

Natural Gas Production Report

Q1

January to March 2019

Production Trends

For the first quarter of 2019, recent data from the Pennsylvania Department of Environmental Protection (DEP) show that total natural gas production volume was 1,655.4 billion cubic feet (bcf) (see **Table 1**). Compared to the first quarter of 2018, total production grew by 14.7 percent. Despite decelerating from the previous two quarters, production growth continued to show significant strength.

Table 1: Production Volume (bcf)

	First Quarter			Calendar Year		
	2018	2019	Growth	2018	2019	Growth
Horizontal	1,441.3	1,653.9	14.7%	1,441.3	1,653.9	14.7%
Vertical	<u>2.0</u>	<u>1.6</u>	<u>-23.0%</u>	<u>2.0</u>	<u>1.6</u>	<u>-23.0%</u>
Total	1,443.4	1,655.4	14.7%	1,443.4	1,655.4	14.7%

Table 2 decomposes first quarter and calendar year production volume from horizontal wells by spud year. All of the production growth for the quarter was from wells spud in 2017 and 2018. These wells comprised more than one-third of all production for the quarter (37.2 percent). Wells spud in 2014 showed the largest decline in production (-22.4 percent) and production from wells spud in 2013 or earlier declined by 10.2 percent.

Table 2: Production Volume by Spud Year (bcf)

Spud Year	First Quarter				Calendar Year			
	2018	2019	Growth	Share	2018	2019	Growth	Share
2019	n.a.	0.2	n.a.	0.0%	n.a.	0.2	n.a.	0.0%
2018	0.0	217.0	n.a.	13.1%	0.0	217.0	n.a.	13.1%
2017	195.8	398.0	103.3%	24.1%	195.8	398.0	103.3%	24.1%
2016	250.2	198.5	-20.7%	12.0%	250.2	198.5	-20.7%	12.0%
2015	182.2	143.6	-21.2%	8.7%	182.2	143.6	-21.2%	8.7%
2014	276.2	214.5	-22.4%	13.0%	276.2	214.5	-22.4%	13.0%
2013	171.2	146.8	-14.3%	8.9%	171.2	146.8	-14.3%	8.9%
2012	<u>365.6</u>	<u>335.3</u>	<u>-8.3%</u>	<u>20.3%</u>	<u>365.6</u>	<u>335.3</u>	<u>-8.3%</u>	<u>20.3%</u>
Total	1,441.3	1,653.9	14.7%	100.0%	1,441.3	1,653.9	14.7%	100.0%

Notes: Horizontal wells only. This table displays 2018 and 2019 production based on the year wells were spud. For example, wells with spud year 2014 were spud during calendar year 2014, and their production is shown for the first quarter of 2018 and the first quarter of 2019. Spud year 2012 includes all wells spud in 2012 or earlier.

Figure 1 displays horizontal well production over the last nine quarters. From the first quarter of 2017 to the first quarter of 2019, horizontal production increased by 26.3 percent. There has been a quarter-over-quarter increase in horizontal production in eleven consecutive quarters.

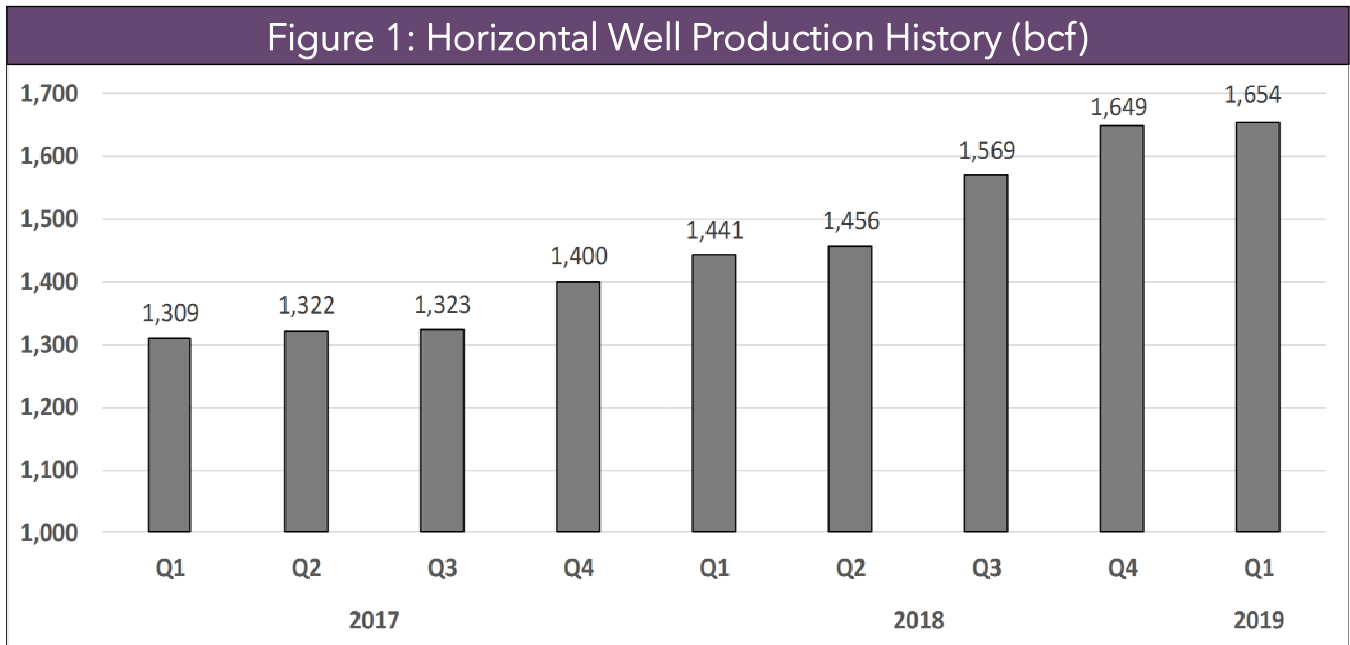
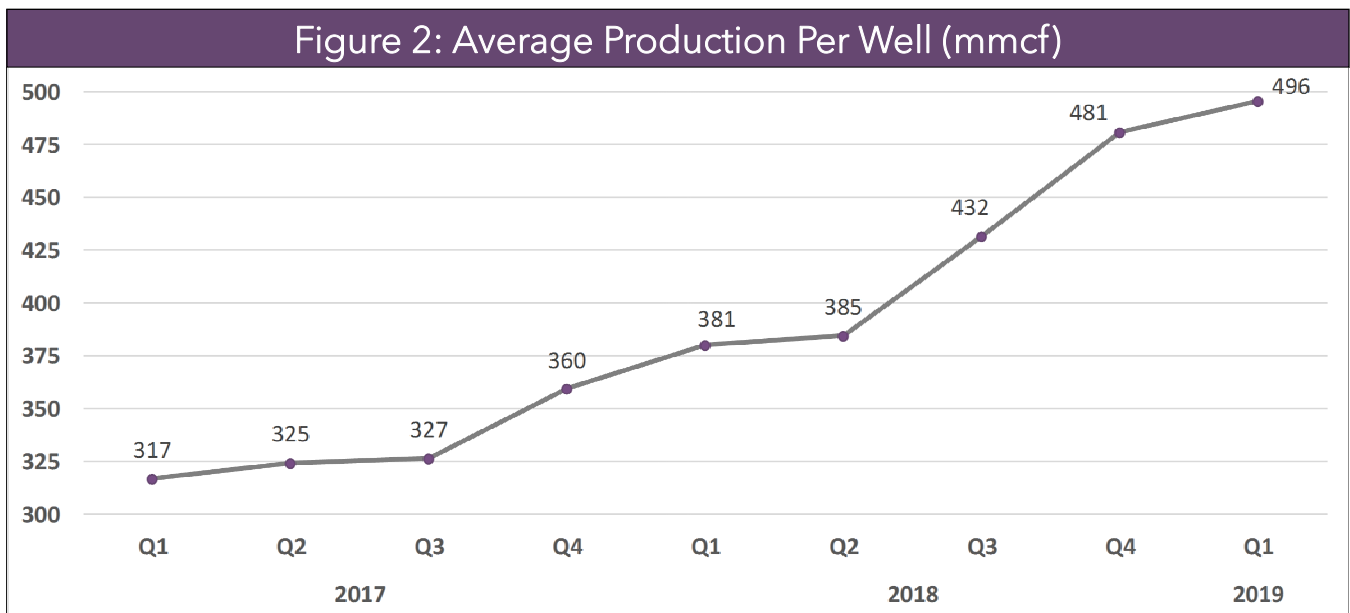


Figure 2 displays the average production per well for selected horizontal wells. Each data point in this figure represents horizontal wells that (1) were spud at least three quarters before the reporting period and no earlier than 12 quarters before that date and (2) produced above 90 mcf per day (i.e., did not qualify for stripper well status). From the first quarter of 2017 to the first quarter of 2019, average production per well increased by 56.4 percent. There has been a quarter-over-quarter increase in average production per well in ten consecutive quarters.



Well Count Trends

Table 3 displays the number of wells in the first quarter of 2019 and provides a breakdown based on well type (horizontal vs. vertical) and production status. There were 8,765 producing horizontal wells in the first quarter, a 10.7 percent increase over the prior year. Total producing wells increased by 9.9 percent compared to the prior year. Total non-producing wells decreased by 1.9 percent compared to the prior year.

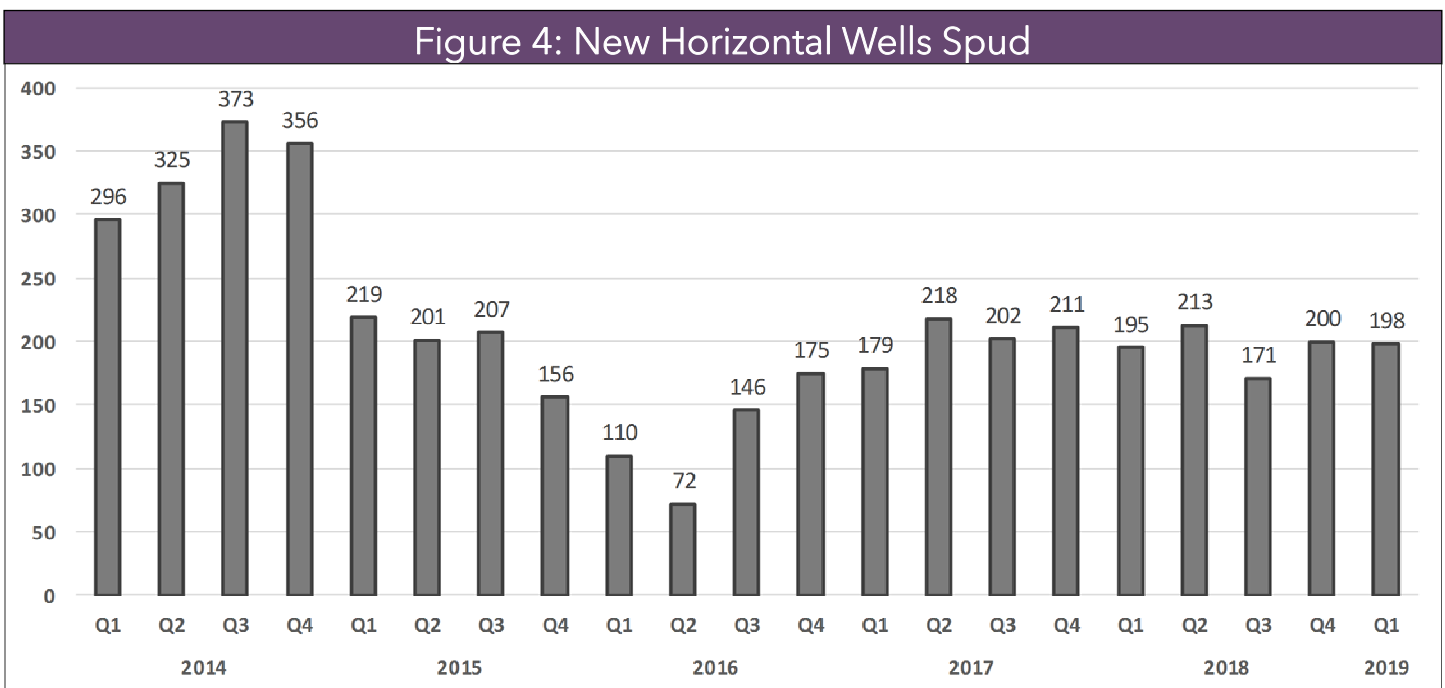
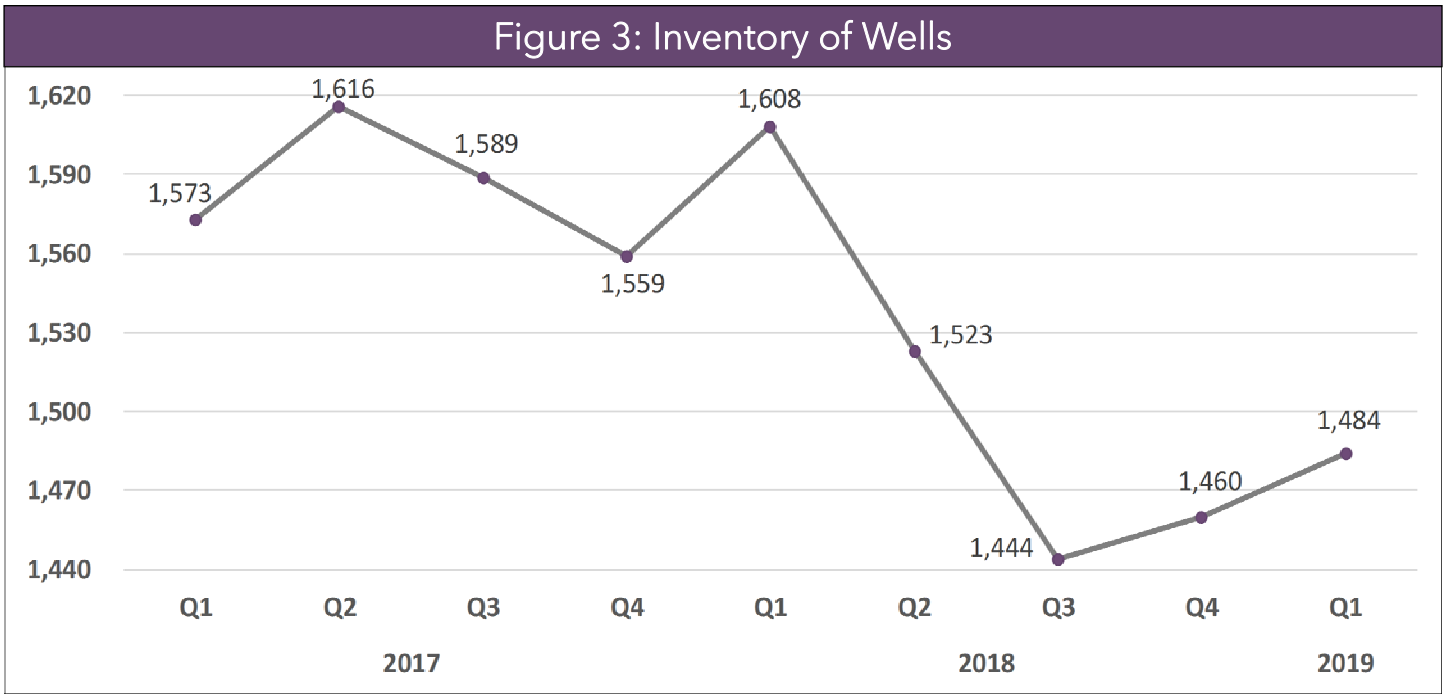
Table 3: Number of Wells, First Quarter									
	Producing			Non-Producing			Total		
	2018	2019	Growth	2018	2019	Growth	2018	2019	Growth
Horizontal	7,916	8,765	10.7%	2,209	2,141	-3.1%	10,125	10,906	7.7%
Vertical	<u>494</u>	<u>478</u>	<u>-3.2%</u>	<u>505</u>	<u>522</u>	<u>3.4%</u>	<u>999</u>	<u>1,000</u>	<u>0.1%</u>
Total	8,410	9,243	9.9%	2,714	2,663	-1.9%	11,124	11,906	7.0%

Table 4 shows a history of well counts broken down by well type and production status over the last nine quarters. It also provides detail for non-producing horizontal wells. Since the first quarter of 2017, total producing wells increased by 20.1 percent, while total non-producing wells increased by 2.4 percent.

Table 4: Quarterly Well Count History									
	2017				2018				2019
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Producing Wells									
Horizontal	7,204	7,347	7,582	7,778	7,916	8,197	8,431	8,606	8,765
Vertical	<u>495</u>	<u>506</u>	<u>494</u>	<u>493</u>	<u>494</u>	<u>483</u>	<u>488</u>	<u>486</u>	<u>478</u>
Total	7,699	7,853	8,076	8,271	8,410	8,680	8,919	9,092	9,243
Non-Producing Wells									
Horizontal	2,098	2,173	2,139	2,154	2,209	2,140	2,077	2,102	2,141
Vertical	<u>503</u>	<u>492</u>	<u>505</u>	<u>506</u>	<u>505</u>	<u>517</u>	<u>512</u>	<u>514</u>	<u>522</u>
Total	2,601	2,665	2,644	2,660	2,714	2,657	2,589	2,616	2,663
Horizontal Detail									
Shut In	842	832	778	854	843	747	722	756	733
Spud, Not Completed	731	784	811	705	765	776	722	704	751
Plugged	497	534	544	588	593	610	621	639	646
Other	<u>28</u>	<u>23</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>12</u>	<u>3</u>	<u>11</u>
Total	2,098	2,173	2,139	2,154	2,209	2,140	2,077	2,102	2,141

Notes: All characterizations of wells are based on information submitted by the operator or DEP. "Other" includes wells with miscellaneous designations such as abandoned.

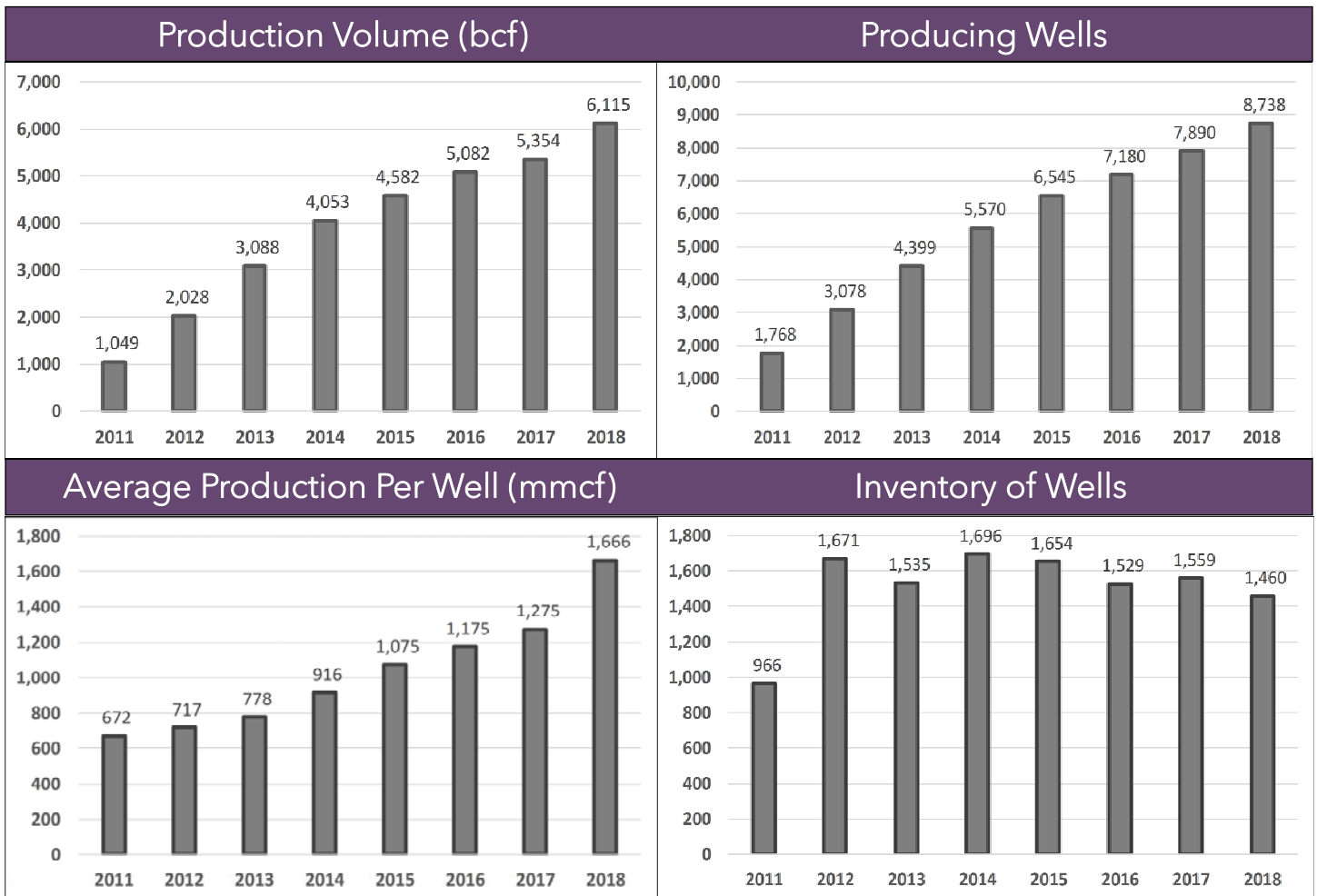
Figures 3 and 4 display recent trends in well counts. Figure 3 shows the quarterly history of the inventory of wells in Pennsylvania. Well inventory includes horizontal wells that are in the “Shut In” or “Spud, Not Completed” categories from Table 4. These are wells that are already spud and considered available to be brought into production in the future. The inventory of wells for the first quarter of 2019 increased by 24 wells (1.6 percent) from the previous quarter. Figure 4 displays the number of new horizontal wells spud in each quarter over the last five calendar years. For the first quarter of 2019, there were 198 new horizontal wells spud, an increase of 3 wells (1.5 percent) from the same period in the prior year.



Annual Trends

The following graphs display annual totals for production volume, producing well counts, average production per well and inventory well counts (i.e., non-producing wells that could produce at some point in the future). These graphs pertain only to horizontal production and well counts. All figures are based on DEP data for the full calendar year.

For 2018, production volume was 6,115 bcf, an increase of 14.2 percent from the prior year. From 2011 to 2018, production volume increased at an average rate of 28.6 percent per annum. The number of producing wells was 8,738, which was 10.7 percent higher than 2017. From 2011 to 2018, the number of producing wells grew at an average rate of 25.6 percent per annum. Average production per well in 2018 was 1,666 mmcf, an increase of 30.7 percent over 2017. The cumulative increase of average production from 2011 to 2018 was 147.9 percent (13.8 percent per annum). The inventory of wells was 1,460 in 2018, a decrease of 6.4 percent from 2017. From 2012 to 2018, the inventory of wells decreased at an average rate of 1.9 percent per annum.



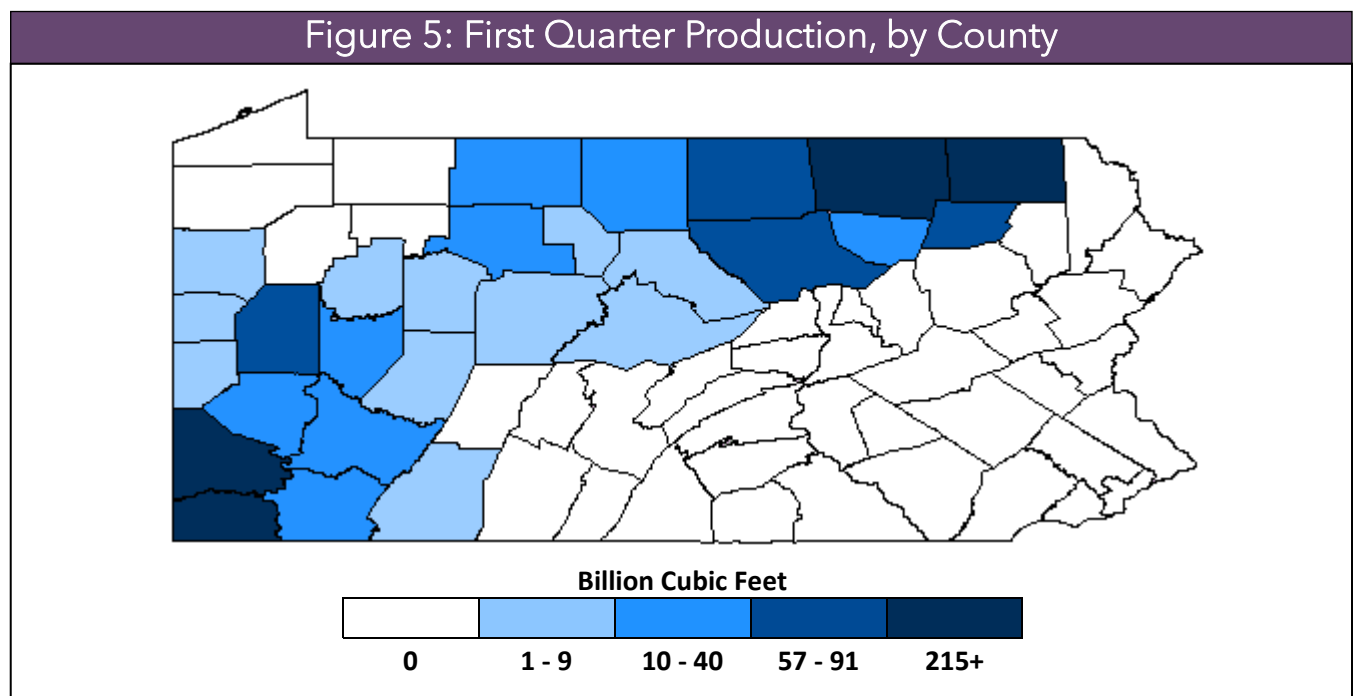
Notes: Producing wells represents the number of wells that produced gas at any point during the year. Average production per well represents horizontal wells that produced above the stripper well threshold of 90 mcf per day and were spud in any of the previous three years. Inventory of wells represents the number of wells that did not produce gas at any point during the year and were characterized as shut in or spud but not completed at the end of the listed calendar year.

County Comparison

Table 5 shows county-level production volume and producing well counts for the first quarter of 2018 and 2019. Four counties (Susquehanna, Washington, Greene and Bradford) comprised over two-thirds of statewide production. Among those in the top ten, all counties except Wyoming registered production gains. **Figure 5** displays a map of calendar year production by county.

Table 5: First Quarter Production, by County									
Rank	County	Production Volume (bcf)				Number of Producing Wells			
		First Quarter		2019 Metrics		First Quarter		2019 Metrics	
		2018	2019	Share	Growth	2018	2019	Share	Growth
1	Susquehanna	349.2	408.9	24.7%	17.1%	1,214	1,364	15.6%	12.4%
2	Washington	281.9	293.2	17.7%	4.0%	1,377	1,509	17.2%	9.6%
3	Greene	170.8	243.1	14.7%	42.4%	875	1,022	11.7%	16.8%
4	Bradford	174.1	215.0	13.0%	23.5%	1,089	1,213	13.8%	11.4%
5	Lycoming	83.6	91.4	5.5%	9.4%	767	805	9.2%	5.0%
6	Tioga	68.7	75.6	4.6%	10.1%	603	643	7.3%	6.6%
7	Wyoming	96.5	70.2	4.2%	-27.2%	236	245	2.8%	3.8%
8	Butler	50.6	57.1	3.5%	12.8%	395	453	5.2%	14.7%
9	Allegheny	21.4	40.4	2.4%	89.3%	85	114	1.3%	34.1%
10	Sullivan	34.8	38.6	2.3%	10.8%	111	123	1.4%	10.8%
11	All Other	109.7	120.2	7.3%	9.5%	1,164	1,274	14.5%	9.5%

Note: Horizontal wells only. Data shown pertain to the full calendar year.



State Comparison

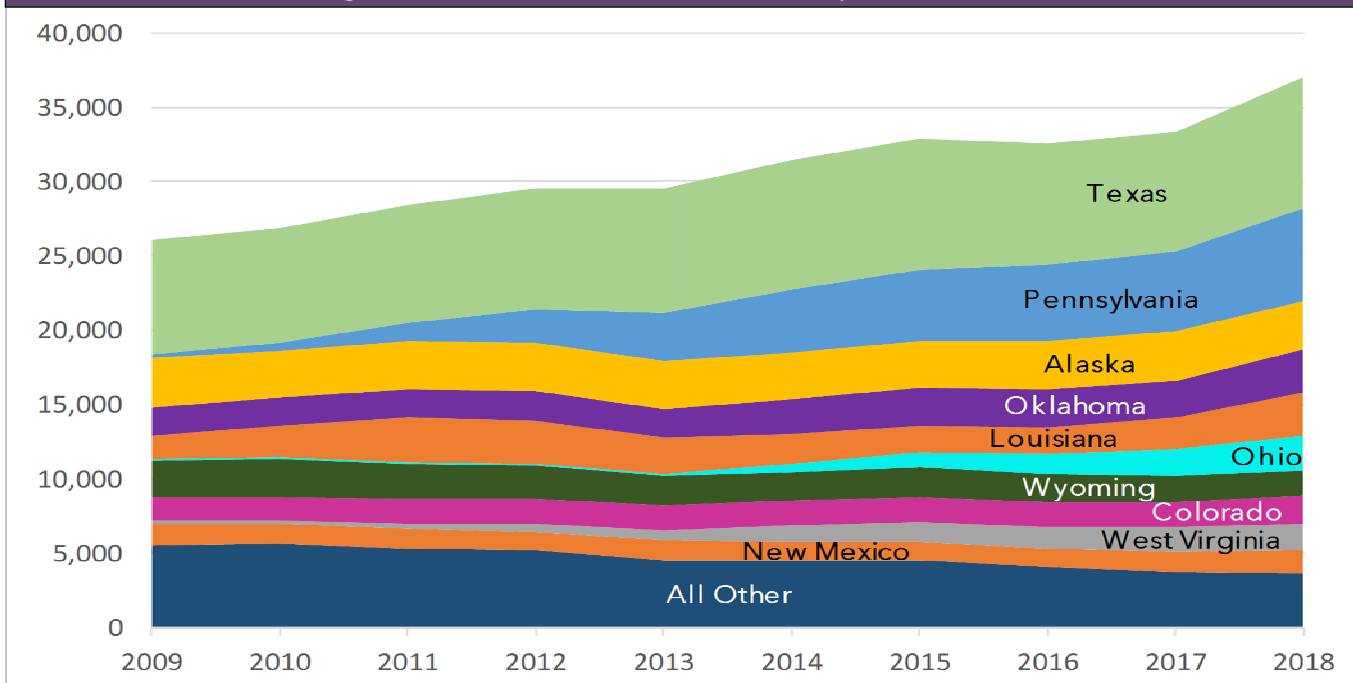
Table 6 provides a state comparison of gross natural gas production from all well types. Among the top-ten producing states, Louisiana and Ohio recorded the largest year-over-year production gains for 2018 while Wyoming was the only state in the top ten to register a decline. **Figure 6** displays the composition of total U.S. production by state over the last decade. National production of natural gas in 2018 grew by 10.9 percent compared to 2017, the largest year-over-year increase on record (since 1980).

Table 6: State Production Comparison (bcf)

Rank	State	Production Volume			Annual Growth Rate		
		CY 2016	CY 2017	CY 2018	CY 2016	CY 2017	CY 2018
1	Texas	8,156.3	7,995.7	8,814.0	-7.3%	-2.0%	10.2%
2	Pennsylvania	5,210.2	5,463.9	6,206.9	8.3%	4.9%	13.6%
3	Alaska	3,230.2	3,250.8	3,254.7	1.7%	0.6%	0.1%
4	Oklahoma	2,468.3	2,513.9	2,946.1	-1.3%	1.8%	17.2%
5	Louisiana	1,793.4	2,147.6	2,829.7	-1.1%	19.8%	31.8%
6	Ohio	1,437.3	1,772.9	2,385.1	42.7%	23.4%	34.5%
7	Colorado	1,688.4	1,687.7	1,830.5	0.0%	0.0%	8.5%
8	West Virginia	1,384.5	1,601.1	1,799.1	5.3%	15.6%	12.4%
9	Wyoming	1,848.6	1,804.7	1,720.9	-7.4%	-2.4%	-4.6%
10	New Mexico	1,282.7	1,324.9	1,524.4	-1.1%	3.3%	15.1%
11	All Other	4,091.8	3,794.2	3,697.4	-9.3%	-7.3%	-2.6%

Source: U.S. Energy Information Administration. Production does not directly correspond to DEP data.

Figure 6: State Production Comparison (bcf)



Glossary of Natural Gas Terminology

Abandoned	No longer producing, but not plugged, and without an available operator.
Bcf	Billion cubic feet. Used as a measure of production volume.
Completed	Capable of producing. Includes drilling and casing and, in the case of an unconventional well, fracturing the shale formation to release gas.
Mcf	Thousand cubic feet. Used as a measure of production volume.
MMcf	Million cubic feet. Used as a measure of production volume.
Plugged	Permanently sealed with cement or by some similar method.
Production	The natural gas recovered from a well.
Shut In	Temporary suspension of production activity. Directly corresponds to the term “capped,” as defined in Act 13 of 2012.
Spud	The commencement of drilling activity. Often refers to the first stage at which casing is placed into the wellbore. “Spud year” refers to the year in which a well was spud, as reported to the Department of Environmental Protection.
Unconventional	Requiring technological methods that go beyond merely drilling a well and capturing the gas. These methods usually include horizontal drilling into deep formations and fracturing with fluids.

About the Report

The IFO publishes this report on a quarterly basis each May, August, November and February for the preceding quarter using monthly production data submitted to DEP by natural gas extractors that operate in the state. Unless otherwise noted, this report uses those data, in conjunction with DEP data on wells spud, to develop statewide tabulations of production volume and well counts. These data pertain only to gas produced from unconventional formations, which include the Marcellus and Utica. The data included in this report are current as of May 28, 2019.