New Oil and Gas Drilling Technologies Bring Significant Changes and Challenges to Housing Markets

Increased oil and gas drilling activity in predominantly rural areas across the United States in recent years, driven by new drilling technologies that enable production from previously inaccessible rock formations, has caused serious disruptions in local housing markets in and around the new activity. When these housing market disruptions were brought to the attention of the U.S. Department of Housing and Urban Development (HUD) in 2011, the Economic and Market Analysis Division (EMAD) in the Office of Policy Development and Research at HUD formed the Gas and Oil Task Force (GOTF) of field economists to explore and analyze the effect of gas and oil exploration and development activity on housing markets in the affected areas. This article provides a summary of the economists' initial findings.

Technological advances, such as horizontal drilling techniques and hydraulic fracturing, have increased extraction capacity for oil and gas. A horizontal well is any well in which the lower part of the well bore parallels the oil or gas zone, but the angle of inclination for the well bore does not have to reach 90 degrees. Horizontal drilling differs slightly from directional drilling in that it uses a tighter turn radius. Horizontal and directional wells are often more cost effective than traditional straight-line, vertical wells because reservoirs are typically horizontal and directional and horizontal wells offer greater contact area.

Hydraulic fracturing involves pumping a fracturing fluid into a formation at a calculated rate and pressure to generate fractures in the surrounding rock. Beginning at the end of the horizontal section of a well, segments of the wellbore are isolated, the casing is perforated, and water is pumped under high pressure (thousands of pounds per square inch) through the perforations, cracking the shale and creating one or more fractures that extend out into the surrounding rock. The fracture is only a fraction of an inch wide, held open by sand grains.

Development of oil and natural gas fields usually leads to an influx of temporary workers to an area, and in rural areas this surge of workers can represent sizable percentages of the local population. In the Eagle Ford Shale area of south Texas, Dimmit and LaSalle Counties have seen their combined resident employment increase 27 percent, or by 1,825 jobs, to 8,575 jobs in 2011 compared with the number of jobs in 2010. During the same period, Williams County, North Dakota, recorded resident employment growth of nearly 41 percent annually and the population increased 8 percent annually from April 2010 through July 2011. Other areas being monitored and analyzed have also seen strong employment growth. As explained in the Data Issues, Constraints, and Needs section, the numbers cited previously likely understate by a significant amount the actual number of workers in an area because of the way the data are collected; temporary or mobile workers are usually reported by place of permanent residence or by the site of the permanent facility of their employer, rather than by place of work.

Eight Areas of Focus

To better understand where drilling activity causes employment and population changes, which directly affect housing markets, the GOTF undertook months of research and discussion, focusing on eight areas: (1) the Bakken Formation in Montana and North Dakota; (2) the Niobrara Formation in northern Colorado; (3) the Piceance Shale Formation in western Colorado; (4) the Permian Basin Formation in eastern New Mexico and western Texas; (5) the Barnett Shale Formation in northeastern Texas; (6) the Eagle Ford Shale Formation in south Texas; (7) the Marcellus Shale Formation in Maryland, New York, Pennsylvania, Virginia, and West Virginia; and (8) the Utica Shale Formation in Maryland, New York, Ohio, Pennsylvania, and West Virginia.

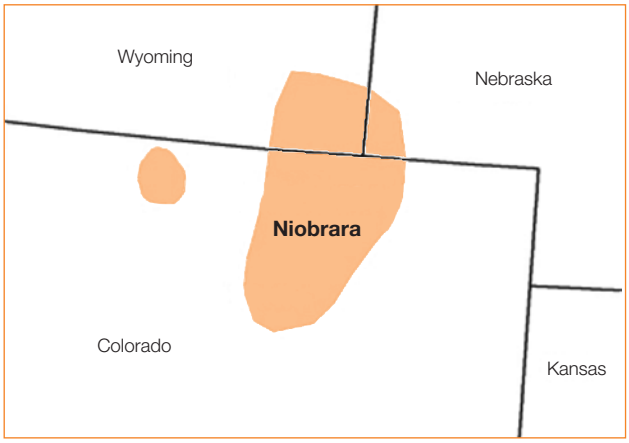
The Bakken Formation. Located in North Dakota and Montana, the Bakken Formation (Figure 1) contains both oil and natural gas reserves. The current phase of horizontal drilling using hydraulic fracturing techniques began in 2004. In North Dakota, 19 counties in the northwestern part of the state, with a combined population of 179,800 as of July 1, 2011, produce oil or natural gas. Of the 19 counties, 10 generated more than 98 percent of the state's oil and natural gas production during the 12 months ending March 2012.

An average of 180 oil and gas rigs operated in North Dakota during the 12 months ending March 2012, up from 140 rigs during the same period in 2011. North Dakota issued 1,850 drilling permits in 2012, down slightly from 1,875 permits during the same period in 2011. Mountrail County is the most dramatic example of booming shale oil production in North Dakota, with production increasing from 246,900 barrels during the 12 months ending March 2006 to 54.8 million barrels during the same period in 2012. Resident employment in the 19 counties of North Dakota during the 12 months ending March 2012 grew by 12,350 jobs, or 12.4 percent,

Figure 1. The Bakken Formation

Sources: U.S. Energy Information Administration; U.S. Department of Housing and Urban Development, Office of Policy Development and Research

Figure 2. The Niobrara Formation



Sources: U.S. Energy Information Administration; U.S. Department of Housing and Urban Development, Office of Policy Development and Research

reaching 111,900 jobs. The population in the 19 counties was 179,800 as of July 1, 2011, an increase of 6,225, or 3.6 percent, since 2010.

In Montana, drilling activity since 2000 has been centered in the eastern portion of the state. Oil production peaked at 36.2 million barrels during the 12 months ending March 2007, declining to 25 million barrels in 2011 and 24.3 million barrels in 2012. Thirty-three counties produce oil or natural gas; of these, ten counties accounted for 94 percent of state oil production and 32 percent of state natural gas production in 2011. There was an average of 17 oil and natural gas rigs operating during the 12 months ending March 2012, up from 15 rigs during the same period in 2011. Approximately 600 drilling permits were issued in 2012, down from 790 permits during the same period in 2011. Richland, Fallon, Roosevelt, Sheridan, and Wibaux Counties accounted for 74 percent of completed oil wells and 44 percent of completed natural gas wells in 2010. Resident employment in the 10 primary oil- and gas-producing counties during the 12 months ending March 2012 grew by 830 jobs, or 6 percent, reaching 14,500 jobs. The population in these Montana counties was 28,100 as of July 1, 2011, an increase of 560, or 2 percent, since the previous year.

The Niobrara Formation. Located in northern Colorado, the Niobrara Formation (Figure 2) is largely a natural gas "play"[1] covering five counties with a combined population of 721,900 as of July 2011. Although exploration and drilling have been ongoing for nearly 100 years in this formation, heightened activity has occurred in the area since 2007 because of advancements in drilling technology. Weld County, which is part of the Greeley Metropolitan Statistical Area (MSA), is the most populous county in the Niobrara area, with a population exceeding 250,000. The drilling permits during the first quarter of 2012 for the Niobrara play totaled 550, a 25-percent increase from the 440 drilling permits issued during the same period a year earlier. Weld County accounts for 76 percent of drilling permits and well starts in the Niobrara Shale Formation and has, by far, the most population and employment growth of any county in the area. During the 12 months ending March 2012, resident employment in the five counties averaged 355,800 jobs, an increase of 1.6 percent from the previous 12 months. As of July 1, 2011, the population in the in the five counties was 721,900, an increase of 1.9 percent from April 2010.

The Piceance[2] Shale Formation. Located in western Colorado, the Piceance Shale Formation (Figure 3) is both an oil and natural gas play, primarily covering two counties with a combined population of 203,400 in 78,200 households. Oil and gas production in Colorado continued to increase with the use of horizontal drilling and hydraulic fracturing, reaching an average of 4.56 billion cubic feet (BCF) of natural gas and 88,700 barrels (bbl) of oil per day in 2011. Garfield County, at the southern tip of the Piceance Shale Formation, is near the Grand Junction MSA and has a population of nearly 56,300. In the Piceance Shale area, 280 drilling permits were issued during the first quarter of 2012, a 25-percent decrease from the 375 drilling permits during the same period a year earlier. Garfield County has the largest population, the most employment growth, and the most drilling activity of any county in the Piceance Shale area. During the 12 months ending March 2012, resident employment in the Piceance Shale area averaged 102,400 jobs,

an increase of 1.4 percent from the previous 12 months. As of July 1, 2011, the population in the area was 203,400, an increase of 0.1 percent from 2010.

The Permian Basin Formation. Located in western Texas and eastern New Mexico, where drilling began in 1925, the Permian Basin Formation (Figure 4) is an oil and natural gas play covering 20 counties with a combined population of 553,300 as of July 2011. Approximately one-half of the population is located in the Midland (Midland County) and Odessa (Ector County) MSAs. The Texas Railroad Commission Districts 8 and 7C, which contain the Permian Basin area, had 373 active rigs in March 2012, up 30 percent from the 288 active rigs in March 2011. Drilling occurs throughout the Basin and is not concentrated in only a few counties; however, employment and population growth are concentrated in Midland and Odessa Counties. During the 12 months ending March 2012, resident employment in the Permian Basin area averaged 278,600 jobs, an increase of 6.3 percent from the previous 12 months. As of July 1, 2011, the population in the area was 553,281, an increase of 1.6 percent from 2010.

The Barnett Shale. Located in northeastern Texas, where drilling began in 1982, the Barnett Shale (Figure 5) is a natural gas play covering 25 counties with a combined population of 5,852,000 as of July 2011; the primary counties are located in the Fort Worth Division of the Dallas-Fort Worth-Arlington, TX Metropolitan Core Based Statistical Area. The primary county in the Fort Worth area is Tarrant County, which includes approximately 32 percent of the population located in the Barnett Shale area. The Barnett Shale area is located within Texas Railroad Commission Districts 9, 7B, and 5. In March 2012, these districts had 96 active rigs, a 29-percent decrease from the 136 active rigs in May 2011. The core counties for employment, population growth, and drilling activity are Denton, Johnson, Tarrant, and Wise. During 2011, resident employment in the Barnett Shale area averaged 2,704,000 jobs, an increase of 1.7 percent from the previous 12 months. As of July 1, 2011, the population in the area was 5,852,000, an increase of 1.7 percent from the previous year.

The Eagle Ford Shale. Located in south Texas, where drilling began in 2008, the Eagle Ford Shale (Figure 6) is an oil and natural gas play covering 14 counties, with a combined population of 547,000 as of July 1, 2011.

Figure 3. The Piceance Shale Formation

Sources: U.S. Energy Information Administration; U.S. Department of Housing and Urban Development, Office of Policy Development and Research

Figure 4. The Permian Basin Formation

Sources: U.S. Energy Information Administration; U.S. Department of Housing and Urban Development, Office of Policy Development and Research

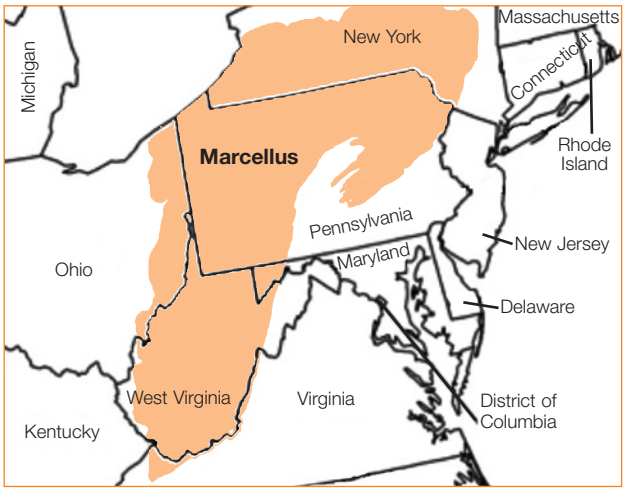
Figure 5. The Barnett Shale

Sources: U.S. Energy Information Administration; U.S. Department of Housing and Urban Development, Office of Policy Development and Research

Figure 6. The Eagle Ford Shale

Sources: U.S. Energy Information Administration; U.S. Department of Housing and Urban Development, Office of Policy Development and Research

Figure 7. The Marcellus Shale Formation



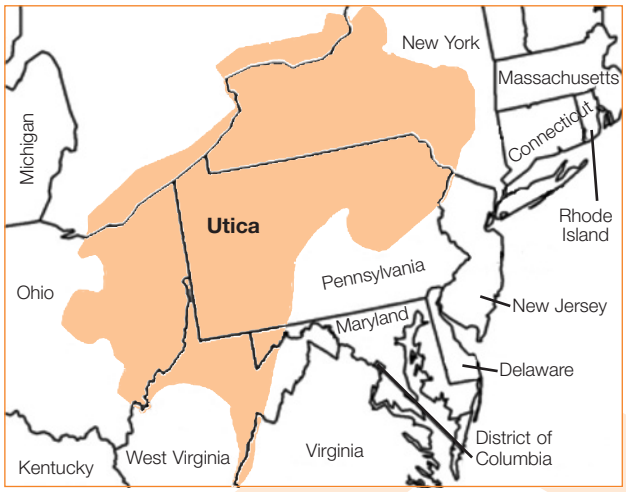
Sources: U.S. Energy Information Administration; U.S. Department of Housing and Urban Development, Office of Policy Development and Research

Webb County, which is the only county in the Laredo MSA, is the largest county at the far southern end of the play and has a population exceeding 250,000. The rig count in the Eagle Ford Shale as of March 31, 2011, was 274 active oil and natural gas rigs. During 2011, oil production from Eagle Ford Shale totaled 36.6 million bbl. This total production is an increase of 737 percent, or more than 32 million bbl compared with the number of barrels in 2010. Natural gas production also increased by 179 BCF, or 165 percent, to 287 BCF produced during 2011. Webb, Karnes, and LaSalle Counties have 111 active wells (combined oil and gas) of the 261 total. Corpus Christi, Texas, is 80 miles from Karnes County, which has the largest concentration of rigs in the Eagle Ford Shale play; the Corpus Christi area has recorded a $1.25 billion increase in gross regional product and more than 5,000 new jobs related to the Eagle Ford Shale play in the past several years.

The Marcellus Shale Formation. Located in Maryland, New York, Pennsylvania, and West Virginia, the Marcellus Shale Formation (Figure 7) yields primarily natural gas. In Maryland and New York, moratoriums on new drilling are in effect. The renewed interest in the Marcellus Shale play started in 2003 when Range Resources drilled a highly productive gas well in Washington County, Pennsylvania, through the Marcellus Shale layer using hydraulic fracturing. The Northern Tier area has been a focal point of Marcellus Shale activity in Pennsylvania. Located in the northeast corner of the state, the Northern Tier has a combined population of 183,400 as of July 1, 2011, an increase of 0.3 percent since 2010. During the 12 months ending March 2012, resident employment averaged nearly 89,150 jobs, an increase of 2,745 jobs, or 3.2 percent, compared with the previous 12-month period. Employment gains were concentrated in Bradford, Susquehanna, and Tioga Counties. During the 12 months ending March 2012, the unemployment rate in those counties averaged 6.9 percent, down from the 7.6-percent rate recorded during the previous 12-month period. Another area of intensive Marcellus Shale activity is in southwestern Pennsylvania, near Pittsburgh. During the 12 months ending March 2012, resident employment in the southwestern Pennsylvania area averaged nearly 951,900 jobs, an increase of 16,850 jobs, or 1.8 percent, from the previous 12-month period. During the 12 months ending March 2012, the unemployment rate in southwestern Pennsylvania averaged 7.1 percent, down from the 7.7-percent rate recorded during the previous 12-month period. In the West Virginia portion of the Marcellus Shale area during 2011, resident employment averaged 177,400 jobs, an increase of 2,475 jobs, or 1.4 percent, compared with employment during the previous 12-month period. The unemployment rate in in the Marcellus Shale area of West Virginia averaged 7.3 percent during the 12 months ending March 2012, down from the 8.4-percent rate recorded during the previous 12-month period.

The Utica Shale Formation. Located in Maryland, New York, Ohio, Pennsylvania, and West Virginia, the Utica Shale Formation (Figure 8) yields both oil and natural gas. In Maryland and New York, moratoriums on drilling are in effect. Geologically, the Utica Shale is beneath the Marcellus Shale. Most of the Utica Shale drilling activity, where significant drilling began in 2011, is currently located in Ohio in 7 counties with a combined population in July 2011 of approximately 848,000, relatively unchanged since 2010. During the 12 months ending March 2012, resident employment averaged 371,500 jobs, an increase of 3,125 jobs, or 0.8 percent,

Figure 8. The Utica Shale Formation



Sources: U.S. Energy Information Administration; U.S. Department of Housing and Urban Development, Office of Policy Development and Research

compared with employment during the previous 12-month period. Employment gains were concentrated in Stark and Mahoning Counties. During the 12 months ending March 2012, the unemployment rate in the Utica Shale portion of Ohio averaged 9.3 percent, down from the 11.1-percent rate recorded during the previous 12-month period.

Economic Effects of Oil and Gas Activity

The housing market areas about which the GOTF is concerned are affected most directly by *upstream activities,* which are characterized by recovering and producing crude oil and gas, including exploring for oil and gas, drilling wells, and operating the wells to deliver crude oil and natural gas to refining or distribution facilities. *Downstream activities* are characterized by refining crude oil and transporting, distributing, and selling natural gas and products derived from crude oil. According to the U.S. Bureau of Labor Statistics (BLS), in 2011, 186,300 people were employed in the upstream oil and gas extraction sector, with an average hourly salary of $35.15, including more than 30,000 petroleum engineers, with an average hourly salary of $66.82. Oil and gas extraction sector payrolls have increased by 9.9 percent, or by 15,700 jobs, since 2010. Employment in the extraction sector has increased at an average annual rate of 5.6 percent, or by 8,200 jobs, since 2005. Support activities for mining employed more than 366,500 people in 2011. This category includes in excess of 17,000 rig operators and 39,000 roustabouts (workers who maintain all things in the oil field).

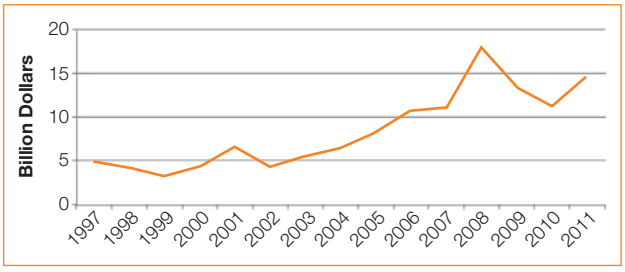
Oil and gas activity brings a significant amount of money to each geographic area that the GOTF monitors. According to a study by the University of Texas at San Antonio's Institute for Economic Development, the economic impact of gas and oil activities in the rural 14-county Eagle Ford Shale play was nearly $20 billion during 2011.

Federal, state, and local governments benefit from oil and natural gas drilling in several ways. In addition to collecting taxes from employees and businesses involved, governments also derive income by collecting lease and royalty payments. Several states impose a severance tax, which is levied on the extraction, or severance, of natural resources from the earth. At the state level, severance taxes are the main form of revenue from oil and gas drilling, totaling $14.7 billion in 2011, according to the U.S. Census Bureau, increasing at an average annual rate of 7.6 percent from nearly $4.9 billion in revenues in 1997. Figure 9 shows annual severance tax revenues for all the states from 1997 through 2011.

Ongoing Federal leases for oil and natural gas exploration generated nearly $9 billion in revenue from royalties in 2009. New lease sales in 2010 generated an additional $256 million in revenue. When the government sells a lease to a firm, the company is buying only the right to drill on the land. After oil is extracted, royalty payments to the government are made in accordance with the terms of the lease. According to the U.S. Energy Information Administration, the oil and natural gas industry paid an average of $20 billion a year in income taxes from 2003 through 2009.

In addition to generating tax revenue, the oil and gas industry creates significant spillover effects, such as indirect and induced economic benefits. Indirect economic benefits go to industries providing goods and services to the oil and gas industry. The induced economic benefits consist of increased economic activity because of spending by people employed in the oil and gas industry, which provides additional dollars to local economies. According to a report commissioned by the American Petroleum Industry, Pricewaterhouse-Coopers[3] estimated that the oil and natural gas industry supported 5.8 million indirect and induced jobs in the United States during 2009, and an additional 1.2 million

Figure 9. State Severance Tax Revenue



Source: U.S. Census

indirect and induced jobs were added because of capital investments made by the industry. Indirect and induced labor income (including wages and salaries, benefits, and proprietors' income) was $357 billion and the indirect and induced value added was $616.7 billion in 2009.

An influx of new energy sector workers into an area stimulates economic growth in other industries because workers require goods and services provided by the locality wherever sufficient retail presence exists for purchasing food, clothing, entertainment, electronics, and even new vehicles. The relatively high median wages that oil and gas workers receive allow them to spend more disposable income on luxury items. Depending on the workers' temporary location, such purchases may come from outside a very rural drilling area in a nearby community with a sufficient retail base.

As was evidenced in the regional summaries previously, drilling activity increased significantly in most of the eight areas for which the GOTF is maintaining data. Relatively less employment and population growth were recorded in the same areas, however. In an attempt to assess the effect of growth in these areas, the GOTF is researching and obtaining data about sales-tax revenues within the counties in the shale areas, especially those counties that contain larger cities and trade centers. The preliminary data for all areas except Montana, which does not impose a sales tax, show significant increases in sales tax revenue in many of the areas. With the added income and employment, however, pressures are also on local housing markets, infrastructure, and resources.

Sales Tax Information by GOTF Oil and Gas Region

The Bakken Formation. North Dakota is recording significant increases in sales tax revenue, and counties with the strongest growth are weighted heavily toward the oil and gas areas in western North Dakota. Slope and Hettinger Counties were the outliers, with declines of 37 and 3 percent, and Burke County increased by 0.2 percent. Slope County produced roughly 560,000 bbls of oil, or 0.4 percent of the state total. Hettinger County recorded little production of either oil or natural gas in recent years and recorded none during 2011. Burke County produced 2.7 million bbls of oil, or 1.5 percent of the state total. In summary, most of the state is benefitting from the oil boom, but the oil and gas counties where most of the drilling and production are taking place are the ones experiencing the fastest growth. Montana has no sales tax, and the oil and gas severance tax collection data do not seem useful for GOTF purposes.

The Niobrara Formation. Since 2009, sales tax revenue has increased. Weld County is home to Greeley, the largest city within the Niobrara Shale area and the center for goods and services within a large geographic area. More than 75 percent of drilling permits and well activity in the Niobrara area are concentrated within Weld County, and Greeley is the regional headquarters for many energy exploration companies and related subcontractors. During 2011, average monthly sales tax revenue in Weld County increased nearly 30 percent, to $7,084,000 from $5,550,700 during 2010. Sales tax revenue in the region increased by an average of 5.6 percent annually from 2008 through 2011.

The Piceance Shale Formation. Sales tax revenue within the Piceance Shale area has declined since 2008. The area is experiencing a "mini-bust," because declining natural gas prices and expanding inventories are decreasing demand for natural gas exploration and production. Sales tax revenue in the region decreased by an average of 4.2 percent annually from 2008 through 2011. Like the Niobrara region, the Piceance area has a single center for goods and services, the city of Grand Junction, within Mesa County. Garfield County, immediately north of Mesa County, is where most of the drilling activity is located, however. During 2011, only 1,325 drilling permits were filed for Garfield County, a 35-percent decrease from the 2,050 permits that were filed during 2010.

The Permian Basin Formation. During the fourth quarter of 2011, the latest data available, gross sales in the Permian Basin region of Texas totaled $7.8 billion, an increase of 36 percent compared with sales in the fourth quarter of 2010. The most recent number exceeds the previous record for a fourth quarter of $6.5 billion recorded during the fourth quarter of 2008.

The Barnett Shale. During the fourth quarter of 2011, the latest data available, gross sales in the Barnett Shale region of Texas totaled $108.8 billion, an increase of 6 percent compared with sales in the fourth quarter of 2010. The most recent figure remains less than the previous record for a fourth quarter of $111.5 billion recorded during the fourth quarter of 2008.

The Eagle Ford Shale. Gross sales in the Eagle Ford Shale for 2011 totaled more than $18.7 billion, an increase of more than $3.8 billion, or 26 percent, compared with sales in 2010. During the same period, sales tax revenue increased by more than $805 million, or 23 percent, to $4.2 billion. McMullen and La Salle Counties both had percentage increases in sales tax revenue of more than 100 percent for 2011 compared with sales tax revenue in 2010.

The Marcellus Shale Formation. The areas with the strongest sales tax remittance growth both in terms of percentage and dollar figures are Bradford, Susquehanna, and Tioga Counties. Sales tax remittances in the three counties increased by $5.7 million, or 18.3 percent, during 2011 compared with sales tax in 2010. Before this increase, from 2008 through 2010, sales tax remittances in the three counties increased by an

average of $1.1 million, or 3.9 percent, a year. Exploration and related drilling activity in the Marcellus Shale Formation was limited until approximately 2008. Before 2008, from 2001 through 2007, sales tax remittances increased by an average of $681,600, or 2.4 percent, a year.

The areas with growth in sales tax remittances in terms of percent and overall increase were Allegheny, Fayette, and Washington Counties in Pennsylvania. Sales tax remittances in the three counties increased by $57.7 million, or 9.3 percent, during 2011 compared with sales tax remittances in 2010. Before 2011, from 2008 through 2010, sales tax remittances in the three counties declined by an average of $11.6 million, or 1.8 percent, a year. Exploration and related drilling activity in the Marcellus Shale Formation was limited until approximately 2008. From 2001 through 2007, sales tax remittances increased by an average of $9.8 million, or 1.7 percent, a year.

During 2011 in West Virginia, the areas with the strongest sales tax remittance growth, both in terms of percentage and dollar figures, are Barbour, Marshall, Monongalia, and Upshur Counties. Sales tax remittances in the four counties increased by approximately $7.4 million, or nearly 11 percent, during 2011 compared with sales tax in 2010. From 2009 through 2010, sales tax remittances in the four counties increased by an average of $1.9 million, or 3.0 percent, a year. Exploration and related drilling activity in the Marcellus Shale Formation was limited until approximately 2007.

The Utica Shale Formation. Significant drilling here began only in 2011; sufficient data are not yet available to include at this time.

Housing Market Effects of Oil and Gas Activity

The tremendous influx of money and workers into oil and gas drilling areas quickly absorbs the supply of available, affordable housing. In some cases, the increase in often highly paid workers results in the direct (or sometimes indirect by the employers) lease up of units at much higher rents than local residents not employed by the drilling companies can afford. According to housing authorities in the Eagle Ford Shale area, as leases expired, current tenants had to vacate units for workers hired by oil and gas firms, subcontractors, and suppliers.

The following examples provide a small sample of the effects on four of the eight housing market areas the GOTF is studying.

Bakken Formation Area Housing Markets. Lack of housing—affordable and otherwise—continues to be the main problem for the Bakken Formation oil and gas area. Limited housing supply in the immediate vicinity of the oil and gas activity is affecting adjacent housing markets located along accessible highway and Interstate routes as workers commute from greater distances or bring family members to live in nearby communities. The recent experience in Minot (Ward County), North Dakota, is a good example. Ward County is located in the oil and gas area of North Dakota, although it is not one of the counties experiencing the fastest oil production growth: a total of 38,845 barrels of oil was produced in 2011, less than 1 percent of the state total and resident employment increased 0.9 percent annually from 2010 through 2011. Ward County is benefitting from increased oil production elsewhere however, as the population grew 3.2 percent annually from 2010 through 2011.The commute from Minot to Williston at the center of the most active area is a 125-mile, 2-hour drive along US Highway 2. The viability of this drive during North Dakota's winters is of concern.

Rental market data are difficult to acquire for eastern Montana and western North Dakota, but anecdotal evidence shows that rent growth in these areas is continuing to outpace construction. The GOTF surveyed apartment complexes in Williston, North Dakota, during August 2011 and found that most apartment complexes in the region were constructed during the previous oil boom of the 1980s. The newest complexes (2008 and 2010) were asking $950 to $1,060 for a one-bedroom/one-bathroom unit, $1,145 to $1,310 for a two-bedroom/two-bathroom unit, and $1,270 to $1,430 for a three-bedroom/two-bathroom unit. A report in August 2011 cited a similar figure of $1,200 for a newer two-bedroom unit in Tioga, located approximately 50 miles northeast of Williston. Current rental listings in the area include several two-bedroom units ranging from $2,100 to $2,800, a three-bedroom/two-bathroom duplex unit available for $3,150, and a four-bedroom unit in the basement of a house for $3,000. These rent levels would be comparable to new complexes in larger metropolitan areas in the United States.

Affordability issues are hampering county and city efforts to expand services to meet the needs of a growing population base and maintain services for current residents. McVay Elementary School in Williston is reopening for the 2012-13 school year with an expected increase of 1,200 students in the school district. "We are hiring 52 new teachers," District 1 Superintendent Viola LaFontaine said. "The problem is trying to find affordable housing for them. A new teacher's starting salary is $31,000 a year. We have two four-plex buildings. We are going to ask for the new teachers to share a room with another teacher. It will help some, but affordable housing is an obstacle."[4]

During the past 2 years, two Section 8 projects opted out of their rental assistance contracts: a 30-unit project in Williams County and a 96-unit project in Ward

County. The Ward County project had been renting a two-bedroom unit for $485 a month and, after the change to market-rate units, the project increased the rent to $1,100 a month for the same unit. Although the subsidized tenants received Tenant Protection Vouchers, the large rent increase forced tenants to move from the project. In response to a lack of affordable housing options, Williston is converting an old junior high school into 44 units of housing for low-income seniors, at a cost of $8.5 million. The project will be funded in part by federal housing assistance.

Housing Choice Voucher holders are finding that the disparity between the payment standard applicable for a unit with a particular number of bedrooms and the asking rent of a unit with that number of bedrooms in the market is increasing, making it difficult to find a unit to occupy. North Dakota public housing authorities (PHAs) are having trouble using the total number of vouchers permitted with available funding because of rising per-unit rental costs. During 2011, the seven PHAs closest to the oil production area in the state leased only 56 percent of their Housing Choice Voucher Unit Months Available (UMA) because of funding constraints and housing availability. By comparison, the rest of North Dakota PHAs leased 84 percent of UMA and HUD Rocky Mountain Region VIII PHAs leased 89 percent.

Niobrara Formation Area Housing Markets. In the Niobrara drilling area in Colorado, the relative proximity of two fairly large cities, Fort Collins and Loveland, in addition to Greeley, has eased some of the pressure on housing. Greeley is the largest city in Weld County, and Fort Collins and Loveland are about 20 miles to the west of Greeley. The existing rental stock in these areas has been able to absorb the influx of workers to the region thus far. Average rents in the Fort Collins-Loveland MSA, however, have increased 14 percent, to $1,000 a month, during the first quarter of 2012 compared with rents a year earlier. In addition, the Fort Collins-Loveland MSA had a vacancy rate of 3 percent, down from 4 percent a year earlier. Hotel occupancy rates are increasing, and local recreational vehicle (RV) parks are full.

Permian Basin Shale Formation Area Housing Markets. According to an article by Lyxan Toledanes, published in the Odessa American,[5] the housing and hotel markets are extremely tight. The article cites Hoxie Smith, director of the Petroleum Professional Development Center at Midland College and also a consultant with Summit Power Group Texas, as stating that "you just can't find a place to live in Midland-Odessa," and that crew and work camps are becoming options as traditional housing options are running out. The article also cites Molly Thorn, of the Convention and Visitor's Bureau State Association Sales, as stating that "the lack of traditional housing opportunities has relegated many incoming workers to temporary housing, such as hotels and RV parks." County Judge John Farmer is also cited as stating that Crane County, Texas, has applied for "sewer and water grants from the United States Department of Agriculture to develop land north of the city limits" and that there would be housing development if the necessary infrastructure was there.

Marcellus Shale Formation Area Housing Markets. In the Northern Tier portion of the Marcellus Shale area in Pennsylvania, PHA officials, along with a housing advocacy group, cited a shortage of affordable housing and large rent increases as a result of drilling and exploration activity. The Northern Tier area is rural and had a limited supply of housing before any exploration or drilling. The GOTF is attempting to gather data from affected PHAs.

PHAs in North Dakota and Texas have applied for emergency payment standards for operating the Section 8 Housing Choice Voucher programs in their jurisdictions at rents higher than allowed under normal regulations.

Other Effects: Local officials have raised a number of other concerns. For example, the current transportation infrastructures in rural North Dakota and Montana were not designed or built to accommodate the current daily volume of heavy trucks and rail shipments. North Dakota Department of Transportation estimates indicate that vehicle-miles traveled (VMTs) had historically increased at an annual rate of 3 to 4 percent. From 2010 through 2011, however, VMTs on state highways grew by 9 percent overall and by more than 29 percent in oil and gas counties. Truck traffic on U.S. Highway 85 (which runs north to south, connecting Williston in Williams County, Watford City in McKenzie County, and Bowman in Bowman County) increased by 124 percent.[6] The Upper Great Plains Institute of Transportation at North Dakota State University estimates that additional road investments of $907 million for oil-affected roads during the next 20 years will be needed to maintain industry activity.[7] Heavy use and deterioration of roads is reported elsewhere in the formations being monitored, but specific data are not yet readily available.

Solutions for the Housing Shortages

As mentioned previously, oil and gas companies and subcontractors are increasingly resorting to workforce housing—camps and lodges—to provide places for their workers to stay while in a work area. Many workers remain in the area for weeks or months, with breaks to return to their place of residence or elsewhere, then come back to work another term in the oil and gas fields.

In the Bakken Formation area, workforce housing plays a critical role in meeting the demand for oil and gas

workers' housing, particularly in western North Dakota. Williams County has a camp capacity for approximately 9,000 beds, and Mountrail County has a capacity for about 4,000 beds. Williams, Mountrail, and Dunn Counties all declared moratoriums on new camp development in 2011 because of concerns that the existing infrastructure was already operating at or beyond capacity. The Dunn County Board of County Commissioners lifted the moratorium on June 1, 2012, and allowed the Planning and Zoning Board to determine the requirements for new developments. On June 5th, the Dunn County Planning and Zoning Board endorsed plans by Five Diamond Funds Managers to build a new 500-bed camp and expand an existing Target Logistics workforce camp by 400 beds. Figure 10 shows a workforce lodge with 200 one-bedroom units completed in December 2010 in the Williston, North Dakota area and operated by ATCO Structures & Logistics.

In the Eagle Ford Shale area, workforce camps and lodges have been developed. One such workforce camp is located in Dimmit County—81 miles north of Laredo. Figure 11 shows an unnamed crew camp with 20 mobile homes 15 miles south of Carrizo Springs, Texas, on U.S. Highway 83.

Figure 10. Workforce lodge with one-bedroom units, Williston, North Dakota area

Photo courtesy of the Associated Press

Figure 11. Crew camp with mobile homes, south of Carizzo Springs, Texas

Photo courtesy of Tim McDonald, GOTF member

Figure 12 shows the 96-unit Energy Lodge in Carrizo Springs, Texas.

Within the Marcellus Shale Formation area, Chesapeake Energy Corporation developed a $7 million housing and training facility in Bradford County, Pennsylvania. The facility houses 276 workers (Figure 13). Smaller size workforce camps have been developed in West Virginia.

Data Issues, Constraints, and Needs

Notwithstanding the value of the previously mentioned information, particular issues concerning the available data make it difficult to assess the effect of oil and gas industry activities on a housing market area, especially

Figure 12. Energy Lodge, Carrizo Springs, Texas

Photo courtesy of Tim McDonald

Figure 13. Housing and training facility, Bradford County, Pennsylvania

Photo courtesy of Chesapeake Energy Corporation

the determination of housing needs and demand. Available employment data have certain characteristics that present some challenges to the GOTF in conducting an analysis.

Monthly job payroll data are available from the BLS. The data are based on a Census Bureau survey that obtains employment levels from employers across the country. These data are reported by place of employment and direct employment, including those employees of a firm that are contracted out to work on the site of another employer. If neither the direct employer nor the employer of record overseeing the actual work site is located within a particular shale area, it is unlikely that the jobs in an oil and gas area will be reported in the statistics for the county, or counties, in the area. The nature of the oil and gas jobs in the specific areas being studied is such that a very small proportion of the jobs—and thus the change in job levels—is being reported in the statistics for the areas where the activity is occurring. One situation in which such jobs would likely be included is a local company being hired to provide subcontracted materials or services (for example, onsite cleanup, meals). It is more likely, however, that the direct hires of companies or services related to increased oil and gas industry activity would show up in the employment data of the small metropolitan cities nearby or wherever the subcontractors' offices are physically located rather than in the county where the work sites are located.

Resident employment data are also available from BLS. These data are obtained by a monthly Census Bureau survey of the number of people in a household who worked during a week. Because the data reflect where people live and not the physical location of the job, we would expect it to be more useful in our analysis. The character of upstream petroleum industry jobs, however, is that workers come from all over the country to work in the oil and gas fields, so a significant portion of the change in employment will be reported in the county data of permanent residence of the workers rather than in the location of their short-term housing nearer the job site.

As an example of how the statistical methods undercount oil and gas workers, consider a worker whose permanent residence is in Beaumont (Jefferson County), Texas, who is hired by a contractor or subcontractor, whose primary office is located in Houston (Harris County), Texas, to work in the Bakken Formation fields in Williams County, North Dakota. This worker would not show up in Williams County, North Dakota payroll or resident employment statistics. Instead, this worker would show up in job payroll data for Harris County, Texas (the location of the contractor and subcontractor), and in the resident employment data for Jefferson County, Texas.

The Census Bureau conducts the official complete Census of Population and Housing decennially (most recently in April 2010). In addition, the Census Bureau conducts an annual sample survey (of about 3 million households) called the American Community Survey (ACS). For this count, questionnaires (similar to the 2000 and previous decennial census "long-form" questionnaires) are sent to a sample of households in every county across the country. Data are compiled and released for 1-year, 3-year, and 5-year estimates.[8] For many counties in the areas on which the GOTF is focused and recording data, only 5-year detailed data are available because of small sample sizes related to the areas' small populations.

Beyond the data constraints of the sample size is the problem of how gas and oil workers are counted. The Census Bureau counts people by where they reside (or live). People in motels, hotels, and other temporary residences would not be counted in either the decennial or ACS data. In both cases, the mail surveys would be sent to residence addresses. In such cases, workers would be away from their permanent residence but would be counted at their home.

The same employee in the previous example, working for a month or even 1 to 2 years in the Bakken Formation field but living in a motel, local housing rented out for such occupancy by the employer, or a workforce camp, would likely report the residence for the ACS count as Beaumont, Jefferson County, Texas. Only if the worker were to obtain a housing unit locally and become a resident household in Williams County, North Dakota (for example, by signing an individual lease or buying a house), would he or she respond to the ACS and be counted as a resident of Williams County, North Dakota.

Another possibility could record the presence of this worker in the population count for Williams County, North Dakota. If the Census Bureau includes workforce camps in its ACS, and the respondent for the owner or manager of the workforce camp receives, completes, and returns the ACS questionnaire, it is possible that the entire facility would be included in the ACS "group quarters" data. The group quarters category typically includes college dormitories, prisons, military barracks, and similar facilities. A critical factor here for newly added workforce camps is that the Census Bureau becomes aware of them, includes them in the mail-out survey, and receives a completed survey in reply.

Conclusion

Through the efforts of the GOTF, HUD now has a foundation for understanding the effect of oil and gas energy exploration and production on U.S. housing markets and HUD programs. Despite a long history of domestic drilling activity, recent technological advances have increased access to new shale oil and gas formations across the United States and renewed interest in onshore drilling activity. The effect of recent activity is still evolving and varies by geography and type of formation. Data constraints do not allow for the traditional housing market analysis EMAD completes on a housing market area, because population and employment data do not fully evidence the actual growth and effect on the affected areas, despite the significant growth in the same counties in oil and gas production activity. With continued analysis, research, and experience, the task force is committed to developing a methodology for assessing the effect of oil and gas production on an area's existing housing stock, housing demand, and HUD programs and resources.

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Notes

[1] The word *play* refers to the extent of a gas- or petroleum-bearing formation.

[2] Pronounced *pee-yance*.

[3] PricewaterhouseCoopers LLP (May 2011).

[4] Matthews (2012).

[5] Toledanes (2012).

[6] NDDOT/PAM (2012).

[7] Tolliver and Dybing (2010).

[8] In general, the Census Bureau releases ACS 1-year tabulations for areas with populations of 65,000 or more, 3-year tabulations for areas with populations of 20, 000 or more, and 5-year tabulations for all areas.