,142	-$14,692,307
8	Food services and drinking places	-353	-$16,164,638	-$7,244,110
9	Wholesale trade	-273	-$51,575,984	-$20,959,854
10	Real estate	-242	-$51,881,887	-$2,903,700

Economic Impact of New Wells Drilled in 2010

Ongoing exploration and development are critical reinvestments being made by Ohio natural gas and crude oil producers to sustain their enterprises. Producers must constantly drill new wells in order to maintain natural gas and crude oil production levels since wells and entire reservoirs eventually become depleted and less productive. If exploration and development activities ceased, there would be fewer industry and supply chain jobs, along with a reduction of economic spending by both interindustry and by households. The following analysis attempts to estimate the value of reinvestment made by the Ohio Oil and Natural Gas Industry annually into the Ohio economy by estimating the economic impact of the new wells drilled in 2010.

Modeling Methodology and Assumptions

To estimate the annual impact of wells drilled in 2010, data on drilling expenditures were assembled based on a sampling of actual costs of typical wells drilled during this period. Kleinhenz & Associates obtained costs for a sample of wells.[25] The cost data compiled actual expenditures for labor, materials, equipment and professional services for both development and exploratory wells. Using the Ohio Department of Natural Resources (ODNR)[26] data set that

[24] Table only contains industries with employment of 10 or greater.
[25] Due to the confidentiality of the cost information, the actual data collected is not reported in this document.
[26] Go to www.ohiodnr.com/mineral for the *Summary of Ohio Oil and Gas Activities 2010 b*y the Division of Mineral Resources Management that provides details on wells drilled.

shows 357 wells by county reported drilled and completed in 2010, the average cost per well was multiplied by the number of wells completed to get the combined total for all these expenditures of $169.4 million.[27] The total value of expenditures based on the cost data obtained for the sample wells are used to allocate share of spending to specific industrial sectors in the REMI model. The impacts are not affected by the success of each well, only the inputs (both labor and material) are used in the model. As estimated above, the industry employs 4,491 workers. In order to model the net impact of the annual drilling activity, the number of jobs involved only in drilling must be estimated. It is important to note that these jobs are simply "jobs" as they are counted and are not necessarily workers. Some of the workers would remain employed by the industry in the event that re-investment was not undertaken.

Results

Table 23 shows the estimated economic impacts (total direct, indirect and induced) of the 2010 drilling activity in the State of Ohio.[28] Ohio's total economic output as measured by gross regional product (the value-added) increased by $135 million and generated approximately 2,249 jobs. Total labor earnings for the 2010 activity are approximately $116 million and $2.3 million in local wage taxes paid. It is estimated that output (total sales) increased $247 million due to the natural gas and crude oil drilling activities.

Table 23: Impact of 2010 Drilling Activity on the State of Ohio

Measure	2010 Amount
Employment	2,249
Gross Regional Product (2010$)	$135,133,440
Wages by Place of Work	$116,348,270
Output (2010$)	$247,001,534
Local Wage Tax (@2%)	$2,326,965

Results from modeling the 2010 drilling impacts are less than the full impact analysis presented earlier due to limiting the shocks to the model. Survey and secondary data led to estimates of jobs and expenditures that were devoted only to drilling. It is these devoted jobs and concurrent well-drilling supply expenditures that shocked the 2010 model. The remaining

[27] This estimate is slightly more conservative but comparable to industry development estimates of $178 million discussed later. Only data was collected on sample wells that were drilled and completed. There are other exploratory wells that were drilled but were either dry or not completed that may account for differences.

[28] The results from the 2010 simulation are significantly less than those of the 2007 simulation. Primary causes of smaller impacts are: reduced spending by producers; notable shrinkage of oil and gas supply chain industry activity in Ohio; improved QCEW wage and employment data.

industry expenditures for the year were assumed to be devoted to lifting and office-type overhead activities and personnel.

Major sectors impacted by drilling activities in 2010 were professional and technical services and fabricated metal product manufacturing as shown in Table 24. Sectors such as construction and retail trade were also boosted.

Table 24: Net Impacts by Selected Sectors from 2010 Drilling Activities

Category	Employment	Output	Wages
Support activities for mining	726	$91,186,320	$54,020,941
Professional and technical services	235	$22,561,350	$15,361,786
Fabricated metal product manufacturing	194	$41,208,826	$13,565,540
Construction	172	$17,664,816	$8,566,856
Retail trade	165	$12,202,572	$5,369,186
Ambulatory health care services	104	$10,809,251	$6,761,551
Administrative and support services	103	$6,059,382	$3,460,884
Truck transportation; Couriers and messengers	77	$11,083,724	$4,199,028
Food services and drinking places	69	$3,195,214	$1,511,574
Wholesale trade	51	$10,585,061	$4,655,838

V. VALUE OF LOCAL NATURAL GAS TO OHIO CONSUMERS

The value of local natural gas to Ohio consumers is derived from four elements:

1) Beneficial price-reducing impact that Ohio supply provides at the national level.

2) Avoided interstate pipeline transportation costs otherwise required to bring natural gas to Ohio.

3) Security or un-interruptability of supply.

4) The storage-like benefit of reduced price volatility or peak shaving.

These four elements are analyzed and discussed below.

Price-Reducing Impact of Ohio's Supply

Ohio consumers saved an estimated $9.2 million in 2010 due to the price-reducing impact the state's supply of natural gas has on the national equilibrium price of natural gas.[29] Ohio's supply of natural gas to the national market is small but significant. As is demonstrated in the section following, a change in supply, even at the margin, can have an impact on the equilibrium price for the entire market. This beneficial impact is felt by consumers across the U.S. and is thus much larger nationwide than the $9.2 million saved by Ohioans. This result is based on a conservative estimate relative to others presented in Table 25 below.

Ohio's supply of natural gas and crude oil adds to the domestic supply and helps keep energy prices from rising. It is important to Ohio and other states that natural gas prices do not increase and the harmful impact has been reported in several studies. For example, Stephan Brown reports in a recent study by the Federal Reserve Bank of Dallas:

> "Sustained high natural gas prices are a drag on the U.S. economy. Natural gas is a basic input to production and, if prices increase, can cause a classic supply-side shock that reduces potential output. This causes output and productivity growth to slow, which lessens real wage growth and increases the unemployment rate…then inflation can accelerate. If market participants expect the near-term effects on output to be greater than the long-term effects, they will attempt to smooth their consumption by saving less or borrowing more, which boosts the interest rate. With slowing output growth and an increase in the real interest rate, the demand for real cash balances falls, and for a given rate of growth in the

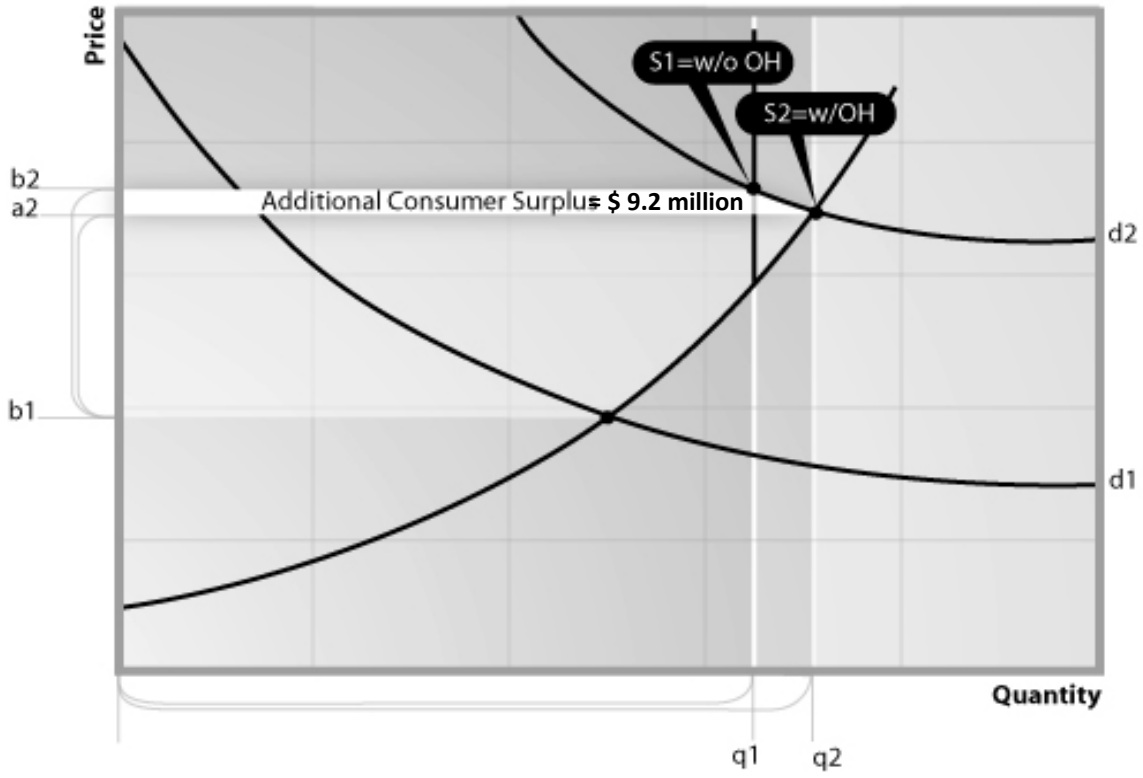
[29] Kleinhenz & Associates employed the USDOE AEO 2007 Report to arrive at this estimate.

monetary aggregate, the rate of inflation increases. Therefore, rising natural gas prices reduce GDP growth and boost real interest rates and the measured rate of inflation."[30]

Brown concludes that the impact of a sustained doubling of natural gas prices will reduce U.S. GDP by 0.6 to 2.1% below what it would otherwise be.

The supply/demand graph below is used to illustrate savings. Without Ohio's production of natural gas, the national gas supply is at q1, a fixed amount beyond which the supply curve becomes inelastic. Under this scenario, as the demand for natural gas swings from d1 to d2, the price for natural gas increases to b2. An improved pricing scenario for Ohio and the rest of the nation occurs when Ohio's natural gas supply is brought to the market. The supply curve, S, is no longer quite so inelastic and swings to S2, where the market finds equilibrium at price a2 rather than price b2. Ohio consumers realize a benefit, or "surplus," from the price savings (b2 – a2) multiplied by the quantity of natural gas purchased (q2).

Figure 4: Value of Ohio Natural Gas Production: U.S. Market



[30] Brown, Stephan. U.S. Natural Gas Markets in Turmoil, Testimony to U.S. House of Representatives Subcommittee on Energy and Mineral Resources. Federal Reserve Bank of Dallas, June 19, 2003.

Price and Market Impacts of Various Supply Scenarios

Applying the actual dollars and cents to the shaded consumer surplus area shown in Figure 4 is an economic art form. Academics, industry and government researchers have derived a variety of ways to measure the benefit. Many "what if" studies attempted to show the impact of changes in the supply of natural gas on the price of natural gas. These studies recognize constantly increasing demand both for base and peak load as well as improved natural gas supply technologies and are able to forecast long-term changes.

Table 25: Natural Gas Supply Scenarios

Study	Supply Shock or Impact	Resulting Price Impact
National Commission On Energy Policy[31]	4 bcf per day increase	$2.1/mmbtu price decrease
EIA, February 2004[32]	2 tcf lower per year	$0.20/mcf higher
ESAI June 2007 memo[33]	12% increase in supply	3.5% decrease /winter price
Energy Modeling Stanford[34]	1 to 3.5 tcf per year increase	6 to 17% wellhead price decrease
American Council for EEE[35]	1% decrease in demand (or 1% of "new supply")	10% price reduction @ wholesale level
DOE AEO, 2010	-34% increase in supply	24% change in price

[31] National Commission on Energy Policy, "Increasing U.S. Natural Gas Supplies, A Discussion Paper and Recommendations from the National Commission on Energy Policy." October 2003, pages 4-7. www.energycommission.org

[32] Energy Information Agency, Analysis of Restricted Natural Gas Supply Cases, February 2004, pages 2-5.

[33] LNG Will Cut Transportation Values, Put Downward Pressure on Prices. June 2007, ESAI Analysis.

[34] Energy Modeling Forum, "Natural Gas, Fuel Diversity and North American Energy Markets," EMF Report 20, September 2003, pages 25-29.

[35] American Council for an Energy-Efficient Economy, "Examining the Potential for Energy Efficiency To Help Address the Natural Gas Crisis in the Midwest," January 2005, page 5.

The Annual Energy Outlook 2010 is selected to address the question, "What would be the price impact if Ohio natural gas production fell to zero?" The study examines 10- and 20-year time frames, allows for other energy sources and market reactions, and reports the results of an annually updated DOE model that has been well-researched. It results in a conservative estimated impact relative to other studies mentioned above. Natural gas supply is homogeneous; Ohio production is just as marketable as extra shale from other regions. The findings of worth of these extra or new supplies are interpreted as measures of worth of any domestically produced natural gas, including Ohio's.

The U.S. Department of Energy's Annual Energy Outlook looks at the impact of less than expected shale recovery on natural gas prices in 2025. The change in price given the change in supply of natural gas offers a measure of price response that can be conveyed to other sources of natural gas. The price response is calculated as the percent change in price of natural gas divided by the causal percent change in supply of natural gas.

Price Response = % Change in Price / % Change in Supply

Or

% Change in Supply x Price Response = % Change in Price

Ohio consumed 770,585,000 Mcf of natural gas in 2010.[36] If the Ohio-produced natural gas had not been in existence, the price of natural gas across the U.S. would have increased $0.012 per Mcf as per the 2010 scenario. Having Ohio natural gas translates into savings for Ohio consumers of $9.2 million per year due to the state adding production to the national supply of natural gas. Calculations follow.

[36] 2005 was the most recent data available at the time of the analysis.

Table 26: Calculated Price Response of Shale Gas Production

	Estimated 2025		
	Low Shale Recovery	Reference	High Shale Recovery
Average Lower 48 Wellhead prices (2009$ per million btu)	6.54	5.29	4.57
Shale Gas Production* Tcf	6.44	9.69	11.88
Source:EIA AEO 2011, Appendix D, Shale Gas Supply			
Percent Change in Supply from Reference Case 2025	-34%	0%	23%
Percent Change in Price	24%	0%	-14%
Calculated Price Response	-0.705		-0.602
(the percent change in price given a percent change in quantity supplied)			

Table 27: Ohio's Contribution of U.S. Supply

78.1 bcf of production in Ohio 2010
24,133 bcf is US consumption in 2010
0.32% Ohio' share of production

Table 28: Percent Change in Supply x Price Response = Ohio's Price Impact

	Low Shale Recovery	Reference	High Shale Recovery
% change in supply w/o Ohio production	0.32%	0.32%	0.32%
Calculated Price Response	-0.7045	0.0000	-0.6022
Ohio's Supply Impact on US Price	-0.228%	0.000%	-0.195%

Table 29: Cost-savings Effect of Ohio's Production on the U.S. Market as a Whole

	Low Shale Recovery	Reference	High Shale Recovery
Average Lower 48 Wellhead prices (2009$ per mcf)	6.54	5.29	4.57
Savings per Mcf	$ (0.015)	$ -	$ (0.009)
	ave.savings	$ 0.012	per Mcf nationwide

Table 30: Savings to Ohioans Due to Ohio's Price-Dampening Supply

Expected savings:	$ 0.012	x	770,585,000	= $9,165,068
	($/mcf)		(mcf consumed)	(amount saved by Ohioans annually)

*As of July 20, 2011, Ohio annual total ng consumption was not available.
Monthly 2010 data used. And for April & Nov, 2009 used.

Avoided Interstate Pipeline Transportation Costs into Ohio

How Interstate Pipeline Transportation Costs are Avoided – the Integrated Gathering System

The following is a description of a unique relationship between Dominion East Ohio (DEO) and the Ohio natural gas producers: the integrated gathering system. It is through this integrated gathering system that Ohioans benefit by avoiding interstate pipeline transportation costs. Gatherco, a second system operating in Ohio, gathers natural gas in the Columbia Gas territory.

DEO's integrated gathering system is a very unique fully integrated system that provides production gathering, storage, transmission and distribution services. The beginning of DEO's integrated system goes back over 100 years to when DEO was one of the first companies to explore for and produce natural gas and crude oil in Appalachia. On DEO's system there are no service charges at the interconnections between the different systems as you would find in a nonintegrated system, saving producers, marketers and end users money. There are only a few other systems that are similar to DEO's integrated gathering system.

Dominion's integrated gathering system consists of almost 21,000 miles of total pipe with over 1,350 miles of gathering pipeline ranging from 2 inch to 20 inches, with a large portion of that being 6 to 8 inch pipe. DEO operates 25 compressor stations with over 32,000 total horsepower available. The compressor stations maintain pressures in the gathering system to help maximize natural gas production. The pressures in DEO's pipeline systems varies; as a result, some producer wells experience lower pressures and others higher pressures. Typical pressures range from 25 pounds per square inch (psi) to over 300 psi. By way of comparison, natural gas is transported through interstate pipelines at a much higher pressure, typically starting at600 psi and going as high as 1500 psi.[37] According to the Sierra Pacific website, natural gas moves through the interstate pipelines at about 15 miles per hour. The elevated pressure reduces the volume of the natural gas being transported and provides the force to move the natural gas through the pipelines.

The DEO's integrated system has interconnects with wells owned by over 450 different Ohio producers. The producers range in size from just one well, to much larger companies that have thousands of wells connected into DEO's system. Dominion estimates approximately 40,000 wells of varying production levels are tied into the integrated gathering system. In 2009, 159 wells were added to the DEO system and in 2010, 121 wells were added on.

DEO and the Ohio Oil and Gas Association (OOGA) have a joint Project Review Committee that was established as part of the Production Enhancement Agreement (PEA) entered into between DEO and the OOGA in 2003. The Project Review Committee is made up of representatives from DEO and the OOGA. The Committee is responsible for allocating capital funds for projects on

[37] http://www.energysolutionscenter.org.

DEO's system designed to improve the production of Ohio natural gas. The Committee meets regularly to evaluate gathering and compression projects and to discuss problems and production bottlenecks developing on DEO's integrated gathering system. The Project Review Committee partnership between DEO and the OOGA was maintained in 2007 when DEO and the OOGA entered into the Heat Content Agreement (HCA) that took the place of the PEA. Over the years, as part of the PEA and HCA agreements, $30 million has been invested in the integrated gathering system, adding pipelines and new compressors. In addition, DEO employs a sophisticated hydraulic modeling tool. The tool allows for evaluation of system flows and problems, and simulates changing conditions on the integrated gathering system. The modeling tool is used to optimize system operating pressures across the integrated system to maximize the production of local Ohio production gas.

DEO operates two main storage fields, the Chippewa Field and the Stark-Summit Field. Combined, these fields hold over 140 bcf of natural gas with the capability to cycle 60 bcf of natural gas summer to winter. DEO owns and operates the storage fields, but large industrial customers and marketers contract with DEO for storage services and capacity. The large customers and marketers do not physically manage the natural gas storage operation, but rather manage commodity timing and price regarding, filling and depleting their allotted space per the contracts they have with DEO. The large customers and marketers must re-subscribe each year in order to maintain their allotted storage rights. For example, Timken Steel manages its own natural gas portfolio much like a broker/natural gas marketer would. This is viewed as a benefit for large industrial users of natural gas and is counted as a benefit to base-load users seeking to locate a facility in northeast Ohio.

According to DEO, the local Ohio supply of natural gas is a reliable source that is available to marketers and is closer to the end user than other sources, like the Gulf of Mexico. Local Ohio production is not exposed to shut-ins due to Gulf of Mexico hurricanes, which helps mitigate supply disruptions to Ohio users as well as natural gas price spikes when those events do occur. For example, during the storms of Rita and Katrina, there were no supply disruptions for DEO; however, local prices did respond.

DEO explained that Ohio producers benefit from a positive natural gas pricing basis, i.e., they will be able to sell their production to a marketer at just under what it would cost marketers to buy natural gas shipped up from the Henry Hub (Louisiana). In short, due to being near a large source of demand, Ohio producers realize a higher natural gas price than found in other regions of major production. The argument is made that the end user customer still benefits, because in a competitive marketplace, the total cost to the DEO end user when the source of the natural gas is local Ohio production should be lower than natural gas produced outside of Ohio.

DEO no longer buys natural gas from producers for system supply. DEO merely gathers and transports it to the end users. Historically, when DEO was the primary purchaser of Ohio natural gas, some producers found it more profitable to sell direct to particular industrial customers or drill wells for those customers. Once deregulation occurred and the active market for natural gas that exists today came into existence, the producers found it less restrictive, less

risky, and less expensive to use marketers to sell their natural gas and use DEO's integrated gathering system to transport it to market.

The production natural gas on DEO's system is purchased and aggregated by marketers. Dominion has 38 active marketers of natural gas operating on the DEO system, with a large percentage of the marketers purchasing natural gas supply from local Ohio producers. In 2010, over 62 bcf of local Ohio production was delivered into DEO integrated gathering system, about 25% of DEO's total customer throughput of 249bcf.[38]The remaining DEO supply comes from interstate pipelines and is delivered to DEO's system at interstate delivery points.

Estimation of Avoided Interstate Pipeline Costs

Due to Ohio natural gas production and the state's gathering systems, Ohioans avoid $30 million per year in interstate pipeline transmission and storage costs.

DEO and Columbia Gas distribution companies both place Ohio-produced natural gas directly into their pipelines. During peak periods of demand, these utilities draw natural gas from many sources. There is, in effect, a "stack" of natural gas from which to draw. The stack is described as direct well natural gas, stored natural gas and interstate pipeline natural gas. Each portion of the stack is more costly for the utility to draw from than the previous portion. Any cost savings they accrue due to lower (transportation) cost from local natural gas can be passed on to consumers.

In 2010, Ohio natural gas producers provided 78.1 bcf of natural gas to Ohioans.[39] DEO handled 62 bcf and Gatherco, Inc., gathering for Columbia Gas, estimated it purchased 6.95 bcf during the year.[40]These two major utilities combine to handle nearly 70 bcf out of a total of 78.1 bcf of local natural gas produced. The remaining 9.2 bcf is consumed in Ohio and transported on small public and private pipeline transportation systems and also avoiding the interstate pipeline transport cost for end users.

With the advent of shale gas production in the Appalachian region, the natural gas transmission market has changed.[41] Natural gas in the past flowed into the region via the Gulf and Western regions. This was due in part to the large Ohio and New York demand for natural gas and to the predominant supply of natural gas being in the Gulf or West. Demand has decreased because of industrial transformations and for recessionary reasons, causing a drag on local regional gas prices. Due to local regional production of shale gas, the local supply has increased and "pushed back" supply both from the Rockies and the Gulf regions. This trend is expected to continue.

[38] Dominion interview, 2011.
[39] Summary of Ohio Oil and Gas Activities, 2010. Ohio Division of Mineral Resources Management.
[40] Gatherco, Inc.
[41] Dominion East Ohio Gas Interview (2011).

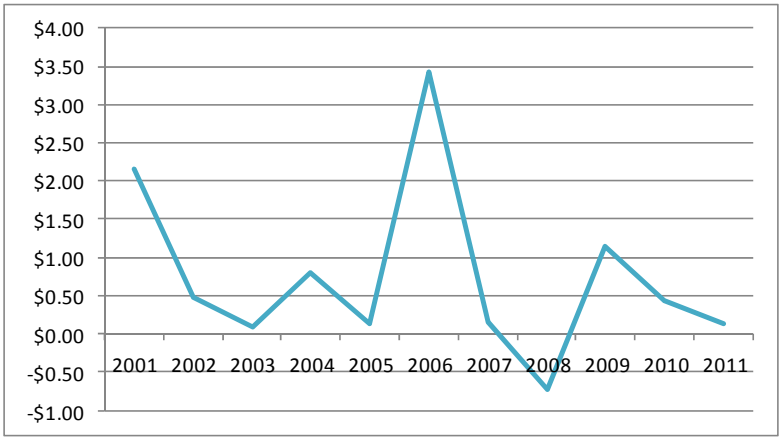
A direct, cost-accounting calculation of transmission costs to the local distribution company is difficult for several reasons:

- the daily commodity cost is woven into the transportation cost as compression fuel
- the volume of natural gas changes daily and originates from stored, well-drawn, and/or transported natural gas
- there are negotiated monthly minimum payments made by the distribution company to the interstate pipeline company
- there are penalty payments that may be levied on portions of natural gas if demand or storage input surges, placing an unexpected cost on the transmission company

Figure5 illustrates the basis trend. While in 2006, when the Ohio price of natural gas was nearly $3.50 greater than the price of gas at the Gulf, during the winter of 2010, the difference was a mere 14 cents. At the price difference of $3.50, Gulf gas was economically transported into the Ohio market and resulted in Ohio natural gas users paying a transmission amount on that gas. Since June 2011, the price difference has moved between 10 and 15 cents per mcf. Over the past 12 months, the average basis has been 16.5 cents.[42] Such basis data indicates that natural gas production in Ohio and surrounding states has, to some degree, replaced natural gas brought up from the Gulf.

[42] Price data provided by Hess Corporation which uses Dominion Appalachian 1st of the Month series and the Henry Hub series.

Figure 5: The Basis: Ohio Natural Gas Price Minus Gulf Price, January 15, 2001-2011



Based on the above figures, the estimated amount saved would be Ohio's production of 78.1 bcf, multiplied by the average basis amount of $0.165 per mcf. This calculation yields a savings to Ohioans of $12.9 million per year for Ohio end users.

EIA provides an alternative approach for estimation. The broad difference between wellhead price and city gate price captures the transmission costs in the classic, pre deregulation era calculation. In 2010, the U.S. natural gas consumer, on average, paid about $2.00 per mcf of natural gas for the pipeline transmission or transportation charge (see Table 31). Ohio's transmission costs are above the U.S. average, probably due to strong seasonal and industrial demand. Over the course of 20 years, Ohio's wellhead to city gate costs averaged about 15 cents above the U.S. cost. In 2009, the most recent year for which Ohio's composite wellhead and residential prices are available from EIA, Ohioans paid $2.24 per mcf in transmission or storage costs. The 2010 cost of $1.68 is estimated based upon 25% lower year-over-year prices observed for the months of January and February of 2011. Savings of $1.68 per mcf imply statewide savings of $131,200,000 ($1.68/mcf multiplied by 78.1 bcf of production). Not all of the savings can be claimed since Ohio's costs include any storage, transmission and gathering costs that would have accrued to either the transmission or the gathering company. Ohio costs also take into account production that does not go via the large gathering system but is put into transmission pipes directly.

Table 31: Natural Gas Transmission Expenditures, Wellhead to Citygate

	Annual Average				
	Wellhead to Citygate Cost			5-year Average:	
Year	Ohio	U.S.		Ohio	U.S.
1990	0.55	1.32			
1991	0.67	1.26			
1992	0.91	1.27			
1993	1.06	1.17			
1994	1.05	1.22		0.848	1.248
1995	1.51	1.23			
1996	1.74	1.1			
1997	2.48	1.34			
1998	1.75	1.11			
1999	2.40	0.91		1.976	1.138
2000	2.04	0.94			
2001	3.71	1.72			
2002	0.16	1.17			
2003	0.64	0.97			
2004	0.84	1.19		1.478	1.198
2005	1.63	1.34			
2006	2.12	2.22			
2007	1.05	1.91			
2008	2.53	1.21			
2009	2.24	2.79		1.914	1.894
2010*	1.68	2.00			
	1.56	1.40	20-Year Average		
Units in $/mcf					
Source is U.S. Energy Information Administration					
*estimated as down by 25% from the prior year based upon Jan and Feb data					

To compute the storage cost portion of what Ohio residential consumers pay, a seasonal pricing approach was employed from a study by Henning, Sloan and Schwindt. Authors report the "average seasonal storage value" of the Columbia Gas Appalachia and the Dominion Southpoint market centers.[43] In 2004, the authors found that the average season storage value for the Columbia Gas Appalachian market center was $0.80 and Dominion Southpoint was $1.25. These prices were the five-year averages from 1999 to 2004 reflecting the winter value less the preceding summer value. Updating their study yields an average season storage value of 54 cents per mcf. While not a direct measure of cost, this price approximated an upper limit to cost if one assumes storage is profitable. Viewing the Ohio winter production as production from storage, end users are avoiding a storage charge of 54 cents per mcf or a state total of $42,170,000 based upon the Henning, Sloan and Schwindt method.

Table 32: Estimate of Maximum Storage Costs Avoided

	DTI 1st of the Month
Year*	Winter less Previous Summer Price
2000-2001	$2.55
2001-2002	($0.99)
2002-2003	$1.62
2003-2004	$0.40
2004-2005	$1.20
2005-2006	$2.91
2006-2007	$0.13
2007-2008	$0.74
2008-2009	($4.12)
2009-2010	$1.58
2010-2011	($0.11)
Average	$0.54
*Year is the winter year.	

Source: Kleinhenz& Associates calculations.

The Public Utilities Commission of Ohio uses a rule of thumb that assumes the interstate pipeline adds $0.4 to $0.5 per mcf transported from the gulf to Ohio.[44] Using a midpoint of $0.45 per mcf multiplied by the total Ohio natural gas production, 78.1 bcf provides an estimated savings of $35,145,000 for Ohio end users.

[43] Henning, Bruce, Michael Sloan, and Richard Schwindt, "Analysis of Competition in Natural Gas Storage Markets for Union Gas Limited," by Energy and Environmental Analysis, Inc and Simon Fraser University, October 28, 2004, page 33.

[44] PUCO analyst, July 2011.

The U.S. Government Accountability Office (GAO) provides a fifth estimate of the cost of transmission. The GAO reports that interstate and other charges (including charges for storage functions) accounted for 9% of the customer's natural gas bill in 2005.[45] Local distributors accounted for 33% and the commodity cost accounted for 59%. Using the 9% proportion of a customer's natural gas bill, the cost in 2010 means that Ohio consumers saved approximately $0.9981per mcf ($11.02 x 9%).This calculation indicates a total savings of $77,950,000. It is important to note that this would be a maximum amount saved by Ohioans since some portion of the $0.9981 is also allocated for storage functions of the interstate pipeline. In the case of Ohio, a fair amount of storage is carried out by the local distributors as well as the producers themselves (as local winter producers).

Along the same lines as the GAO study employed above, Pacific Gas and Electric provided insight into the portions of their customer's bill that would represent interstate demand and storage costs. An estimated 8% of the residential customer's bill is rationed for these activities.[46] For Ohio residential consumers, 8% amounts to $0.89 per mcf. See Table 33. The $0.89 savings per mcf for Ohio residential consumers amounts to $69,500,000 for the state as a whole.

Table 33: Storage and Interstate Percentages of Ohio Residential Bills

Estimated Interstate and Storage Portions of Ohio Residential User Bills					
	PG&E		Ohio calculated		
Item	$/mcf	Percent	$/mcf		
Cost of Gas	6.965	50%	5.54	Estimates of	
Distribution	4.005	29%	3.19	Interstate and Storage	
Interstate Capacity and Other	0.965	7%	0.77	Portions: Ohio	
Gas Public Program Surcharge	0.654	5%	0.52		
Balancing Accounts	0.451	3%	0.36		$0.89
Local Transmission and Rate Adders	0.369	3%	0.29		
Backbone Capacity	0.216	2%	0.17		
Storage	0.151	1%	0.12		
Backbone Usage	0.063	0%	0.05		
Mandated Customer Programs and Other	0.009	0%	0.01		
Self Generation Incentive Program	0.007	0%	0.01		
Total	13.856	100%	11.02		
*2010 Rate Detail by End-Use, Table 11A-2					
GTS-Rate Case 2011 exh PGE, 9/18/2009					

[45] Roles of Federal and State Regulators in Overseeing Prices, Government Accounting Office, Report to the Permanent Sub-committee on Investigations, Committee on Homeland Security and Governmental Affairs, U.S. Senate, September 2006, GAO-06-968, page 12.

[46] GTS-Rate Case 2011 exh PGE, 9/18/2009.

The range of estimates shows a minimum amount of savings to be $12.9 million per year and a maximum amount of savings to be $131 million per year. By eliminating the highest and lowest estimates, the remaining four methods yield a range of between $35.1 million and $77.9 million per year. Using the mid-point of these figures and allowing for the costs of the gathering systems, we project a savings to Ohioans of $57 million per year that can be attributable to local purchases instead of interstate pipeline purchases.

Table 34: Transmission and Storage Savings Estimates

Estimation Method	Avoided Transmission and Storage Costs
	- $ million -
Gulf to Ohio Basis	$12.9
PUCO	$35.1
Henning et al.	$42.2
PGE	$69.5
GAO	$77.9
EIA wellhead to citygate	$131.2

Kleinhenz & Associates estimated the cost of the Ohio gathering systems to be $0.35 per mcf. This cost estimate was arrived at based upon confidential discussions with the Ohio Public Utility Commission and DEO, and upon PGE reports. The amount reflects a hypothetical case and is subject to gas price changes. Kleinhenz & Associates believes it is a good approximation of current costs.

Table 35: Total Net Savings to Ohioans in 2010, Avoided Transmission and Storage Costs

Ohio Production	78,100,000	Mcf
Midpoint estimate of avoided transmission and storage	$ 57,000,000	
Avoided transmission & storage cost per Mcf	$ 0.73	
Cost of Ohio's Gathering Systems	$ 0.35	
Net Savings to Ohioans per Mcf (Avoided Costs less Gathering Costs)	$ 0.38	Per Mcf
Total Net Savings to Ohioans in 2010	$ 29,665,000	

The savings are dependent on the ongoing availability of natural gas and the Dominion gathering system built up and maintained over the years. The two are virtually inseparable.

Ohio producers are "hardwire-connected" to the Dominion gathering system. The system, as described elsewhere, allows Dominion to directly transport the natural gas from the well to its customers. No intermediary transaction costs are incurred by consumers as might be incurred in other markets. During the critical winter months, Dominion accepts natural gas as needed, much like storage. Dominion, at least for the natural gas transported from Ohio wells, avoids third party storage transactions that would be faced by utilities in markets with no local production or gathering system. As reported here, this contributes a large benefit to the Ohio natural gas marketplace.

Security or Un-Interruptability of Supply

Ohio producers provide a supply of natural gas (and crude oil) throughout the year that is not necessarily susceptible to weather or politics. Paper hedging of natural gas prices can help the purchaser avoid these risks up to a point. But consumers, particularly residential consumers, ultimately need to have natural gas. Physical as well as financial tools exist to manage supply and price volatility.[47] This section reviews studies conducted by others that sought to quantify the value of security of the supply of natural gas. One study assigns a $20 million per year value of security associated with Ohio production to Ohio consumers. This benefit does not stand alone, but is rolled up into avoided pipeline costs measured above.

There is willingness to pay for the security of supply of natural gas, but measuring such a willingness is challenging. Graves and Levine explain that a firm's risk management and process controls policies may set specific price targets or source availability targets.[48] A study conducted by the University of California Energy Institute[49] found that "the asymmetry between buyers and sellers creates a forward premium when markets are tight due to concerns about security of supply, but does not create a forward discount when markets are loose due to concerns about 'security of demand.'" The findings include observations consistent with a natural gas interstate pipeline infrastructure that has spare capacity at most times, but occasionally does become constrained. During a market constrained period, having firm transportation rights (or the physical commodity) can be "extremely valuable." To compute this value, they developed a model that found during capacity constrained times, the forward price exceeds the expected spot price. The differential is the premium for security. The authors discuss the duality of pricing risk versus the quantity risk that the local distribution companies face when arranging their supplies. The price risk is well known, but in modeling

[47] Graves, Frank C. and Steven H. Levine, Managing Natural Gas Price Volatility: Principles and Practices Across the Industry, The Brattle Group, prepared for the American Clean Skies Foundation, November 2010.
[48] Ibid, p. 32.
[49] Borenstein et al., Security of Supply and Forward Price Premia: Evidence from Natural Gas Pipeline Rates, March 2006, Preliminary Draft, page 11, 22.

terms, the utility faces near catastrophic risk should supplies fall short, especially for residential demand in the colder climates.

The authors found that if expected spot prices were to rise by $1.00 per mmbtu, then the bid week margin would be predicted to rise by 3.4 cents above the realized spot price. In short, there would be a 3.4 cent premium paid. The report did not show a statistical difference between summer and winter months. The authors believe that their findings imply "that even in an industry where firms are not price risk averse, regulation, and spot market illiquidity can combine to generate forward price premium for an essential input."

Other researchers were very direct in examining the value of storage as a hedge against high prices. "Storage facilities should be rebuilt or expanded," writes Peter Beutel, President of Cameron Hanover, an energy risk management firm.[50] He believes that holding the physical commodity guarantees against "basis risk." When describing fuel oil, similar to natural gas in January, he says, "No number of futures options can fill a single boiler." He encourages his readers to realistically appraise the risk of not having the fuel on hand.

Utilities that can store natural gas, do store it according to the GAO, since storage can provide a hedge against price volatility.[51] The GAO found that 85% of large utilities and 49% of the small utilities use storage as a means of hedging.[52] Location/geological factors appear to determine storage usage.

Since Ohio natural gas and crude oil producers are physically linked to the Dominion system, their natural gas supplies are secure for Dominion. The "quantity risk" as noted in the preceding discussion is not faced by Dominion and thus, the premium of 3.4 cents per $1.00 of price movement is avoided by Dominion and its customers. All in all, a guarantee of the physical commodity is valuable and a critical benefit to Ohioans.

[50] Beutel, Peter, C. Surviving Energy Prices, PennWell Publications. Year unknown, pages 17-28.
[51] General Accounting Office, Report of Congressional Committees and Member of Congress, Natural Gas: Analysis of Changes in Market Price. December 2002, pages 35-36.
[52] Ibid, page 43.

Price Volatility

Research Studies on Price Volatility and its Importance[53]

Much regulatory effort at both state and local levels goes into monitoring and management of volatility. Prices of basic energy (natural gas, electricity, heating oil) are generally more volatile than prices of other commodities. One reason for this is that many consumers are extremely limited in their ability to substitute other fuels when the price of natural gas, for example, fluctuates. Residential customers usually cannot replace their heating system quickly, and in the long run, it may not be economical to do so.

The term "price volatility" is used to describe price fluctuations of a commodity. Volatility is measured by the day-to-day percentage difference in the price of the commodity. The degree of variation, not the level of prices, defines a volatile market. Since price is a function of supply and demand, it follows that volatility is a result of the underlying supply and demand characteristics of the market. Therefore, high levels of volatility reflect extraordinary characteristics of supply, (e.g., Katrina) and/or demand (e.g., prolonged cold weather).

Volatility provides a measure of price uncertainty in markets. When volatility rises, firms may delay investment and other decisions or increase their risk management activities. The costs associated with such activities tend to increase the costs of supplying and consuming natural gas.

As part of this study, several articles are presented suggesting the value of low volatility.

A 2009 study conducted by the California Energy Commission highlights the importance of low volatility. The report reviews major price spikes and volatility periods over the last decade, the most recent being the summer of 2008. Authors concluded that price volatility made for uncertain price forecasts. They also ask: Will increased domestic natural gas production have a sustained impact on natural gas prices and volatility?[54] The author does not estimate the willingness to pay to avoid volatility.

Researcher Mark Bolinger of Lawrence Berkeley Laboratory, examines the issue of the value of reducing price volatility using the financial Capital Asset Pricing Model (CAPM). The CAPM model is used extensively in measuring stock pricing and risks. Bolinger concludes that "it costs approximately 0.5 cents per kwh to hedge away natural gas price risk over a 10-year period using financial swaps." A comparison of 10-year swap prices to a level 10-year natural gas price

[53] Full discussion available on the EIA website http://tonto.eia.doe.gov/oog/info/ngw/historical/2003/10_23/Volatility%2010-22-03.

[54] Roesser, Randy. 2009. Natural Gas Price Volatility, California Energy Commission, CEC—200-2009-009-SD, p 43.

forecast reveals that swap prices traded at a premium of $0.76/mmBtu (some 24% over the price forecasts).[55] Purchasers are paying this premium to avoid volatility in natural gas prices.

Demand for natural gas is also affected by price changes. A 10% increase in the Henry Hub price of natural gas was found to cause a 1.4% decrease in demand.[56]

Robert Pindyck, author, consultant, and professor of Economics and Finance at MIT, found that prices and volatility are correlated.[57] While statistically significant, he concluded that the trend was "not of great economic significance" because shocks to volatility are measured to be short-lived, typically having a duration of several months.

Low volatility is important, however, especially to residential customers. Consumers typically rely on natural gas for home heating and their need can result in significant risk of health and safety when natural gas is priced too high to be affordable.[58] Author Barbara Alexander reports there is a key role for storage facilities in the ability of the natural gas utility to manage its natural gas supply for price stability. In particular, "Those utilities with access to local production are favored, because they avoid the costs associated with transportation of natural gas through interstate pipelines."(p5).

With the combined 409 underground storage facilities in the U.S., the reliability, integrity and capability of the U.S. natural gas transmission and distribution network is sustained. In 2009, Ohio had 24 "Depleted-Reservoir Storage" sites with working natural gas capacity of 225 bcf and daily withdrawal capacity of 4,972 mmcf.[59] This Ohio resource accounts for 5% of U.S. capacity. An EIA report concludes that "access to underground natural gas storage operations is crucial in today's competitive natural gas transportation marketplace."

An EIA study published in August 2007 shows that for every 1% difference from the five-year storage average, there is a 0.12% increase in price volatility.[60]The study, authored by Mastrangelo and Trapmann, reports that the difference from storage could be above or below the average. Either way, a market signal was sent signaling an atypical occurrence. Their research focused on the Henry Hub and national storage data. However, it also examined prices at the Chicago city gate and New York Transco Zone 6 hubs. Results were similar to

[55] Bolinger, Mark, Ryan Wiser and William Golove, "Quantifying the Value that Wind Power Provides as a Hedge Against Volatile Natural Gas Prices," Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, June 2002, LBNL-50484.

[56] Costello, 2006, page 7.

[57] Pindyck, Robert S., "Volatility in Natural Gas and Oil Markets, Center for Energy and Environmental Policy Research, Massachusetts Institute of Technology, June 16, 2003 Draft.

[58] Alexander, Barbara R. Natural Gas Price Volatility: Regulatory Policies to Assure Affordable and Stable Gas Supply Prices for Residential Customers, January 2004. Pages 51, 4, 5.

[59] Daily natural gas withdrawal capacity by state, EIA191a form, 2009 results and Energy Information Agency, Office of Crude Oil and Natural Gas, "U.S. Underground Natural Gas Storage Developments: 1998-2005," October 2006.

[60] Mastrangelo, Erin, and William Trapmann @ eia.gov, "An Analysis of Price Volatility in Natural Gas Markets", EIA, Office of Oil and Gas, August 2007.

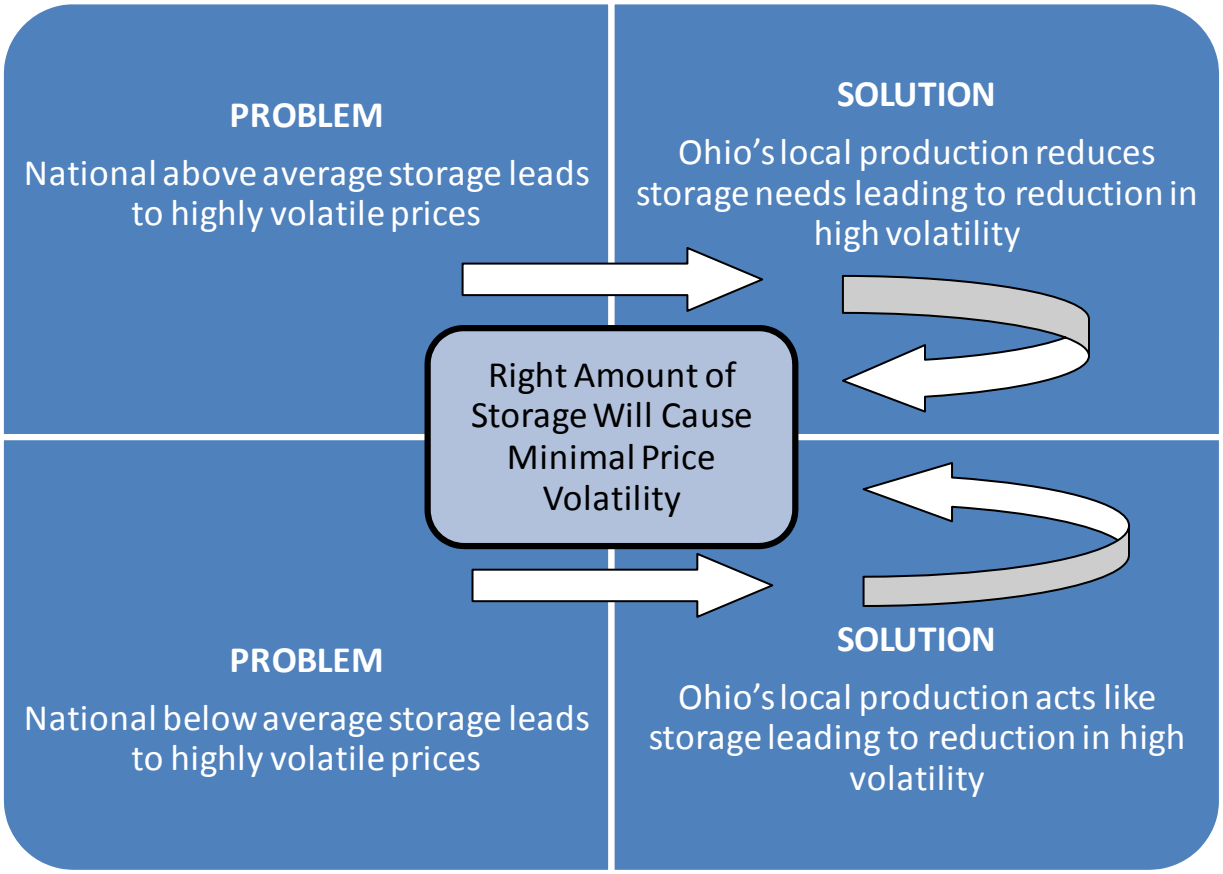
those found in this study and presented below. Insight is provided into how local storage conditions might affect local volatility.

Price Volatility in Ohio

"Customers don't like volatility." — a DEO manager

Findings from the Mastrangelo and Trapmann EIA report discussed above combined with the DTI data analysis presented below indicate that the local Ohio market for natural gas is just as robust as the larger markets of Chicago and NY. The literature indicates that Ohio's stored natural gas and Ohio producers' ability to produce natural gas on the spot during the winter months (like virtual storage) reduces the fluctuation in overall natural gas available to be delivered to Ohio. This reduction in fluctuation, especially as it reduces the deviation from the national five-year storage average, reduces volatility. Figure 6 below depicts how Ohio's local production mitigates volatility.

Figure 6: How Ohio's Local Production Reduces Volatility

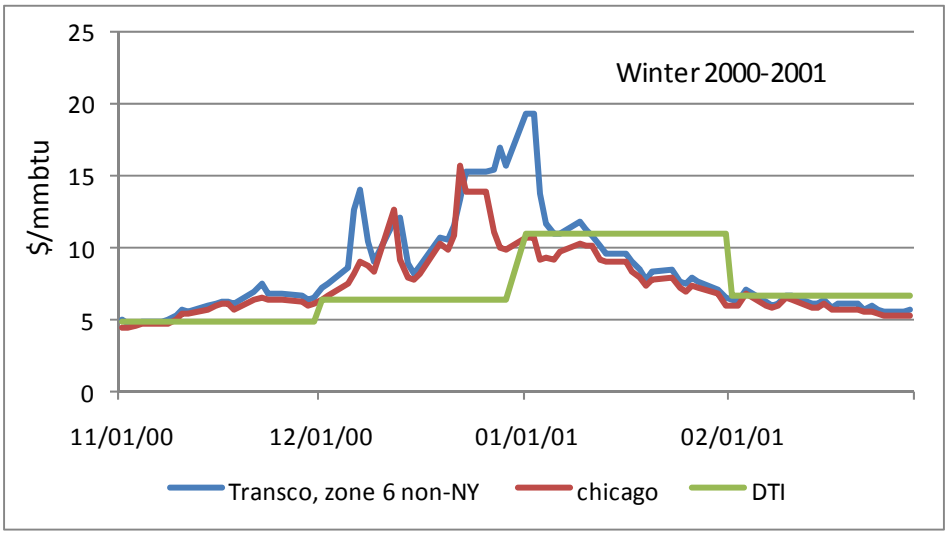


The majority of Ohio-produced natural gas is sold at the price set by the "first of the month index price" system used at the Ohio marketing hubs. The price-setting mechanism offers the buyer (and seller) the opportunity to lock in a single price for the following 30 days. Customers can avoid the "one day peak" events. These prices are arrived at during the last few days of trading prior to the first of the month. Once set, the "first of the month index price" is fixed for 25 days until the cycle starts again. Note that the bulk of natural gas locally produced in Ohio is sold to Ohio consumers under the "first of the month index." It is likely that a large portion of the remainder is also sold under "first of the month index price." Other hubs use "first of the month" contract pricing as well. As in the case of daily pricing, the analysis revealed that Chicago often sported the smallest variance and lowest mean, while New York was at the other end of the spectrum. DTI was in the middle, reporting the smallest variance in the winter of 2004-2005.

Data from the Dominion Transmission Inc. Appalachian and surrounding hubs was analyzed to examine price and volatility levels. The DTI hub was found to have the lowest volatility in six out of the 12 summers analyzed and in six out of the 11 winters analyzed. The Chicago Citygate hub was predominantly the least volatile and had the lowest average prices.

There is some trading that occurs daily at Dominion Transmission, Inc. Appalachian hub primarily to fill unforeseen need for natural gas.[61] The daily prices at the DTI hub are buffeted by national and international events just as are "first of the month index prices." However, during the highs and lows of pricing throughout the month, the natural gas production from Ohio is pumped and sold at the agreed upon "first of the month index."

Figure 7: Winter Prices 2000-2001



[61] Source: Hess Corporation.

During one of the coldest Midwest years on record, the prices at the New York hub reached $20 per million btu. The DTI first of the month index was fixed at just over $10 per million btu; however, even its spot price only ventured as high as $12 per mmbtu. The winter 2000-01 graph highlights supply/demand dictating natural gas prices. As illustrated in the graph in Figure 7, a cold-air incursion arrived around November 10, 2000, elevating prices. A more intense cold developed on or about December 17 and it moved from the Northeast to the West – an unusual weather pattern. The New York price subsequently jumped to $15 while the Chicago price hit only $10. Soon thereafter, both jumped to the $15-$16 range. When the most intense episode of cold began about December 21, Chicago prices jumped to about $16-$17 initially but then declined as the cold air moved East. New York, however, ended the year cold and starts the New Year the same way. Businesses returning to normal operation and demand for natural gas after the Christmas/New Year holiday, push the price spike up to $20 before the cold air finally goes back to Canada. The overall demand falls and the price deflates.

Statistical analysis on data over the past seven winters showed DTI vied with Chicago in offering the lowest variance in pricings during the winters of 2000-2001 to 2010-2011 (Tables36 and37). DTI was found to have the lowest mean price in four out of 11 years analyzed and the lowest variance in price in six out of the 11 years analyzed. In eight out of 11 years, DTI had the lowest maximum price among the three hubs. This was a direct benefit to the millions of natural gas users, residential, commercial and industrial, in Ohio. Wild price swings and uncertainty can undermine the best laid plans and budgets. Ohio utilities are charged with guaranteeing much of the natural gas delivered in the state and they put a premium on deliverability and price stability.[62] Dominion and Columbia Gas pay large fees to the natural gas interstate pipeline companies to guarantee natural gas on a certain day for a certain price.

As shown in Table 36, comparing winter prices for DTI, Chicago and New York, New York usually registers the largest variance in price as well as the largest average price.

[62] Dominion Interview

Table 36: Winter Months Price Comparison: DTI 1st of Month, Chicago, NY

November - March, 2000 to 2011
Winter Months Price Comparion: DTI, Chicago, NY

Winter	Lowest Mean	Smallest Variance	Tightest Range	Lowest Minimum Price	Lowest Maximum Price	Largest Variance	Highest Mean
00-01	DTI	Chicago	DTI	Chicago	DTI	NY	NY
01-02	Chicago	Chicago	DTI	Chicago	Chicago	NY	NY
02-03	DTI	DTI	DTI	Chicago	DTI	NY	NY
03-04	Chicago	DTI	DTI	Chicago	DTI	NY	NY
04-05	Chicago	Chicago	DTI	Chicago	Chicago	NY	DTI
05-06	Chicago	DTI	DTI	Chicago	DTI	NY	DTI
06-07	DTI	DTI	DTI	Chicago	DTI	NY	NY
07-08	Chicago	DTI	DTI	Chicago	DTI	NY	NY
08-09	Chicago	Chicago	DTI	Chicago	Chicago	NY	NY
09-10	Chicago	DTI	DTI	Chicago	DTI	NY	NY
10-11	DTI	Chicago	DTI	Chicago	DTI	NY	NY

A look at summer pricing for the past 10 years indicates that DTI had the smallest variance for the most number of summers and that it had the smallest range (high-low).

Table 37: Summer Months Price Comparison: DTI 1st of Month, Chicago, NY

April-October, 2000 to 2011
Summer Months Price Comparion: DTI, Chicago, NY

Summer	Lowest Mean	Smallest Variance	Tightest Range	Lowest Minimum Price	Lowest Maximum Price	Largest Variance	Highest Mean
2000	Chicago	NY	NY	Chicago	DTI	DTI	NY
2001	Chicago	Chicago	DTI	Chicago	Chicago	DTI	NY
2002	Chicago	DTI	DTI	Chicago	DTI	Chicago	NY
2003	Chicago	Chicago	DTI	Chicago	Chicago	NY	NY
2004	Chicago	DTI	DTI	Chicago	DTI	NY	NY
2005	Chicago	DTI	DTI	Chicago	Chicago	NY	NY
2006	Chicago	Chicago	DTI	Chicago	DTI	NY	NY
2007	Chicago	Chicago	DTI	Chicago	Chicago	DTI	NY
2008	Chicago	DTI	DTI	Chicago	Chicago	NY	DTI
2009	Chicago	DTI	DTI	Chicago	DTI	NY	NY
2010	Chicago	Chicago	DTI	Chicago	DTI	NY	NY
2011 to date	Chicago	DTI	DTI	Chicago	DTI	NY	NY

Figure 8: Katrina & Rita Spike

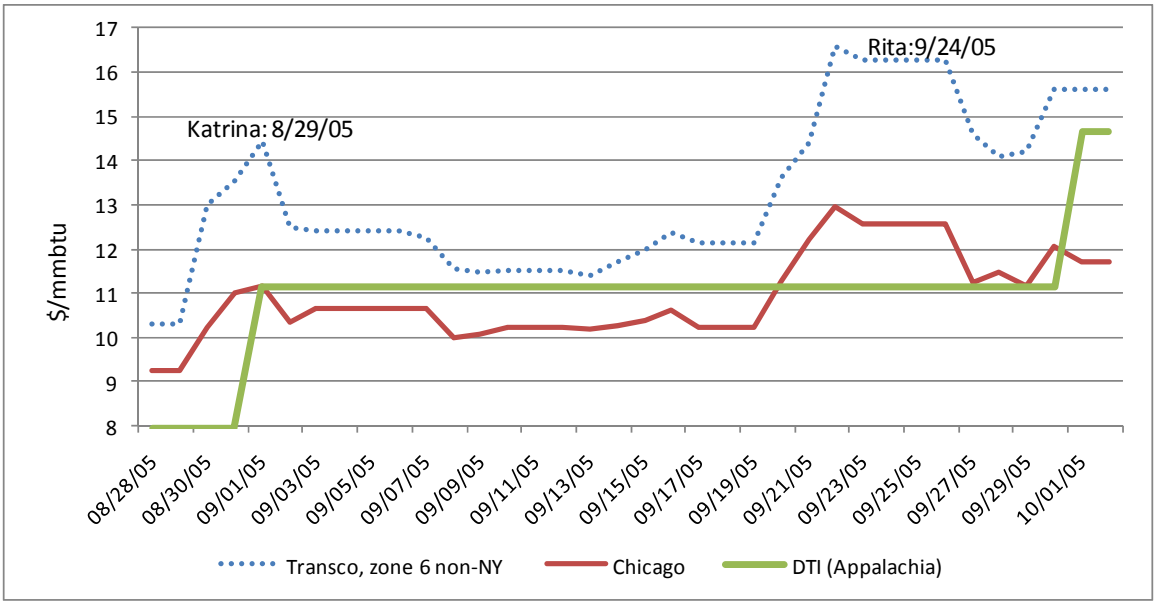
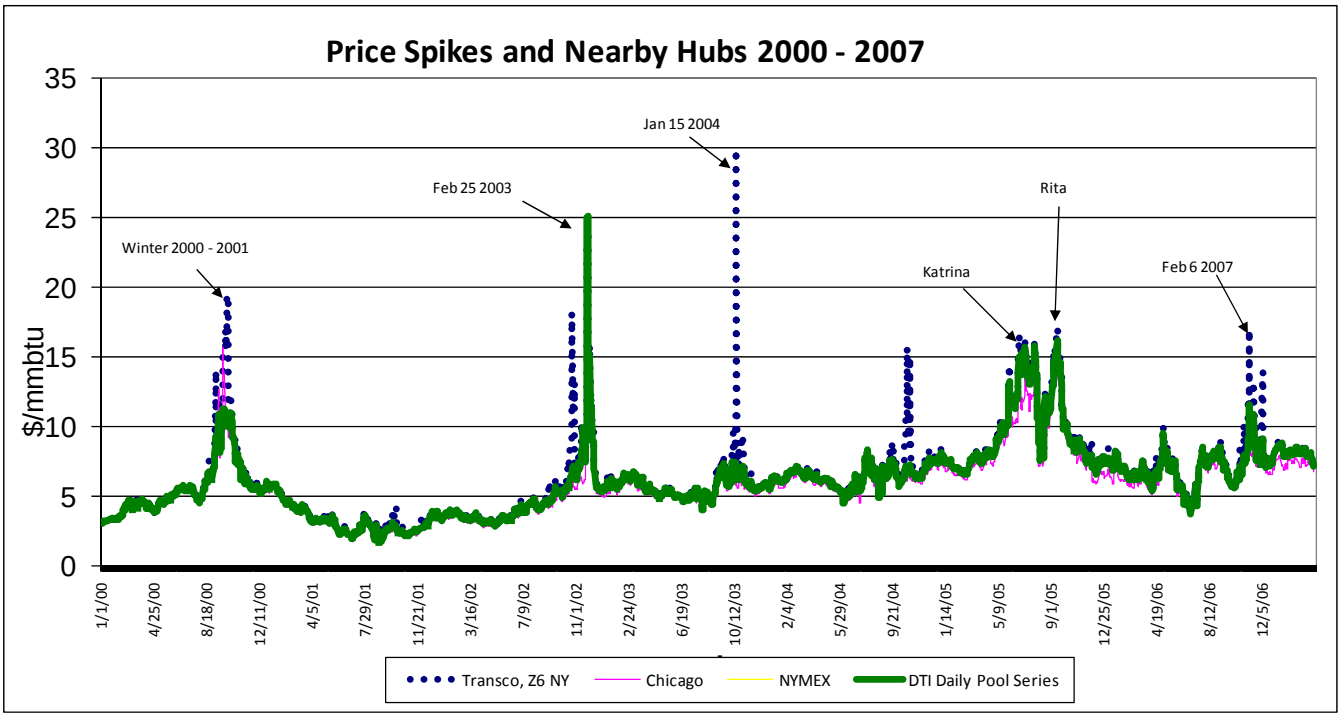


Figure 8 provides recent price volatility trends for Transco Zone-6, Chicago, DTI and NYMEX hubs. When Hurricane Katrina hit as one of the costliest and deadliest hurricanes in U.S. history, 8.8 bcf per day of Gulf of Mexico natural gas production as estimated for August 30, 2005, was shut. This was the equivalent of 88% of daily production for the region. The impact of the immediate Hurricane Rita was slightly less, shut in only 8 bcf per day of Gulf of Mexico natural gas.[63] While Chicago, DTI and NY hubs all tracked together, NY prices were clearly the most reactionary bouncing from $10 on August 28 to over $14 by September 4. DTI bounced from $10 to $13, while Chicago experienced the same percentage bounce but remained lower.

The Katrina and Rita spikes highlight supply curtailment more than demand. Both storms knocked out supply. They also knocked out demand in the Louisiana/Mississippi area. Katrina, occurring at the end of August/early September, didn't have as much natural gas demand as Rita experienced at the end of September when parts of the country start needing natural gas for heating. Chicago had supplies from the Midwest and Canada so it was not affected as much by the loss of supply coming up from Louisiana. Natural gas was available from Texas and a meaningful amount of demand was knocked out by power plant, crude oil and chemical refinery outages.

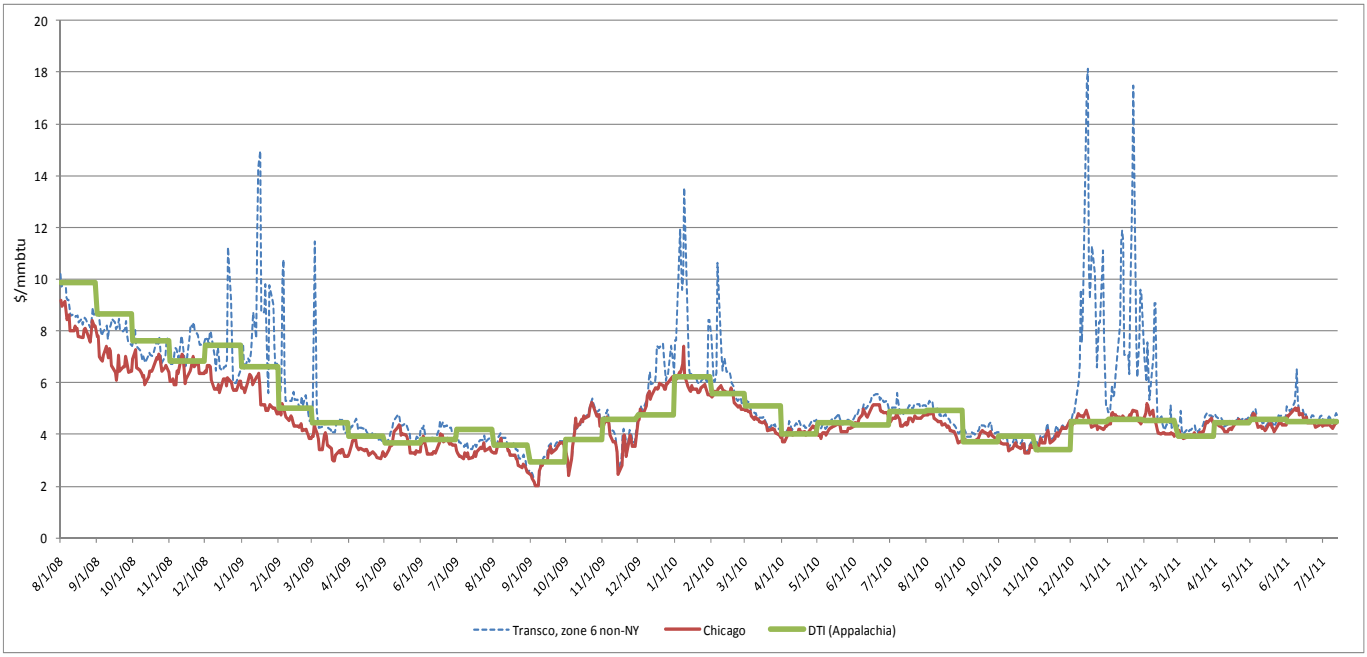
[63] EIA, Hurricane Impacts on the U.S. Oil and Natural Gas Markets Daily Updates, 2005.

Figure 9: Price Spikes and Nearby Hubs 2000 – 2007



Figures 9 and 10 illustrate the major price spikes that have occurred since the year 2000. Of note is DTI's general lack of extreme spikes. This is due to its first of the month pricing and its nearness to markets that allow it to act as storage, dampening volatility. Figure 9 also shows that it is supply and demand at work moving prices. The spike identified in the Winter 2000-2001 occurred when the U.S. experienced the coldest November/December on record. During this period, natural gas inventory was very low. On February 25, 2003, during the coldest part of the winter of 2002/3, a very cold Arctic-air incursion occurred in the Northeast. A counter-clockwise wind pattern centered on New England went up to Canada and pulled the cold air down into the Northeast. In 2004, a big jump in demand relative to supply caused the January 15, 2004, price peak. The jump just below the "K" of Katrina reflects the decrease in supply due to the hurricane damage. At that point in time, demand was relatively stronger than supply. The February 6, 2007, spike was the tug of demand from cold temperatures tightening the supply/demand balance.

Figure 10: Price Spikes and Nearby Hubs 2008 to Current



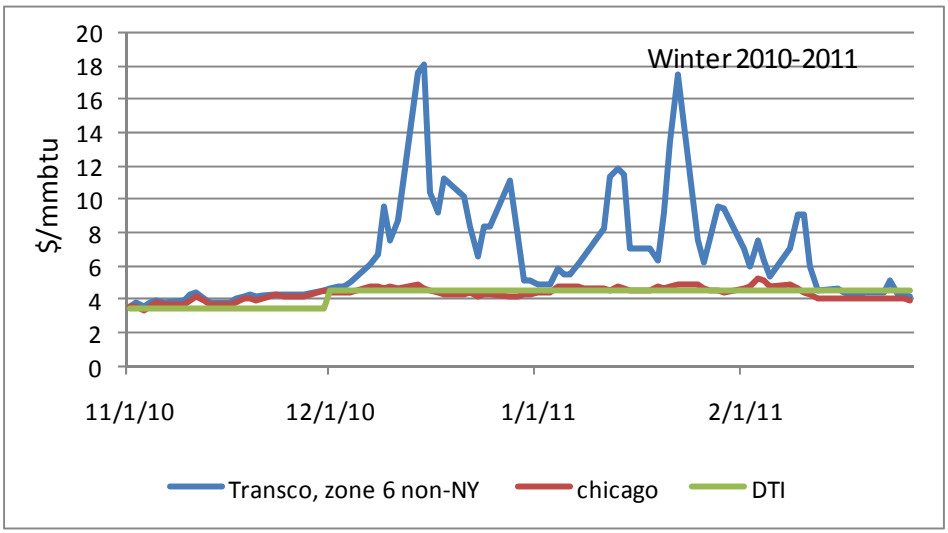
The benefits of low variability to the various natural gas market participants are lower prices for the purchasers who are mainly consumers but there are advantages to producers. If a producer commits to providing natural gas and then is unable to deliver (say due to well freeze ups) the damages done or the cost of trying to mitigate the outage (such as obtaining natural gas from other sources to meet the commitment) are smaller with lower volatility. High volatility indicates a very tight market and implies there are too few providers relative to the demand.

The market price for natural gas reflects supply relative to demand. Of the three markets, Chicago, DTI and New York, the Chicago market has the lowest prices because it has the better supply portfolio. Chicago has the benefit of receiving natural gas from Canada, from the Midwest and from the South. When hurricanes Katrina and Rita knocked out production and transmission capacity from the South, Chicago was able to offset the loss with supply from the Midwest and from Canada. In addition, Chicago's proximity to its producers reduces its transportation component. Transmission of natural gas from Chicago to New York adds additional transportation costs on top of the Chicago price to determine the New York price.

NY has higher prices for two major reasons: the distance involving the cost of transportation and too little infrastructure. The Transco Zone-6 prices are those that feed natural gas to the New York Metro Area. Currently there is insufficient transmission capability to deliver natural gas to Metro New York. Boosting supply has been thwarted for years by a "not in my back yard" (NIMBY) mentality, which is very strong in the NY area. Congestion also makes it difficult and costly to add capacity. When a significant cold snap occurs, New York Metro demand

prices typically surge. The supply sources to meet this demand are 1) what is currently moving in the transmission line, 2) localized storage, and 3) oil-based peak-shaving supply. Perhaps evidence of this was seen in this past winter, 2010 to 2011, when Chicago and DTI buyers enjoyed low prices with almost no change while buyers at the Transco Zone 6 hub saw much volatility (Figure 11).

Figure 11: Price Spikes and Nearby Hubs, Winter of 2010-2011



Chicago is a major natural gas market and as a major hub, more natural gas is traded in Chicago than in NY. NY is big but much smaller than Chicago because so much of the natural gas that passes through Chicago is consumed prior to arriving at NY.

DTI is a less active hub than Chicago and NY from a volume perspective. It primarily measures natural gas produced locally. DTI offers daily pricing and monthly pricing. The DTI hub is a meeting place for producers selling to industrial customers. A majority of the natural gas traded at the DTI hub is priced based on the "first of the month index price." Why is there only one trading day per month for DTI? The load is fairly steady so there isn't the need to have participants calling daily seeking buyers and sellers. As such, the participants at the DTI hub determine the price once a month, for delivery during the month. The infrequent pricing suggests that there are not many participants and that there is not much diversity in demand. Producers prefer to produce full out all the time. While industrial customers have the steadiest demand, retail customers have the most variability day to day with the commercial users a close second. They vary because heating and cooling needs vary with the weather.

We conclude that Transco Zone-6 which supplies to New York City is the marketplace in the U.S. that has too little natural gas most often. When supply is curtailed, a higher price determines who values most the smaller quantity available and who will receive what is available.

"Several factors differentiate New York City from locations such as the Henry Hub and may explain the relatively exaggerated volatility levels. First, New York City is separated geographically from natural gas fields and production; so much of the natural gas coming to market has to be transported over longer distances. This makes the price vulnerable to congestion or disruptions in the supply chain."[64]

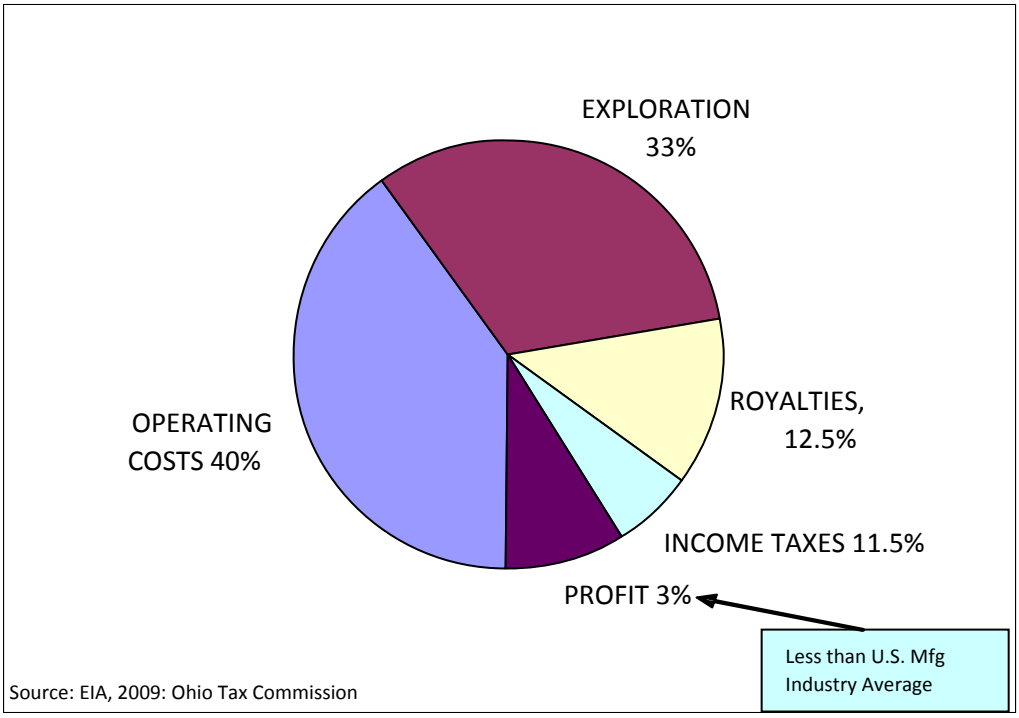
[64] An Analysis of Price Volatility in Natural Gas Markets, Energy Information Administration, Office of Oil and Gas, August 2007, page 11.

VI. OHIO NATURAL GAS AND CRUDE OIL INDUSTRY OUTLAYS

The chart in Figure 12 shows the relative size of the $718 million of revenue outlays in 2010 and offers a way to compare numbers presented in the following sections.

U.S. oil and gas industry profits have been less than broader U.S. manufacturing averages. Royalties or payments to gain access to natural gas, and free natural gas, are unique to the natural gas and crude oil industry. These are ongoing fixed costs and the value of the payments or the value of free natural gas rises and falls with changes in the price of natural gas. Like other industries in Ohio, the natural gas and crude oil industry pays taxes that benefit all Ohioans. We provide estimates of the various taxes paid by the industry, severance taxes, property taxes, commercial activity taxes and finally income taxes.

Figure 12: Natural Gas and Crude Oil Industry Outlays as a Percent of Revenues, 2010

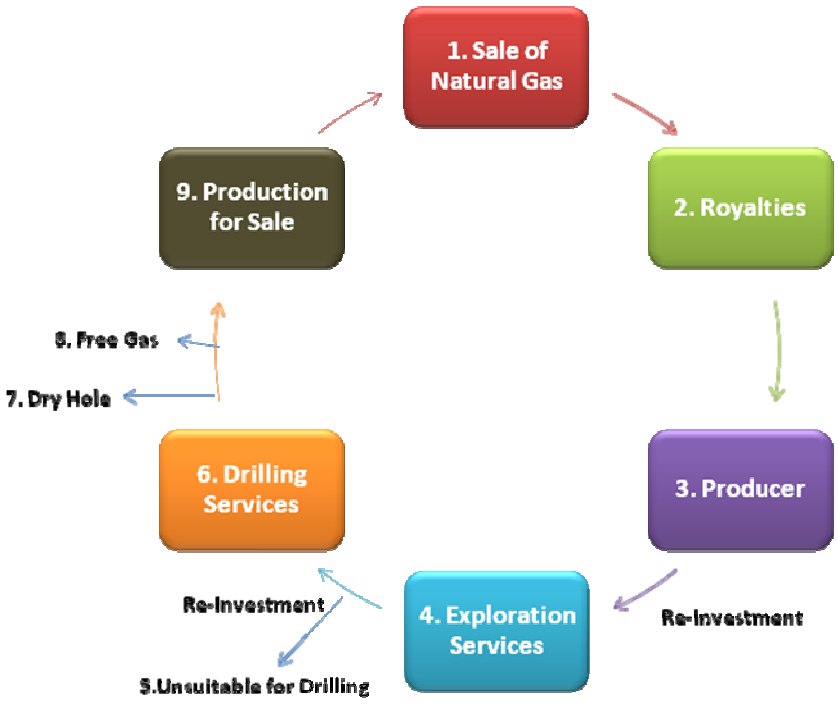


VII. CAPITAL REINVESTMENT OF OHIO'S NATURAL GAS AND CRUDE OIL PRODUCING INDUSTRY

This section provides estimates for the industry's reinvestments. Figure 13 illustrates the cycle of re-investment. The sale of natural gas leads to after-tax and after-royalty revenues for the producers. In order to maintain production and their livelihood, producers reinvest in exploration and drilling. However, not all exploration results in suitable sites and some wells come up dry. After free gas is siphoned off, the producer can sell the remaining production and the cycle continues.

By the nature of the market, producers are price takers. They accept the market price for natural gas and crude oil BUT they also accept the market price for exploration and drilling services. When natural gas or crude oil prices are low, the producer typically cannot reinvest significantly. When prices are high, all the producers crowd the market, demanding exploration and drilling services. The increased demand drives up the price for these services.

Figure 13: Cycle of Re-Investment



Analysis of Exploration, Development and Production (Lifting) Expenditures

In 2010, total expenditures by Ohio producers on exploration, development and production (lifting) costs accounted for 73% of revenues and are estimated to be equivalent to $527 million. As noted previously, the bulk of the remaining revenues are spent on royalties and taxes.

U.S. onshore exploration and development expenditures offer comparable costs to those faced by Ohio natural gas and crude oil producers. According to their published finances, the Majors (the largest natural gas and crude oil producers) spent 33.2% of their U.S.-earned natural gas revenues on U.S. exploration and development. This calculation results in an estimate of $238 million in expenditure on exploration and development and agrees with the Ohio Tax Commission. [65] The Ohio Tax Commission found that Ohio producers incurred production and lifting costs of 40% of revenues or $287 million in the year 2010.

[65] The Tax Commission employs 30%.

Table 38: 2010 Estimated Ohio Natural Gas and Crude Oil Exploration & Development Expenditures Based on Major Producers' Expenditures, 2009

	2009 U.S. (Million Dollars)	as % of Revenues		Estimated Ohio 2010 Expenditures (Million Dollars)
Operating Revenues (U.S. 2009, OH 2010)	$119,905	100%	=	718
Exploration				
Acquisition of Unproved Acreage	$5,195	4.30%	=	$31
Geological and Geophysical	$468	0.40%	=	$3
Drilling and Equipping 1	$3,647	3.00%	=	$22
Other	$820	0.70%	=	$5
Total Exploration	$10,130	8.40%	=	$60
Development			=	
Acquisition of Proved Acreage	$4,003	3.30%	=	$24
Lease Equipment	$1,011	0.80%	=	$6
Drilling and Equipping 1	$20,529	17.10%	=	$123
Other 2	$4,096	3.40%	=	$25
Total Development	$29,639	24.70%	=	$177
Total Exploration and Development	$39,769	33.20%	=	$238
Note: These are onshore expenditures.				
Ohio Tax Commission recognizes:		33%		$238
Performance Profiles of Major Energy Producers, 2009, Published Feb 2011				
found in EIA, Markets and Finance Performance Profiles data				

Add'l source: James memo to Tax Commission, 1-30-06

Table 39: Production (Lifting) Costs

	U.S. (Million Dollars)	U.S. Expend as % of Revenues		Estimated Ohio Expenditures (Million Dollars)
Sales of Natural Gas and Crude Oil (U.S. 2005, OH 2006)	$119,905	100%	=	$718
U.S. Onshore Production Costs (Includes Texas and others with low lifting costs)	$28,151	23.5%	=	$69
Ohio's Lifting Costs as per Tax Commission		40%	=	$287

Source: Performance Profiles of Major Energy Producers 2009, EIA and Ohio Tax Commission.

Production costs for Ohio producers are much higher than for the large Major Producers due to the many stripper wells and low productivity of wells in Ohio relative to the Majors. The Ohio Tax Commission found, for tax purposes, that historical production costs (lifting) for producers in Ohio are around 40% of revenues. For this reason, estimated Ohio expenditures for production are $287 million rather than the $169 million estimated using the comparison to the Majors.

Table 40: Total Exploration, Development and Production Costs for Ohio Producers, 2010

	Estimated Ohio Financials (Million Dollars)	Percent
Sales of Natural Gas and Crude Oil (OH 2010)	$718	100%
Total Exploration and Development	$237	33%
Production Costs	$287	40%
Sum of Costs for Producers	$524	73%

Analysis of Ohio Drilling, Costs and Prices

Kleinhenz& Associates conducted a survey of Ohio producers that highlights increasing drilling costs. Survey respondents provided finding and lifting costs, annual natural gas volumes provided to the mineral interest owners (surface owner) free of cost, estimated reserve volumes, and new well drilling activity for the period 2006 through 2010. Producer response was limited and precluded certain survey interpretations. The survey results are believed to be largely unrepresentative of known 2010 drilling activity in Ohio. Crude oil and natural gas pricing and new well cost on a footage basis are summarized along with secondary data.

Ohio producers who are drilling natural gas wells are not benefiting from the observed worldwide increase in the price of oil. When compared to crude oil pricing, natural gas pricing has been significantly depressed. An analysis of Ohio gas and oil prices for the period 1998 to 2007 reveals that the historical oil-to-gas price ratio was 6.5 to 1 (i.e., oil price: $65/bbl, natural gas price:$10.00/mcf = 6.5 price ratio). Historically, pricing for natural gas and oil would price based upon the heat content. The heat content for six mcf of natural gas equals the heat content of one barrel of crude oil. From 2008 to 2010 the pricing ratio has increased from 6.5 to 16.2.

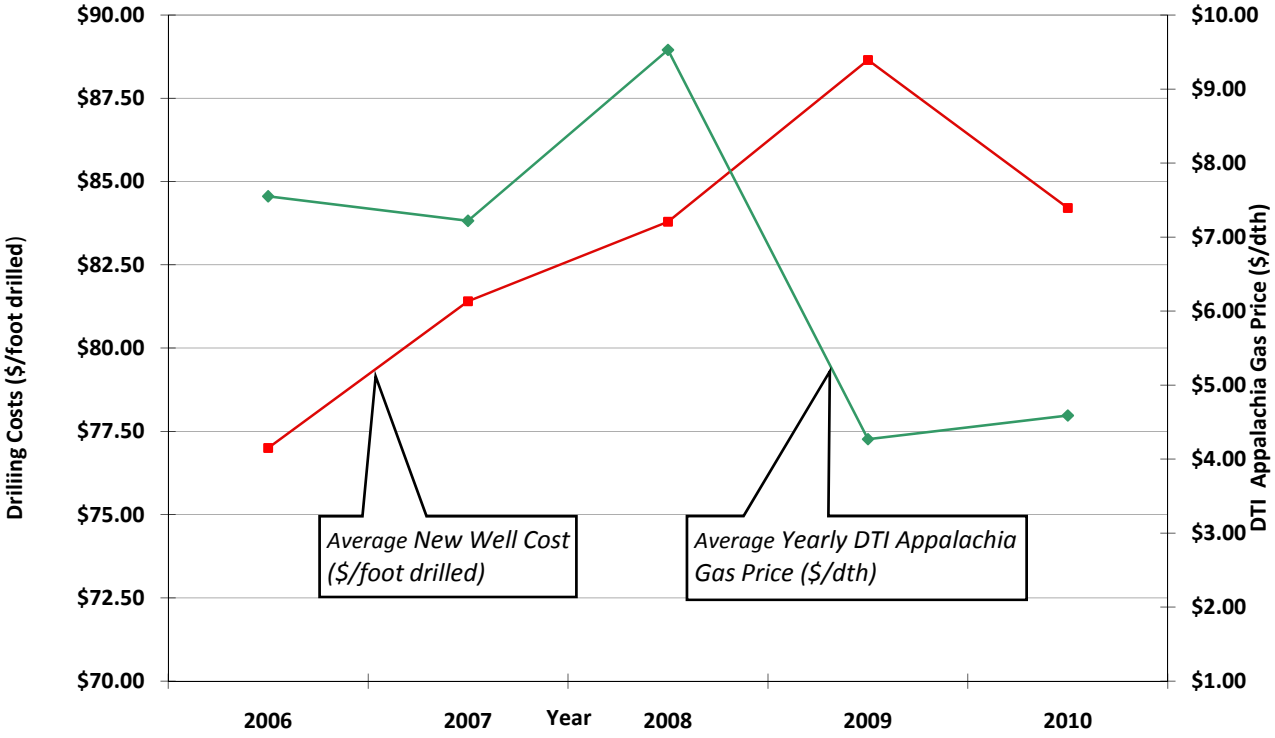
Based on the heat content, the price of natural gas could be multiplied by a factor of 6 to arrive at the equivalent "heat content based" oil price. Today, oil prices are largely being driven by world demand/supply while natural gas prices are largely being driven by domestic demand/supply.

Table 41: Oil to Gas Price Ratio, 1998 to 2010

	Pricing History GAS (dth)	Average Oil (bbl)	Oil /Gas Annual
YEAR	DTI Appalachia ($)	Ergon ($)	Ratio
1998	2.26	11.82	5.2
1999	2.43	16.14	6.6
2000	4.12	26.76	6.5
2001	4.57	22.13	4.8
2002	3.41	22.49	6.6
2003	5.95	27.64	4.6
2004	6.49	38.03	5.9
2005	9.04	53.06	5.9
2006	7.55	62.43	8.3
2007	7.22	67.69	9.4
2008	9.53	93.77	9.8
2009	4.27	55.91	13.1
2010	4.59	74.42	16.2

Reduced market prices in 2010 resulted in the lowest number of wells drilled in Ohio since 1887.[66] Only 431 oil and gas wells were drilled with an 87% completion rate. For the period 2006 through 2010, natural gas prices realized by the Ohio producing community decreased 39.2% while the drilling cost per foot increased 9.4%. On a cautionary note, drilling costs were based upon only261 wells (total during the most recent five years) reported by survey respondents.

Figure 14: Ohio New Well Drilling Costs and Natural Gas Price Annualized for 2006 – 2010



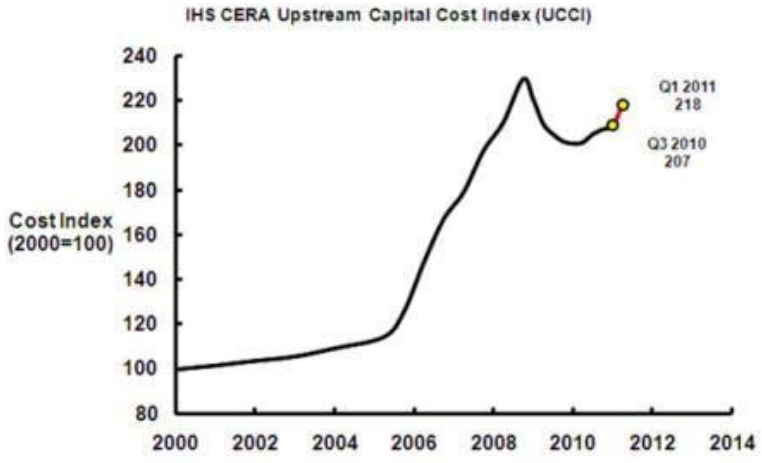
[66] Summary of Ohio Oil and Gas Activities: 2010, Division of Mineral Resources Management, ODNR, p, 2, 2011.

Table 42: Drilling Cost and Pricing History, Ohio 2006-2010

Year	Respondents Drilling Cost Per Foot ($)	Pricing History GAS (dth) DTI Appalachia ($)
2006	$77.00	$7.55
2007	$81.41	$7.22
2008	$83.79	$9.53
2009	$88.65	$4.27
2010	$84.21	$4.59

Increased exploration and production costs are not unique to Ohio producers. A capital cost index (Figure 15) developed by Cambridge Energy Research Associates shows a doubling of capital costs for the industry worldwide since 2000.[67] Between January 2011 and June 2011, the capital cost index rose by 5%. The HIS CERA Upstream Capital Costs Index was developed to track costs of new oil and gas facilities worldwide.

Figure 15: Worldwide Upstream Capital Cost Index



Source: Cambridge Energy Research Associates, 2011, http://press.ihs.com/press-release/energy-power/costs-building-and-operating-upstream-oil-and-gas-facilities-trending-upw

67 http://press.ihs.com/press-release/energy-power/costs-building-and-operating-upstream-oil-and-gas-facilities-trending-upw

VIII. ROYALTIES, FREE NATURAL GAS AND TAXES

Royalties

A royalty payment is made by the natural gas and crude oil producer to the owner of the mineral interest. A royalty payment (and possibly the free natural gas discussed below) is guaranteed to the mineral interest owner. In Ohio, the mineral interest owner is usually the landowner. Private owners, corporations, municipalities, nonprofit organizations, and federal and state landowners could lease their mineral interest to producers. The mineral interest owner receives payment usually amounting to one-eighth (12.5%) of the proceeds garnered from the well. The natural gas and crude oil producer takes all the risk and makes all the investment pertaining to the exploration, development and production of the well.

"A few farmers with one of my wells on their property get $200,000 per year. Sometimes I invest more in the well than their whole farm is worth."

— *a producer*

Ohio natural gas and crude oil producers sold $718 million of oil and natural gas in 2010. Accordingly, Ohio mineral interest owners received $90 million in royalty payments for the year.

Table 43: Natural Gas and Crude Oil Production, 1997-2010

Ohio Crude Oil and Natural Gas Production 1997 - 2010			
Year	Crude Oil*	Natural Gas*	
2001	6,050	98,255	
2002	6,004	97,154	
2003	5,647	93,641	
2004	5,785	90,301	
2005	5,652	84,135	
2006	5,422	86,315	
2007	5,455	88,095	
2008	5,554	84,858	
2009	5,009	88,824	
2010	4,785	78,122	
10 yr Sum	55,363	889,700	
*Oil in thousands of barrels, Gas in mmcf.			

Source: Summary of Oil and Gas Activities, 2010 Ohio Division of Mineral Resources Management

Table 44: Average Wellhead Price

Year	Crude Oil*	Natural Gas*
2001	$21.84	$4.49
2002	$22.50	$3.56
2003	$27.64	$5.90
2004	$38.00	$6.65
2005	$53.03	$9.03
2006	$62.43	$7.75
2007	$67.69	$7.40
2008	$93.79	$9.77
2009	$55.56	$4.36
2010	$74.42	$4.68

Source: Summary of Oil and Gas Activities,
2010 Ohio Division of Mineral Resources Management

Table 45: Calculation of Industry Royalty Payments

Year	Gross Sales	Royalty Payments
2001	$573,296,950	$71,662,119
2002	$480,958,240	$60,119,780
2003	$708,564,980	$88,570,623
2004	$820,331,650	$102,541,456
2005	$1,059,464,610	$132,433,076
2006	$1,007,436,710	$125,929,589
2007	$1,021,151,950	$127,643,994
2008	$1,349,972,320	$168,746,540
2009	$665,572,680	$83,196,585
2010	$718,089,496	$89,761,187
Ten Year Sum	$8,404,839,586	$1,050,604,948

Free Natural Gas

As part of the data and information gathering for this study, a survey was conducted of producers which included information about the mineral interest owners (surface owner) free of cost natural gas usage. It is important to note that the free natural gas consumer (mineral interest owner) has access to the produced natural gas at the wellhead, before the operator sells any natural gas from the well. As such, the mineral interest owner, usually the landowner, has access to the natural gas at a lower wellhead pressure. One implication of this arrangement is that while the wells may be producing very small commercial volumes, the wells may still be providing natural gas free of cost to the mineral interest owner.

Results of the recent producer survey indicate that 43% of the wells operated by the survey respondents provide natural gas to mineral interest owners free of cost. Typically the mineral owners/surface owner receives an annual volume of 200 mcf per well. Survey findings are similar to those of a previous 2007 producer survey. As of 2010, there were 64,378 wells being operated in the State of Ohio.[68] Applying the recent producer survey response (43%), approximately 27,683 wells are providing 5,536,508 mcf of natural gas free of cost annually. Based on the average 2010 residential natural gas price of $11.02/mcf, the natural gas being provided to consumers, free of cost, had a value of $61 million.

In addition, an undetermined number of wells are situated in geographic areas not serviced by natural gas utility companies. In such cases access to produced wellhead natural gas displaces alternative higher cost energy alternatives such as propane and/or electric.

Taxes Paid by Ohio's Natural Gas and Crude Oil Industry

Total taxes collected in 2010 from Ohio's natural gas and crude oil firms are estimated to be $32.7 million. This includes various taxes paid by the industry, severance taxes, property taxes, commercial activity taxes and finally income taxes. The following provides an explanation of how this figure is calculated.

Ohio Severance Tax Collections for fiscal year 2011 show that producers paid $2.5 million to the State of Ohio on natural gas and crude oil produced. Severance tax is levied upon the quantity extracted, not upon its value. Ohio crude oil and natural gas producers pay $0.10 per barrel of oil and two and one-half cents per thousand cubic feet of natural gas.[69]

[68] Summary of Ohio Oil and Gas Activities, 2010:Division of Mineral Resources Management, 2011.
[69] http://codes.ohio.gov/orc/5749

Table 46: FY 2011 Severance Taxes Paid for Crude Oil and Natural Gas

Type of Severance Tax	Taxes Paid
Severance Tax Natural Gas	$2,055,584
Severance Tax Crude Oil	$474,886
Total	$2,530,470

Source: Ohio Tax Commission, 2010.

In addition, Ohio natural gas and crude oil producers pay property taxes. For the property valuation, a discounted cash flow method is used whereby the future net income from production is estimated and the present value of that net income stream is calculated. Specific information on this calculation is provided on the Ohio Oil and Gas Association's (OOGA) website and available from the Ohio Department of Taxation. From OOGA website (August 2011):

2010 Uniform Valuation of Oil and Gas Deposits

The Ohio Department of Taxation has released their 2010 uniform formula for the valuation of oil and gas deposits in Ohio. In 2005, House Bill 66 exempted producers from the tangible personal property tax. Since then, OOGA, the Department of Taxation and state legislators have worked to find a fair and equitable formula to replace this tax. Per 2006's budget bill (HB 699), this new formula was codified for the valuation of these reserves.

The 2010 formula is as follows:

Crude Oil	Taxable Value
Average Daily Production: more than 1 barrel	$4,640 per barrel
Average Daily Production: less than 1 barrel	$2,780 per barrel

Natural Gas	Taxable Value
Average Daily Production: more than 8mcf	$450 per mcf
Average Daily Production: less than 8 mcf	$225 per mcf

Source: http://www.ooga.org/industry-studies-links/tax-information

Multiplying the daily production of each well by the above multipliers provides the taxable amount. The effective tax rate differs from county to county. To complete the tax paid calculation, the Muskingum County effective property tax rate of 5.1% is applied as reported by

a member firm of OOGEEP.[70] Applying the Muskingum County tax rate to Ohio production, producers paid approximately $5.7 million in property taxes in 2010. This number is believed to be conservative due to differing property rates across counties.

The Commercial Activity Taxes (CAT) paid by natural gas and crude oil producers is similar to taxes paid by other Ohio businesses. The Ohio Tax Commission, Ohio Department of Taxation reported that in fiscal year 2010, firms in North American Industry Classification System (NAICS) codes 211110 and 213110 paid $2.77 million in commercial activity taxes to the State of Ohio.

Table 47: Commercial Activity Taxes Paid, FY 2010

Industry Code	Industry Description	Number of Firms	Tax Collections
211110	Oil & Gas Extraction	421	$1,705,551
213110	Support Activities for Mining	119	$1,069,266
Total		540	$2,774,817

Individual and industry income taxes are not reported; however, the EIA Performance Profile of Major Energy Producers shows that natural gas and crude oil firms generated 3% after tax net income based on 2009 operating revenues (most recent data available). This was less than half the 7% net income of all manufacturing companies. The EIA Performance Profiles of Major Energy Producers (the Majors) document is a comprehensive annual financial review and analysis of the domestic and worldwide activities and operations of 29 major U.S.-based energy-producing companies. EIA examines a company's operations on a consolidated corporate level, by individual lines of business, by major functions within each line of business, and by various geographic regions. Performance profiles focus on annual aggregate changes in profits, cash flow, and investment in the U.S. and international energy industry resulting from major energy companies' current operations. Performance profiles also explore changes in the majors' exploration and development expenditures and their success in finding and developing natural gas and crude oil reserves. Results are reported based on detailed financial and operating data and information submitted each year to the EIA on Form EIA-28, the Financial Reporting System (FRS).

[70] Provided for the fiscal year 2010. In addition, the firm provided samples of tax payments made on several wells. The firm's real estate tax payments were also matched against well production, to arrive at taxes per Mcf estimates.

Table 48: Income Statement for Major Crude Oil and Natural Gas Companies and Census' All Manufacturing Companies, 2009

Income Statement Items	Major Crude Oil and Natural Gas Companies		All Manufacturing Companies	
	2009	%	2009	%
	-- billions of dollars --			
Operating Revenues	1,146	100%	1,353,446	100%
Operating Expenses	1,094	96%	1,281,107	95%
Operating Income(Rev less Exp)	51	4%	72,339	5%
Interest Expense	-11	-1%	(27,487)	-2%
Other Revenue	19	2%	65,948	5%
Income Tax Expense	-30	-3%	(16,214)	-1%
Net Income After Tax	30	3%	94,585	7%
Sources: FRS Companies: Energy Information Administration Form EIA-28 (Financial Reporting System);				
All Manufacturing Companies: U.S. Census Bureau, Quarterly Financial				
http://www2.census.gov/econ/qfr/hist/				

These *Major* producers reported 3% income tax expense which, if applied to Ohio producers, would translate to $21.5 million per year (3% of $718 million). Of the $21.5 million, roughly 80% ($17.4 million) is assumed to be paid to the federal government. The remaining 20%, or $4.3 million, is paid to state and local governments in Ohio annually.

Table 49: Summary of Taxes Paid by Ohio Natural Gas and Crude Oil Producers

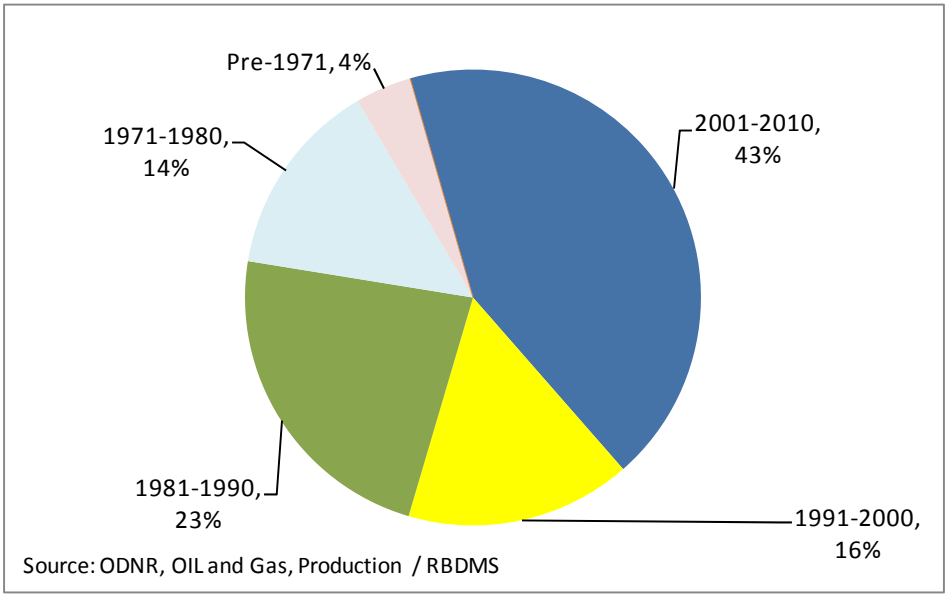
Type of Tax	Annual Amount
	-- million --
Severance	$2.5
Property	$5.7
Commercial Activity	$2.8
Income (Federal)	$17.4
Income (State & Local)	$4.3
Sum	$32.7

IX. BENEFITS OF RESERVES

As a reservoir is tapped, natural gas and crude oil are extracted. The rates of production vary from field to field and well to well but as natural gas and crude oil are drawn out of the reservoir, the amount of natural gas and crude oil remaining in the reservoir is reduced. At times, other wells can be drilled into the same field to boost production but the reservoir itself is still being depleted. When the reservoir is depleted, production of natural gas and crude oil can no longer occur due to operating expenses exceeding production income.

Without new well drilling, Ohio natural gas production would decline quickly and significantly. The figure below shows how older wells are less productive. Wells drilled in before 1971 are contributing only 4% of production. Wells drilled in the past 10 years are delivering 43% of the natural gas produced.

Figure 16: Ohio Natural Gas Production by Decade Well Was Drilled



The only way to replace declining production of natural gas and crude oil is to drill into a new reservoir or one that is not depleted.

If no exploration or development can occur in new reservoirs, then eventually all of the existing reservoirs are depleted and production in Ohio of natural gas and crude oil eventually ceases. In all, 2010 local production kept $718 million circulating in the State of Ohio, rather than being spent out of state.

IX. APPENDIX

Table 50: Utica Employment Impact Analysis: Industries in Ohio with at Least 10 Employees

Category	2011	2012	2013	2014	2015
Support activities for mining	2,473	13,521	63,118	105,709	117,204
Retail trade	166	1,007	4,948	8,990	10,743
Professional and technical services	149	885	4,299	7,675	8,988
Administrative and support services	107	625	3,023	5,365	6,236
Ambulatory health care services	106	634	3,215	5,911	7,060
Construction	98	660	3,235	6,673	9,077
Food services and drinking places	71	434	2,156	3,994	4,940
Wholesale trade	54	321	1,539	2,722	3,162
Real estate	43	259	1,287	2,307	2,670
Personal and laundry services	33	201	1,010	1,834	2,158
Private households	24	148	737	1,349	1,606
Monetary authorities - central bank	23	133	647	1,155	1,348
Repair and maintenance	22	128	616	1,084	1,247
Rental and leasing services	21	117	550	948	1,078
Hospitals	21	125	634	1,168	1,420
Membership associations and organizations	18	109	537	967	1,144
Nursing and residential care facilities	15	93	470	873	1,075
Fabricated metal product manufacturing	13	75	351	588	633
Securities, commodity contracts, investments	12	69	334	598	699
Management of companies and enterprises	11	65	309	526	575
Educational services	10	63	324	619	786
Performing arts and spectator sports	10	61	297	543	658

Table 51: Utica Output (Sales) Impact Analysis: Industries in Ohio with at Least 10 Employees

Sector	2011	2012	2013	2014	2015
	2010$	*2010$*	*2010$*	*2010$*	*2010$*
Support activities for mining	$217,662,494	$1,303,141,969	$6,388,267,992	$11,731,784,056	$14,376,561,780
Retail trade	$11,829,621	$74,330,100	$378,313,285	$718,057,722	$900,027,743
Professional and technical services	$12,441,428	$74,711,424	$363,743,106	$663,975,845	$801,493,650
Administrative and support services	$5,439,197	$32,494,795	$159,733,442	$291,600,422	$350,675,208
Ambulatory health care services	$10,819,722	$64,924,643	$331,983,732	$618,547,243	$751,095,176
Construction	$9,455,735	$63,791,133	$314,777,768	$659,869,210	$917,162,470
Food services and drinking places	$3,088,361	$18,842,326	$93,828,228	$175,611,034	$220,276,977
Wholesale trade	$10,132,499	$62,768,665	$315,934,329	$592,893,348	$734,748,251
Real estate	$7,727,173	$47,712,400	$237,107,887	$438,735,295	$532,060,671
Personal and laundry services	$2,036,551	$12,251,810	$61,189,391	$111,566,900	$132,380,317
Private households	$233,879	$1,428,053	$7,118,221	$13,167,788	$15,898,016
Monetary authorities - central bank	$6,260,520	$37,936,092	$188,842,354	$349,709,309	$425,698,818
Repair and maintenance	$1,954,837	$11,753,144	$57,036,661	$102,489,350	$121,135,256
Rental and leasing services	$6,391,478	$37,672,088	$181,844,320	$327,453,868	$391,320,422
Hospitals	$2,321,503	$14,249,601	$73,225,908	$138,261,608	$172,876,766
Membership associations	$688,805	$4,086,201	$19,979,512	$36,179,250	$43,298,811
Nursing and residential care	$706,090	$4,344,963	$21,979,926	$40,911,302	$50,628,941
Fabricated metal product mfg	$2,918,645	$16,497,774	$78,719,589	$136,841,045	$154,746,809
Securities, commodity contracts	$1,095,274	$6,909,518	$35,789,012	$68,891,421	$86,880,996
Management of companies	$4,379,018	$26,198,651	$128,286,251	$229,590,236	$265,967,477
Educational services	$319,525	$1,968,989	$9,955,452	$19,040,334	$24,323,429
Performing arts and spectator sports	$442,355	$2,652,028	$12,998,229	$23,951,007	$29,258,730

Table 52: Utica GRP Impact Analysis: Industries in Ohio with at Least 10 Employees

Sector	2011	2012	2013	2014	2015
	2010$	*2010$*	*2010$*	*2010$*	*2010$*
Support activities for mining	$90,142,885	$541,043,713	$2,658,034,397	$4,898,912,037	$6,025,023,321
Retail trade	$8,039,371	$50,679,255	$258,772,609	$493,052,036	$620,252,990
Professional and technical services	$8,142,037	$48,961,171	$238,679,420	$436,814,164	$528,716,906
Administrative and support services	$3,485,405	$20,820,237	$102,266,816	$186,801,742	$224,821,652
Ambulatory health care services	$7,410,803	$44,603,102	$228,674,703	$427,479,900	$520,671,204
Real estate	$5,711,576	$35,279,354	$175,365,921	$324,860,030	$394,480,069
Food services and drinking places	$1,596,561	$9,745,936	$48,592,442	$91,140,152	$114,565,795
Wholesale trade	$6,926,805	$43,019,106	$217,203,322	$409,226,252	$509,097,109
Construction	$4,938,441	$33,634,616	$167,519,366	$354,696,101	$497,908,763
Personal and laundry services	$1,206,849	$7,289,283	$36,551,173	$66,965,695	$79,829,840
Private households	$227,332	$1,390,638	$6,941,241	$12,860,636	$15,544,321
Monetary authorities - central bank	$3,610,068	$21,955,835	$109,578,031	$203,687,033	$248,832,784
Repair and maintenance	$1,142,420	$6,848,760	$33,150,618	$59,478,139	$70,208,821
Rental and leasing services	$3,874,590	$22,771,399	$109,553,410	$196,866,034	$234,751,839
Hospitals	$1,321,038	$8,126,322	$41,912,836	$79,473,891	$99,809,071
Membership associations and organizations	$262,427	$1,542,348	$7,481,004	$13,450,693	$15,986,306
Nursing and residential care facilities	$457,806	$2,829,600	$14,364,330	$26,846,622	$33,363,813
Fabricated metal product manufacturing	$1,238,277	$6,989,662	$33,311,943	$57,911,950	$65,507,130
Securities, commodity contracts, investments	$558,639	$3,538,570	$18,410,724	$35,642,622	$45,210,716
Management of companies and enterprises	$2,308,935	$13,815,896	$67,493,394	$120,712,037	$139,749,225
Educational services	$189,356	$1,167,302	$5,896,224	$11,275,713	$14,402,572
Performing arts and spectator sports	$246,058	$1,474,776	$7,230,357	$13,339,637	$16,316,294

Table 53: Counterfactual Impact Analysis: Industries in Ohio with at Least 10 Employees, 2010

Support activities for mining	-1,741	-$301,947,907	-$128,348,258	-$174,961,090
Retail trade	-977	-$69,800,225	-$48,678,293	-$30,082,703
Ambulatory health care services	-582	-$60,799,152	-$42,763,481	-$36,956,787
Professional and technical services	-559	-$59,877,254	-$40,255,500	-$38,175,583
Administrative and support services	-444	-$24,845,142	-$16,412,922	-$14,692,307
Food services and drinking places	-353	-$16,164,638	-$8,585,172	-$7,244,110
Wholesale trade	-273	-$51,575,984	-$36,159,341	-$20,959,854
Real estate	-242	-$51,881,887	-$39,473,982	-$2,903,700
Rental and leasing services	-193	-$70,593,267	-$44,174,613	-$10,658,383
Personal and laundry services	-168	-$11,580,816	-$7,039,160	-$7,485,867
Private households	-137	-$1,394,272	-$1,394,272	-$1,258,701
Hospitals	-119	-$13,786,561	-$8,040,414	-$8,605,003
Repair and maintenance	-115	-$11,197,390	-$6,758,662	-$5,278,111
Monetary authorities - central bank	-108	-$32,348,133	-$19,152,424	-$7,510,185
Nursing and residential care facilities	-92	-$4,439,776	-$2,958,977	-$3,668,308
Membership associations and organizations	-89	-$3,612,687	-$1,427,108	-$3,341,198
Performing arts and spectator sports	-74	-$3,316,474	-$1,897,486	-$1,848,817
Educational services	-67	-$2,262,840	-$1,383,370	-$2,439,499
Management of companies and enterprises	-62	-$25,603,612	-$13,943,702	-$9,057,999
Fabricated metal product manufacturing	-54	-$11,431,531	-$4,997,104	-$4,257,202
Securities, commodity contracts, investments	-42	-$3,964,683	-$2,070,079	-$1,818,419
Amusement, gambling, and recreation	-38	-$1,198,991	-$815,303	-$832,081
Accommodation	-27	-$1,617,511	-$1,047,480	-$893,235
Truck transportation; Couriers and messengers	-27	-$4,286,824	-$2,107,794	-$2,329,350
Broadcasting, except Internet; Telecommunications	-24	-$10,833,345	-$6,238,524	-$2,126,694
Insurance carriers and related activities	-24	-$5,223,388	-$2,876,740	-$2,911,568
Social assistance	-22	-$543,972	-$321,878	-$892,878
Utilities	-21	-$14,554,459	-$8,653,267	-$2,597,809
Nonmetallic mineral product manufacturing	-18	-$4,632,536	-$2,227,744	-$1,492,143
Publishing industries, except Internet	-18	-$6,005,954	-$3,400,545	-$1,377,106
Waste management and remediation services	-18	-$3,593,567	-$1,949,080	-$1,142,561
Internet publishing and broadcasting	-18	-$5,223,127	-$3,075,001	-$1,249,015
Plastics and rubber product manufacturing	-17	-$5,048,438	-$1,940,176	-$1,430,273
Machinery manufacturing	-17	-$4,385,300	-$1,786,701	-$1,883,984
Printing and related support activities	-13	-$2,094,698	-$1,035,302	-$850,201
Motor vehicles, bodies & trailers, and parts manufacturing	-10	-$7,450,610	-$2,027,127	-$1,801,968
Chemical manufacturing	-10	-$6,687,949	-$2,588,647	-$1,532,555

Table 54: 2010 Well Drilling Impact Analysis: Industries in Ohio with an Impact of at Least 10 Employees

Sector	Employment	Output	Gross Regional Product	Earnings by Workplace
		2010 $	*2010 $*	*2010 $*
Support activities for mining	726	$91,186,320	$38,760,346	$54,020,941
Professional and technical services	235	$22,561,350	$15,171,502	$15,361,786
Fabricated metal product manufacturing	194	$41,208,826	$18,013,671	$13,565,540
Construction	172	$17,664,816	$9,409,642	$8,566,856
Retail trade	165	$12,202,572	$8,512,886	$5,369,186
Ambulatory health care services	104	$10,809,251	$7,601,466	$6,761,551
Administrative and support services	103	$6,059,382	$4,000,826	$3,460,884
Truck transportation; Couriers and messengers	77	$11,083,724	$5,447,577	$4,199,028
Food services and drinking places	69	$3,195,214	$1,697,129	$1,511,574
Wholesale trade	51	$10,585,061	$7,421,276	$4,655,838
Real estate	37	$10,174,398	$7,735,559	$611,305
Waste management and remediation services	32	$7,432,800	$4,031,600	$1,903,892
Personal and laundry services	30	$2,151,793	$1,307,942	$1,293,182
Mining (except oil and gas)	29	$4,135,968	$2,138,240	$1,585,335
Private households	26	$281,284	$281,284	$257,790
Hospitals	23	$2,625,313	$1,532,655	$1,837,730
Machinery manufacturing	22	$5,510,434	$2,245,554	$1,730,442
Repair and maintenance	21	$2,143,935	$1,294,324	$921,488
Primary metal manufacturing	20	$8,611,362	$2,586,028	$1,942,873
Monetary authorities - central bank; Credit intermed	19	$6,857,661	$4,060,541	$1,626,492
Nursing and residential care facilities	16	$784,137	$522,757	$696,182
Membership associations and organizations	16	$703,470	$277,617	$661,850
Educational services	14	$515,425	$315,069	$608,444
Securities, commodity contracts, investments	10	$1,049,183	$547,638	$489,235

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