Natural Gas Production Report

Q4

October to December 2018

Production Trends

For the fourth quarter of 2018, recent data from the Pennsylvania Department of Environmental Protection (DEP) show that total natural gas production volume was 1,650.7 billion cubic feet (bcf) (see **Table 1**). Compared to the fourth quarter of 2017, total production grew by 17.7 percent. For the calendar year, total production was up 14.2 percent from the prior year, the largest year-over-year increase in production since 2014.

Table 1: Production Volume (bcf)

	Fourth Quarter			Calendar Year		
	2017	2018	Growth	2017	2018	Growth
Horizontal	1,400.3	1,648.8	17.8%	5,354.3	6,115.1	14.2%
Vertical	1.9	1.8	-6.2%	9.5	8.3	-13.1%
Total	1,402.2	1,650.7	17.7%	5,363.8	6,123.3	14.2%

Table 2 decomposes fourth 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. Wells spud in 2016 or 2017 comprised more than one-third of all production for the quarter (39.5 percent). Wells spud in 2015 showed the largest decline in production (-23.4 percent) and production from wells spud in 2014 or earlier declined by 12.2 percent.

Table 2: Production Volume by Spud Year (bcf)

	Fourth Quarter				Calendar Year			
Spud Year	2017	2018	Growth	Share	2017	2018	Growth	Share
2018	n.a.	114.1	n.a.	6.9%	n.a.	140.3	n.a.	2.3%
2017	107.6	439.3	308.2%	26.6%	134.6	1,322.9	882.9%	21.6%
2016	260.5	212.4	-18.5%	12.9%	617.3	909.2	47.3%	14.9%
2015	203.7	156.0	-23.4%	9.5%	952.3	661.8	-30.5%	10.8%
2014	283.9	230.3	-18.9%	14.0%	1,250.1	1,016.5	-18.7%	16.6%
2013	177.7	150.9	-15.1%	9.1%	789.6	648.3	-17.9%	10.6%
2012	127.2	118.0	-7.3%	7.2%	555.8	481.0	-13.5%	7.9%
2011	239.5	228.0	-4.8%	13.8%	1,054.7	935.1	-11.3%	15.3%
Total	1,400.3	1,648.8	17.8%	100.0%	5,354.3	6,115.1	14.2%	100.0%

Notes: Horizontal wells only. This table displays 2017 and 2018 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 fourth quarter of 2017 and the fourth quarter of 2018. Spud year 2011 includes all wells spud in 2011 or earlier.

Figure 1 displays horizontal well production over the last nine quarters. From the fourth quarter of 2016 to the fourth quarter of 2018, horizontal production increased by 29.1 percent. There has been a quarter-over-quarter increase in horizontal production in eight consecutive quarters.

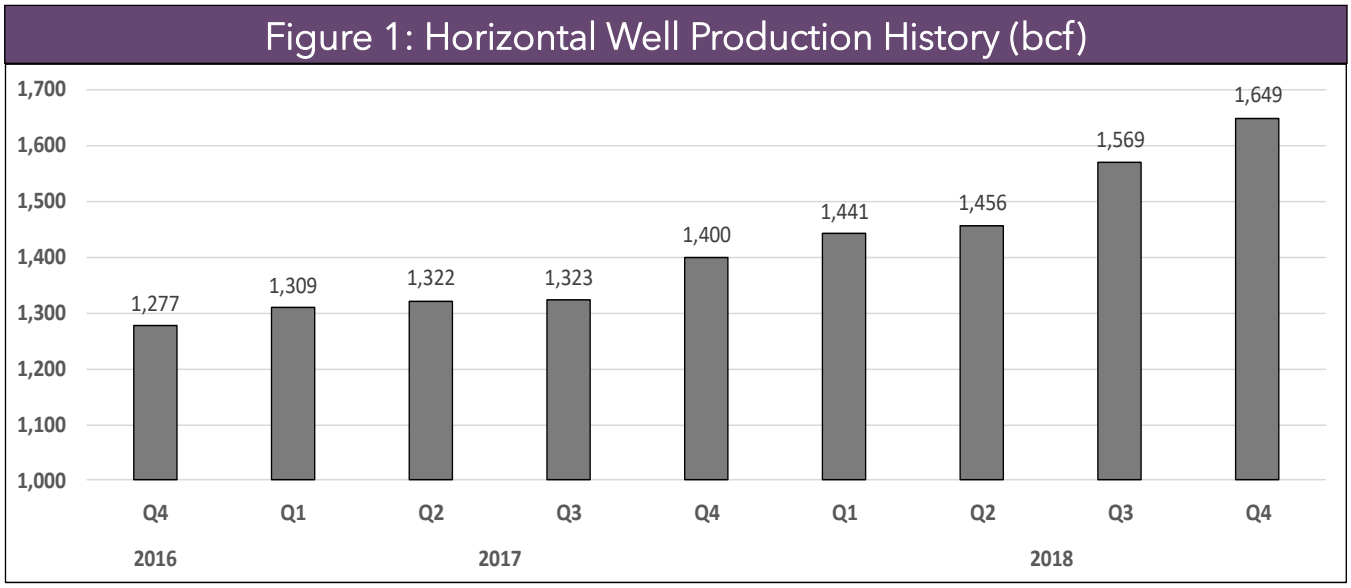
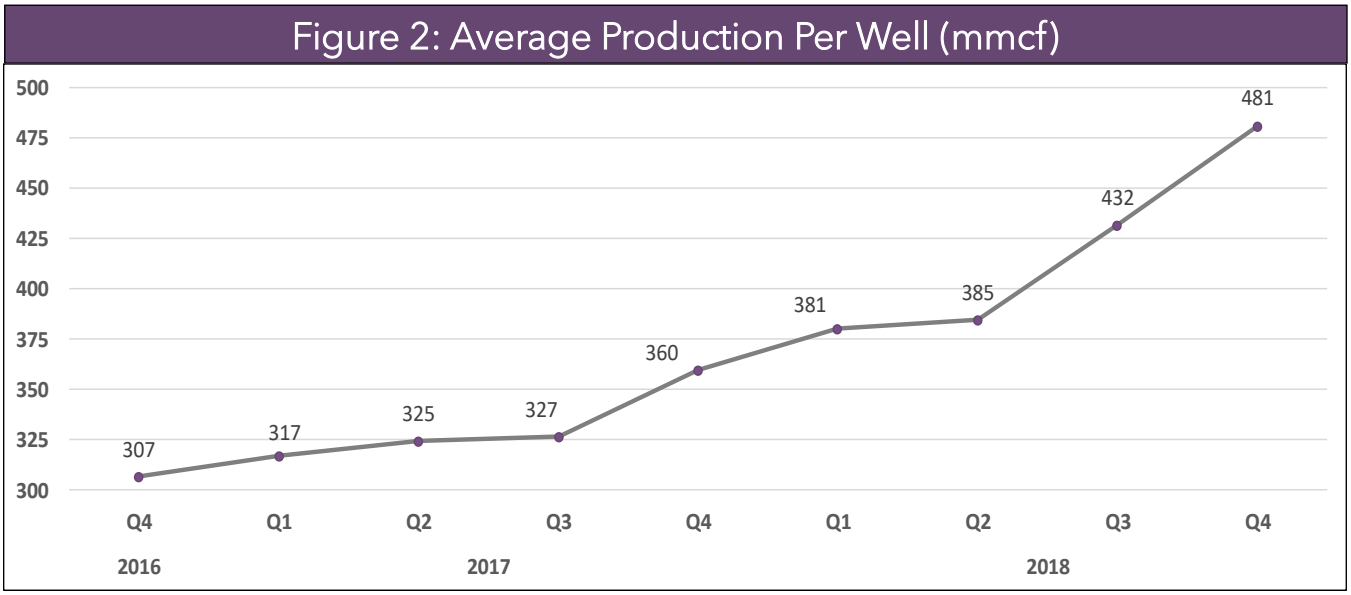


Figure 2 displays the average production per well for selected horizontal wells. Each data point in this figure represents horizontal wells that (1) were spud at least three quarters before the reporting period and no earlier than 12 quarters before that date and (2) produced above 90 mcf per day (i.e., did not qualify for stripper well status). From the fourth quarter of 2016 to the fourth quarter of 2018, average production per well increased by 57.0 percent. There has been a quarter-over-quarter increase in average production per well in eight consecutive quarters.



Well Count Trends

Table 3 displays the number of wells in the fourth quarter of 2018 and provides a breakdown based on well type (horizontal vs. vertical) and production status. There were 8,606 producing horizontal wells in the fourth quarter, a 10.6 percent increase over the prior year. Total producing wells increased by 9.9 percent compared to the prior year. Total non-producing wells declined by 1.5 percent, with horizontal wells declining by 2.3 percent and vertical wells increasing by 1.8 percent.

Table 3: Number of Wells, Fourth Quarter

	Producing			Non-Producing			Total		
	2017	2018	Growth	2017	2018	Growth	2017	2018	Growth
Horizontal	7,778	8,606	10.6%	2,147	2,098	-2.3%	9,925	10,704	7.8%
Vertical	493	485	-1.6%	500	509	1.8%	993	994	0.1%
Total	8,271	9,091	9.9%	2,647	2,607	-1.5%	10,918	11,698	7.1%

Table 4 shows a history of well counts broken down by well type and producing status over the last nine quarters. It also provides detail for non-producing horizontal wells. Since the fourth quarter of 2016, total producing wells increased by 20.1 percent, while total non-producing wells increased by 2.8 percent.

Table 4: Quarterly Well Count History

	2016	2017				2018			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Producing Wells									
Horizontal	7,070	7,204	7,347	7,582	7,778	7,916	8,197	8,431	8,606
Vertical	501	495	506	494	493	494	483	488	485
Total	7,571	7,699	7,853	8,076	8,271	8,410	8,680	8,919	9,091
Non-Producing Wells									
Horizontal	2,046	2,091	2,166	2,132	2,147	2,205	2,136	2,073	2,098
Vertical	491	497	486	499	500	499	511	506	509
Total	2,537	2,588	2,652	2,631	2,647	2,704	2,647	2,579	2,607
Horizontal Detail									
Shut In	820	843	833	780	851	846	751	723	754
Spud, Not Completed	709	727	783	809	719	773	784	736	708
Plugged	485	487	522	532	566	570	583	597	627
Other	32	34	28	11	11	16	18	17	9
Total	2,046	2,091	2,166	2,132	2,147	2,205	2,136	2,073	2,098

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 fall into the "Shut In" or "Spud, Not Completed" categories. These are wells that are already spud and considered available to be brought into production in the future. The inventory of wells for the fourth quarter of 2018 increased by 3 wells (0.2 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 fourth quarter of 2018, there were 200 new horizontal wells spud, which is an increase of 29 wells from the previous quarter and a decrease of 11 wells from the same period in 2017.

Figure 3: Inventory of Wells

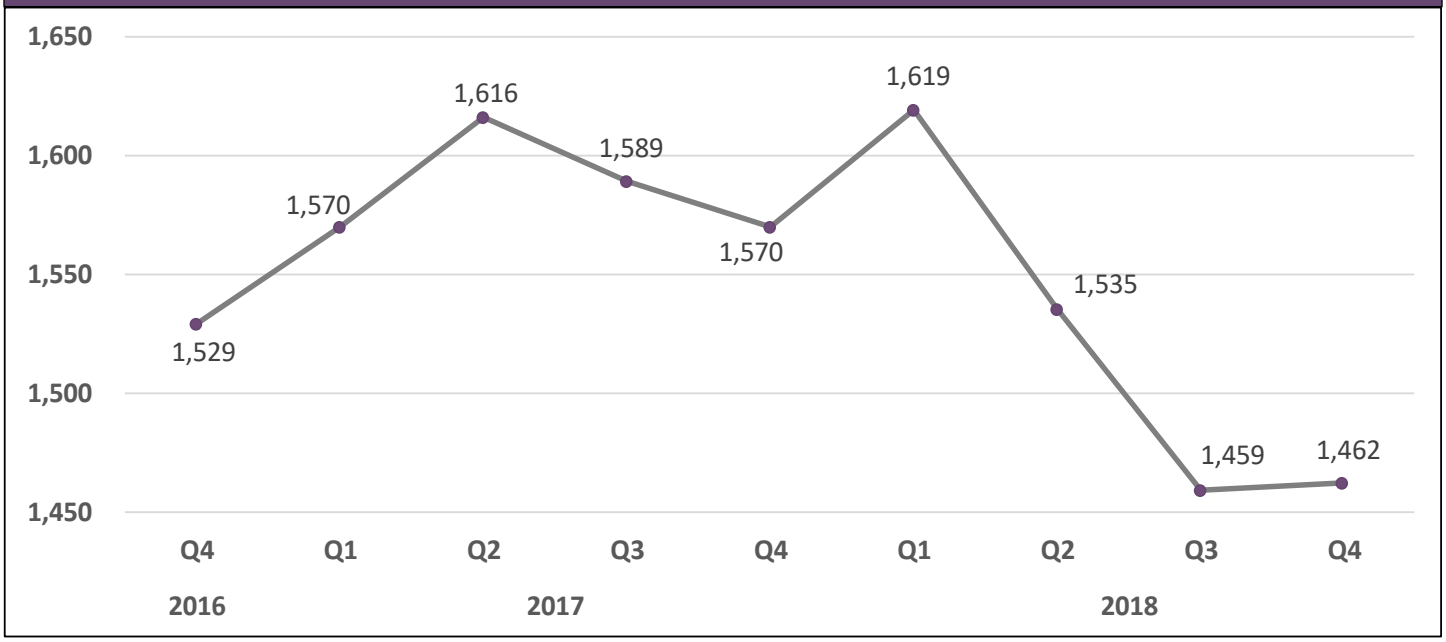
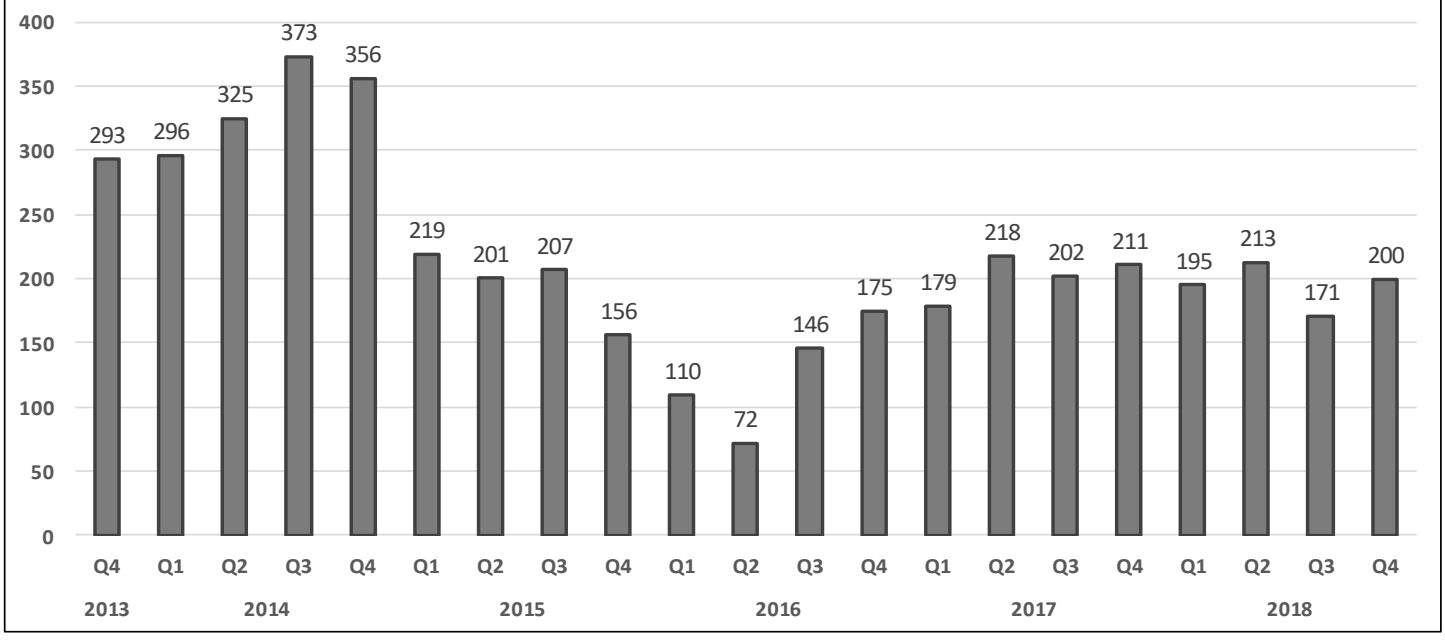


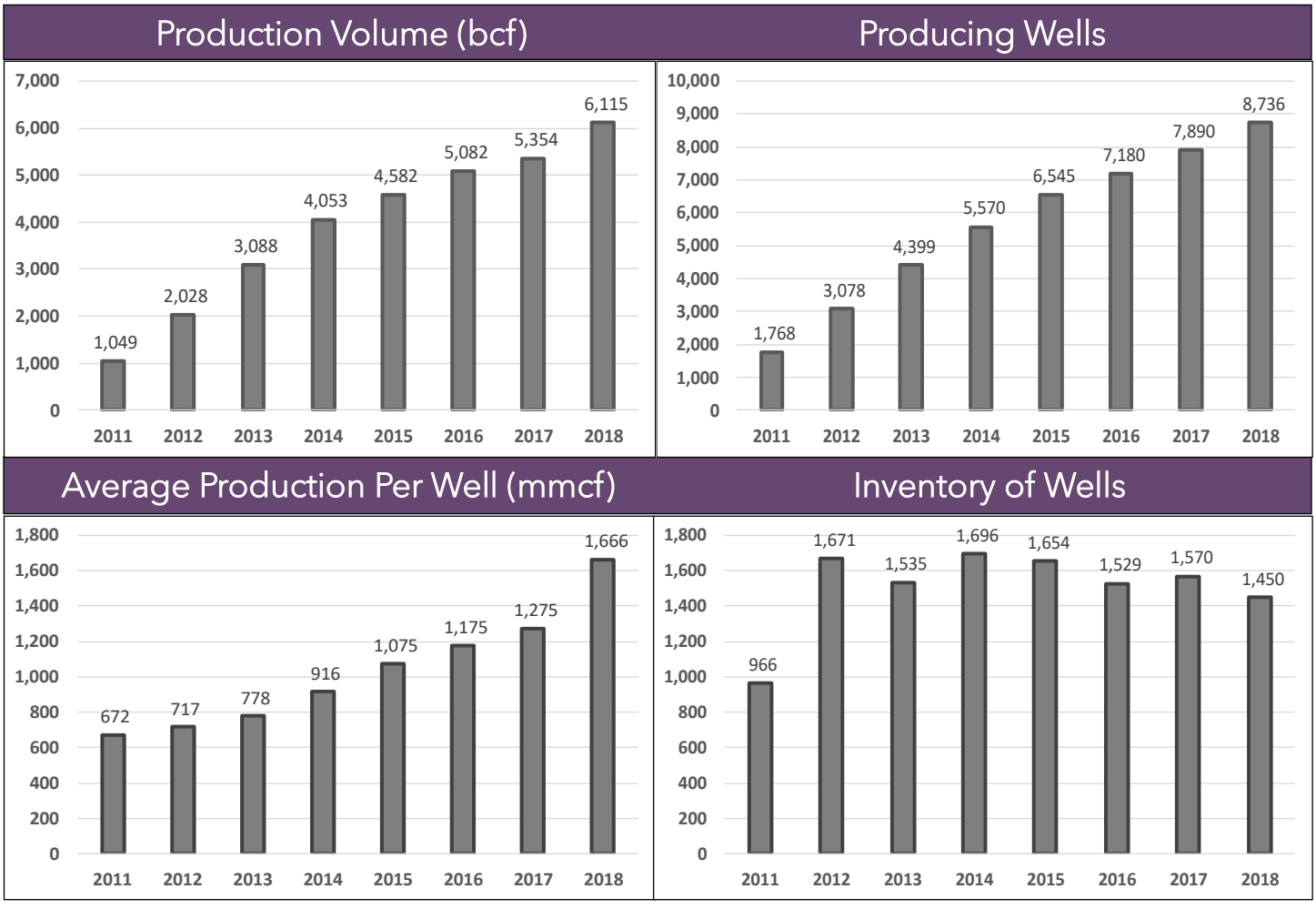
Figure 4: New Horizontal Wells Spud



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, total production 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 8,736, 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 1,450 in 2018, a decrease of 7.6 percent from 2017. From 2012 to 2018, the inventory of wells decreased by an average rate of 2.0 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

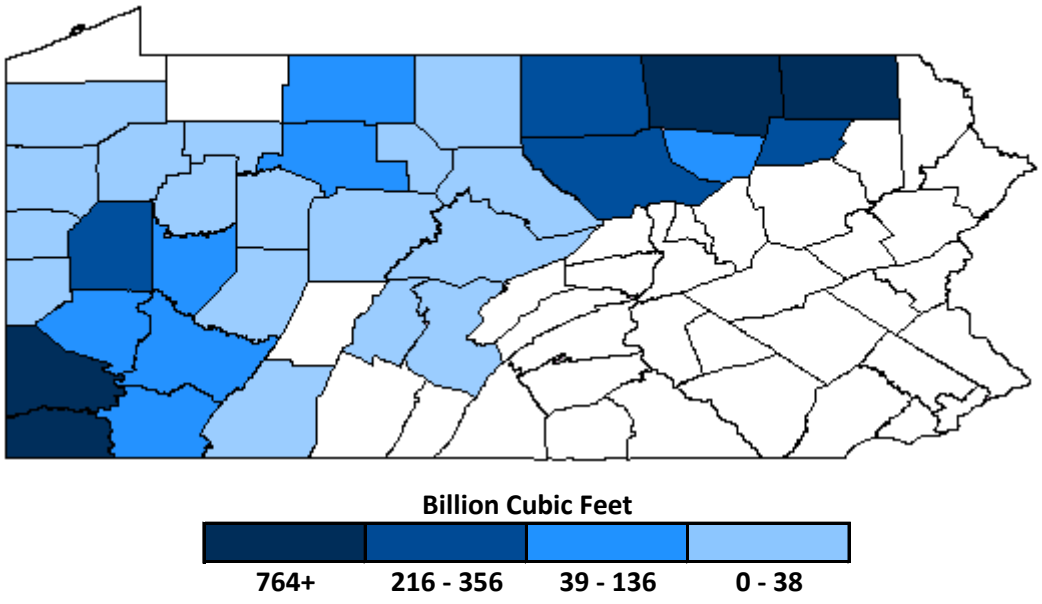
Table 5 shows county-level production volume and producing well counts for the calendar year. Four counties (Susquehanna, Washington, Greene and Bradford) comprised two-thirds of statewide production. Among those in the top ten, all counties except Sullivan and Wyoming registered production gains. **Figure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

Table 5: Calendar Year Production, by County

		Production Volume (bcf)				Number of Producing Wells			
		Calendar Year		2018 Metrics		Calendar Year		2018 Metrics	
Rank	County	2017	2018	Share	Growth	2017	2018	Share	Growth
1	Susquehanna	1,305.1	1,463.3	23.9%	12.1%	1,194	1,347	15.4%	12.8%
2	Washington	945.7	1,164.3	19.0%	23.1%	1,370	1,504	17.2%	9.8%
3	Greene	658.1	797.2	13.0%	21.1%	857	998	11.4%	16.5%
4	Bradford	708.0	764.2	12.5%	7.9%	1,083	1,203	13.8%	11.1%
5	Lycoming	344.2	355.7	5.8%	3.3%	762	816	9.3%	7.1%
6	Wyoming	354.9	344.8	5.6%	-2.8%	232	247	2.8%	6.5%
7	Tioga	220.6	301.4	4.9%	36.6%	625	643	7.4%	2.9%
8	Butler	185.1	216.3	3.5%	16.8%	404	461	5.3%	14.1%
9	Sullivan	139.7	135.3	2.2%	-3.1%	109	124	1.4%	13.8%
10	Allegheny	68.9	106.7	1.7%	54.8%	82	109	1.2%	32.9%
11	All Other	424.1	465.9	7.6%	9.9%	1,172	1,286	14.7%	9.7%

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

Figure 5: Calendar Year Production, by County



State Comparison

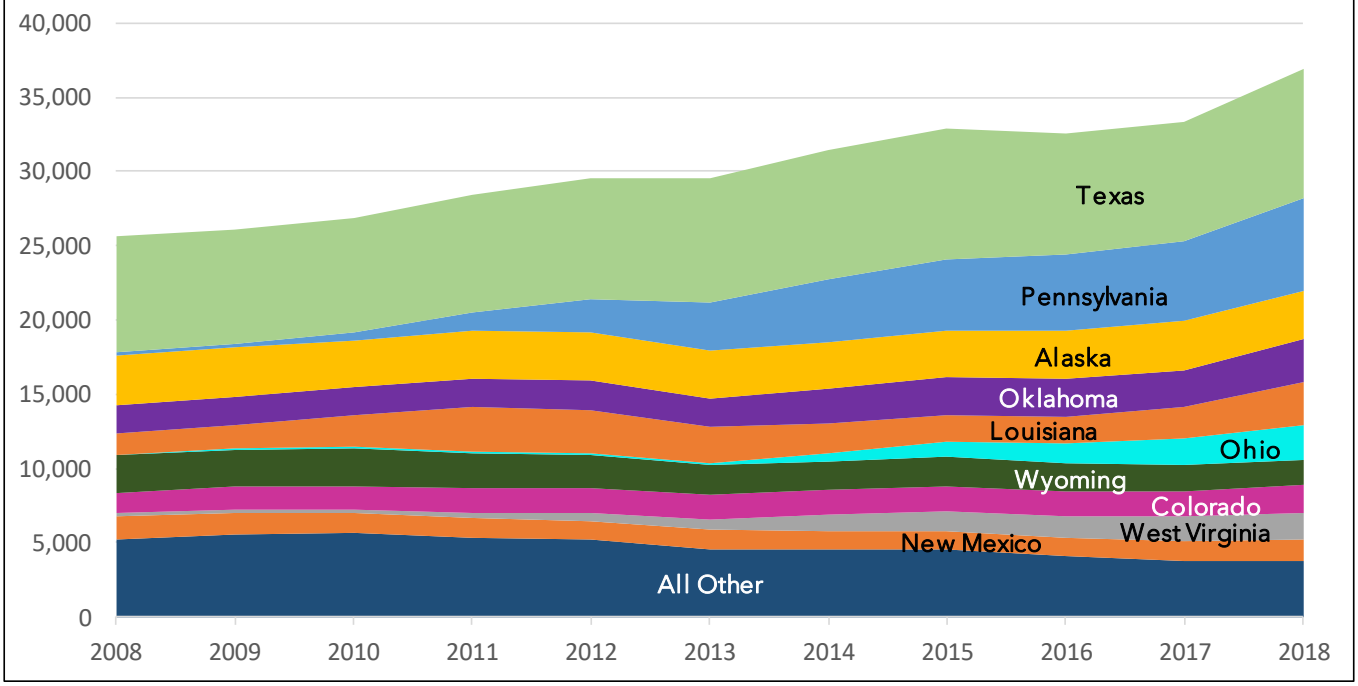
Table 6 provides a state comparison of gross natural gas production from all well types. Among the top-ten producing states, Louisiana and Ohio recorded the largest year-over-year production gains for the first eleven months of 2018 while Alaska and Wyoming were the only states in the top ten to register a decline. **Figure 6** displays the composition of total U.S. production by state over the last decade. Production for December 2018 in Figure 6 is estimated by the IFO.

Table 6: State Production Comparison (bcf)

		Production Volume			Annual Growth Rate		
Rank	State	CY 2016	CY 2017	CY 2018	CY 2016	CY 2017	CY 2018
1	Texas	8,156.3	7,995.7	8,003.7	-7.3%	-2.0%	9.7%
2	Pennsylvania	5,210.2	5,463.9	5,643.2	8.3%	4.9%	13.8%
3	Alaska	3,230.2	3,250.8	2,950.1	1.7%	0.6%	-0.2%
4	Oklahoma	2,468.3	2,513.9	2,679.6	-1.3%	1.8%	17.3%
5	Louisiana	1,793.4	2,147.6	2,577.5	-1.1%	19.8%	33.6%
6	Ohio	1,437.3	1,772.9	2,160.1	42.7%	23.4%	35.1%
7	Colorado	1,688.4	1,687.7	1,664.1	0.0%	0.0%	8.3%
8	West Virginia	1,384.5	1,601.1	1,629.8	5.3%	15.6%	12.2%
9	Wyoming	1,848.6	1,804.7	1,579.2	-7.4%	-2.4%	-4.0%
10	New Mexico	1,282.7	1,324.9	1,383.7	-1.1%	3.3%	12.9%
11	All Other	4,091.8	3,794.2	3,374.9	-1.6%	0.4%	8.0%

Note: CY 2018 includes production through November and the corresponding growth rate is based on the same time period in CY 2017.
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 February 28, 2018.