

Natural Gas Production Report

Q2

April to June 2018

Production Trends

For the second quarter of 2018, recent data from the Pennsylvania Department of Environmental Protection (DEP) show that total natural gas production volume was 1,455.8 billion cubic feet (bcf) (see Table 1). Compared to the second quarter of 2017, total production grew by 9.9 percent. This increase was driven by a 10.0 percent gain in production from horizontal wells, which accounts for nearly all production.

Table 1: Production Volume (bcf)

	Second Quarter			Calendar Year-to-Date		
	2017	2018	Growth	2017	2018	Growth
Horizontal	1,321.9	1,454.0	10.0%	2,631.1	2,895.4	10.0%
Vertical	<u>2.5</u>	<u>1.8</u>	<u>-29.5%</u>	<u>5.2</u>	<u>3.8</u>	<u>-27.1%</u>
Total	1,324.4	1,455.8	9.9%	2,636.3	2,899.2	10.0%

Table 2 decomposes second quarter and calendar year production volume from horizontal wells by spud year. All of the production growth in the second quarter was from wells spud in 2016 and 2017. Wells spud in 2016 or 2017 comprised more than one-third of all production in the quarter (35.4 percent). Wells spud in 2015 showed the largest decline in production (-37.0 percent) and production from wells spud in 2014 or earlier declined by 17.8 percent.

Table 2: Production Volume by Spud Year (bcf)

Spud Year	Second Quarter				Calendar Year-to-Date			
	2017	2018	Growth	Share	2017	2018	Growth	Share
2018	n.a.	0.3	n.a.	n.a.	n.a.	0.3	n.a.	n.a.
2017	1.4	281.5	n.a.	19.4%	1.4	477.3	n.a.	16.5%
2016	117.6	233.1	98.1%	16.0%	163.3	483.4	196.0%	16.7%
2015	257.0	161.8	-37.0%	11.1%	518.6	344.1	-33.6%	11.9%
2014	323.6	262.6	-18.8%	18.1%	671.4	538.9	-19.7%	18.6%
2013	201.7	166.0	-17.7%	11.4%	420.3	337.2	-19.8%	11.6%
2012	144.4	118.5	-17.9%	8.1%	293.2	242.9	-17.2%	8.4%
2011	<u>276.1</u>	<u>230.1</u>	<u>-16.6%</u>	<u>15.8%</u>	<u>562.9</u>	<u>471.3</u>	<u>-16.3%</u>	<u>16.3%</u>
Total	1,321.9	1,454.0	10.0%	100.0%	2,631.1	2,895.4	10.0%	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 second quarter of 2017 and the second 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 second quarter of 2016 to the second quarter of 2018, horizontal production increased by 15.0 percent. There has been a quarter-over-quarter increase in horizontal production in seven consecutive quarters.

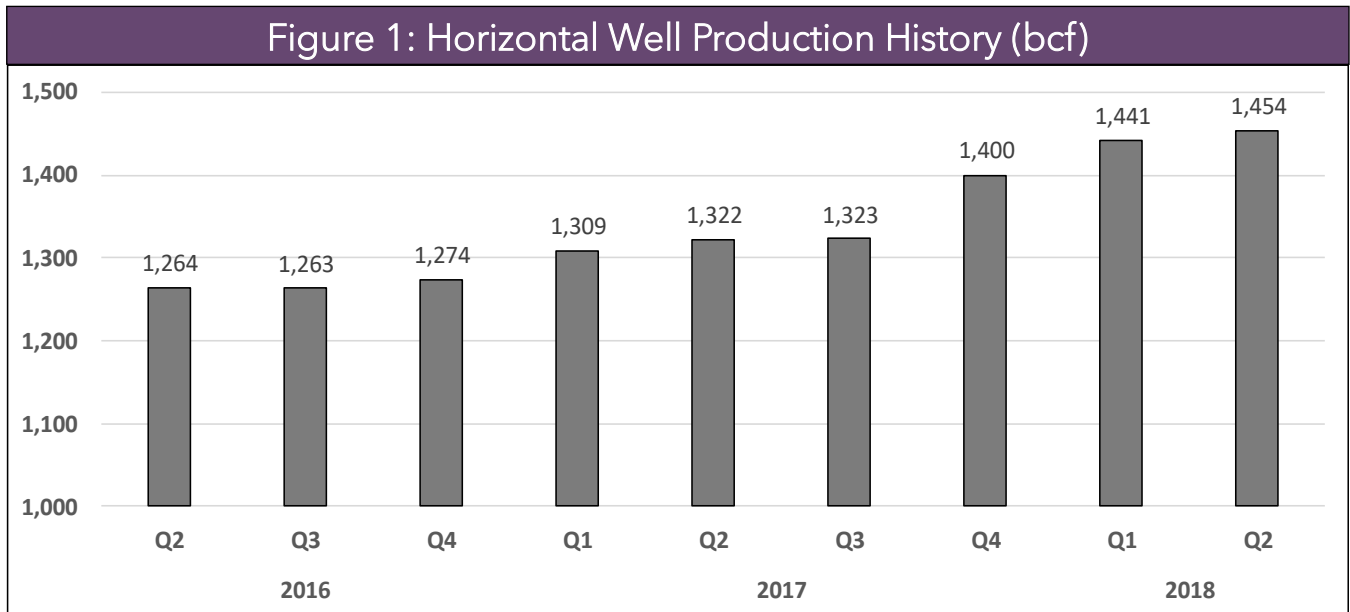
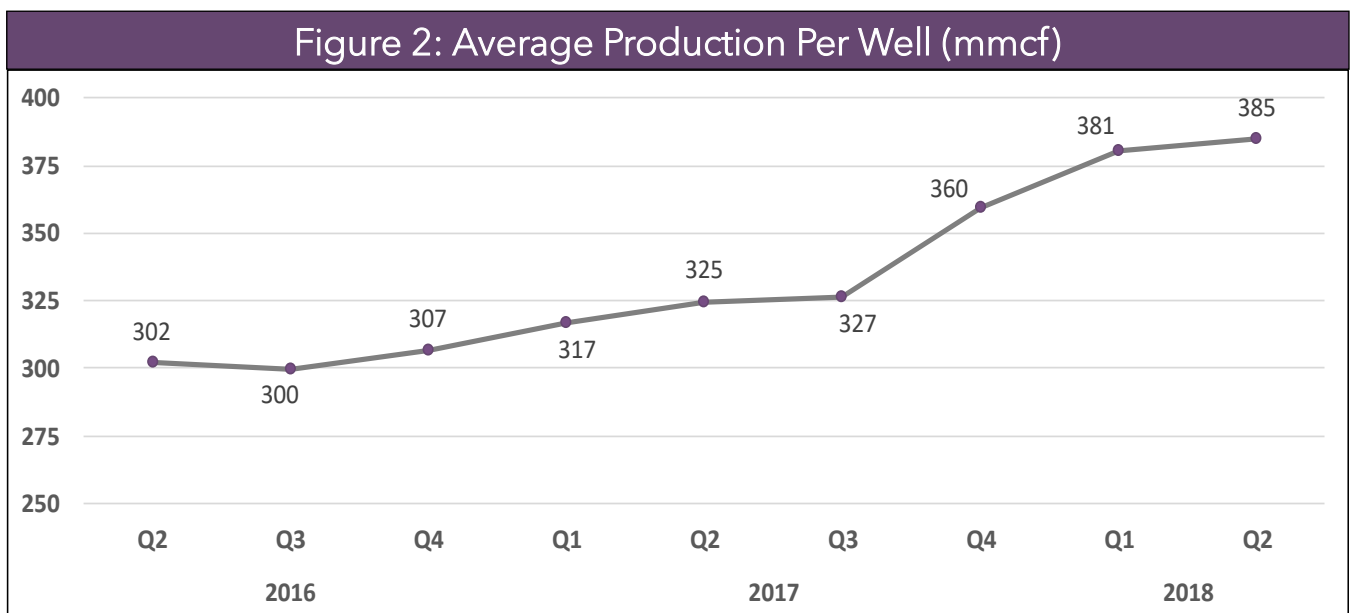


Figure 2 displays the average production per well for selected horizontal wells. Each data point in this figure represents horizontal wells that (1) were spud at least three quarters before the reporting period and no earlier than 12 quarters before that date and (2) produced above 90 mcf per day (i.e., did not qualify for stripper well status). From the second quarter of 2016 to the second quarter of 2018, average production per well increased by 27.4 percent. There has been a quarter-over-quarter increase in average production per well in seven consecutive quarters.



Well Count Trends

Table 3 displays the number of wells in the second quarter of 2018 and provides a breakdown based on well type (horizontal vs. vertical) and production status. There were 8,194 producing horizontal wells in the second quarter, an 11.5 percent increase over the prior year. Total producing wells in the second quarter increased by 10.4 percent compared to the prior year. Total non-producing wells remained flat, as horizontal wells declined (-1.3 percent) and vertical wells increased (6.2 percent).

Table 3: Number of Wells, Second Quarter

	<u>Producing</u>			<u>Non-Producing</u>			<u>Total</u>		
	2017	2018	Growth	2017	2018	Growth	2017	2018	Growth
Horizontal	7,347	8,194	11.5%	2,166	2,139	-1.3%	9,513	10,333	8.6%
Vertical	<u>506</u>	<u>478</u>	<u>-5.5%</u>	<u>487</u>	<u>516</u>	<u>6.2%</u>	<u>993</u>	<u>994</u>	<u>0.1%</u>
Total	7,853	8,672	10.4%	2,653	2,655	0.0%	10,506	11,327	8.0%

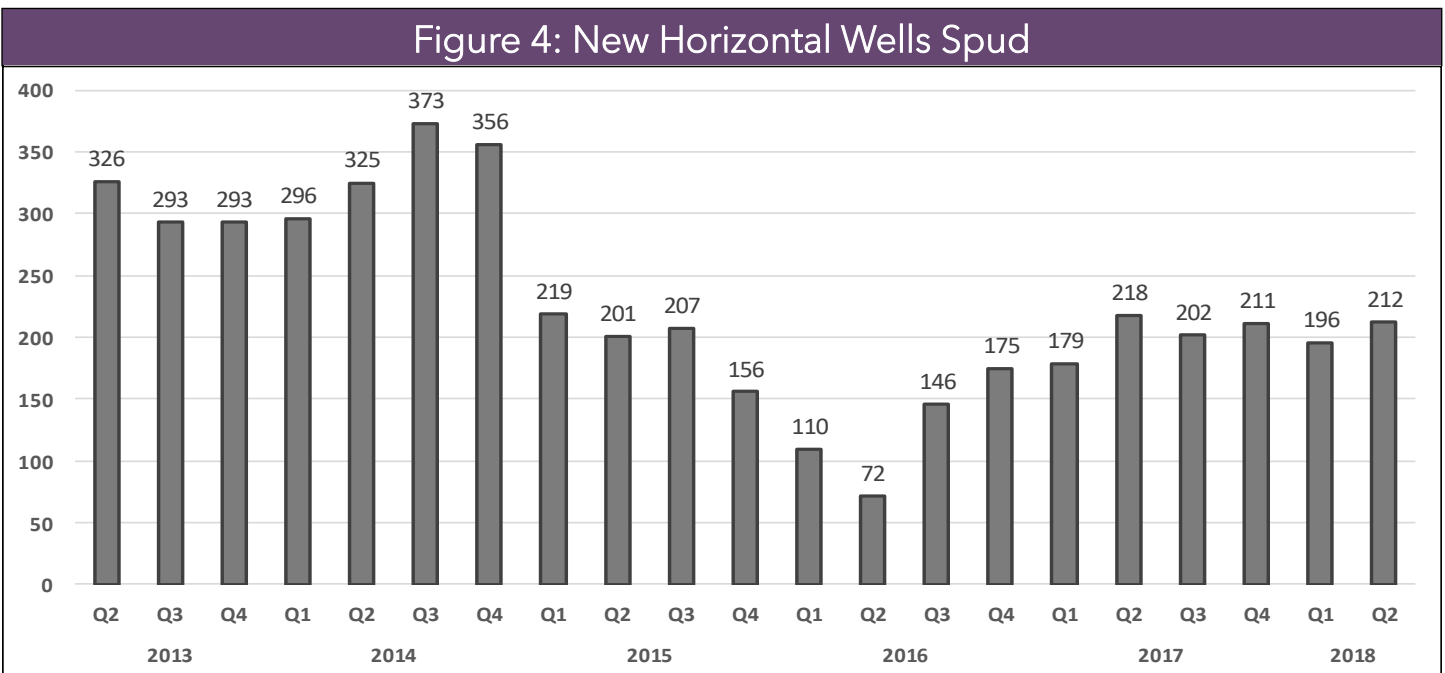
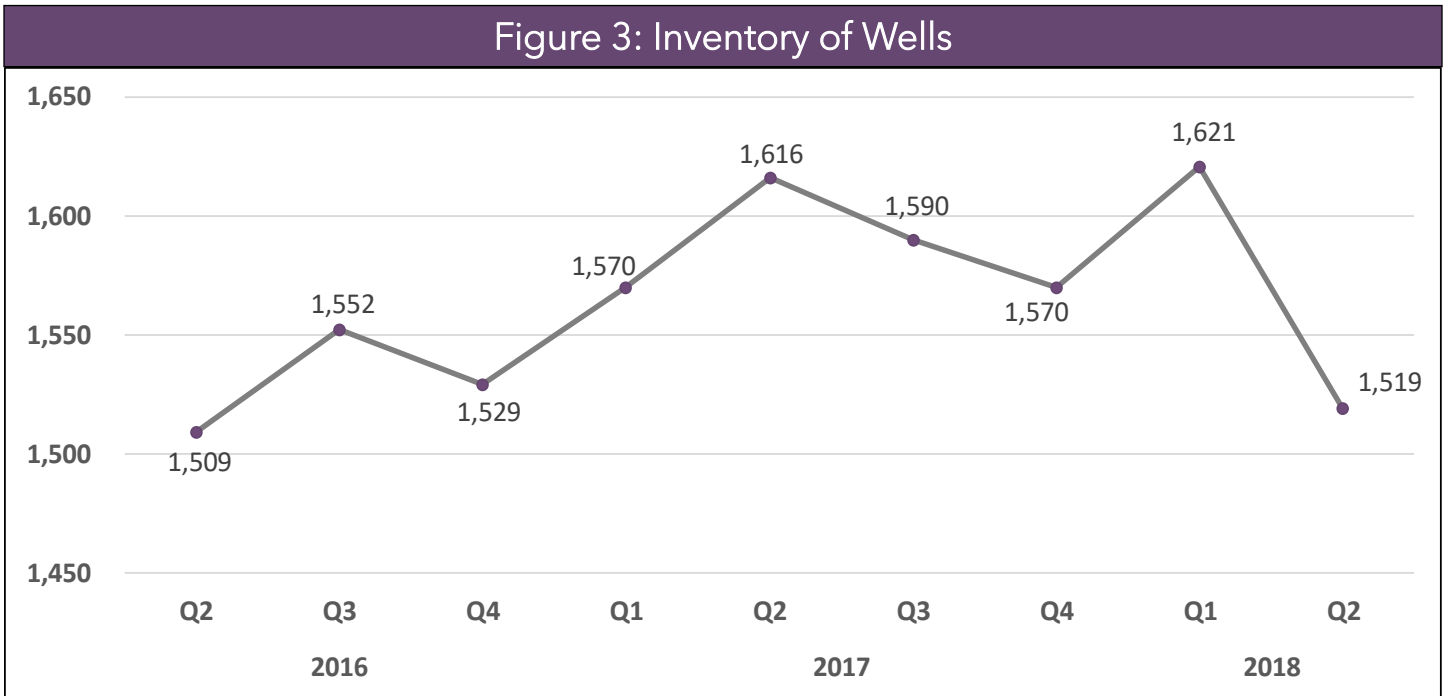
Table 4 shows a history of well counts broken down by type and producing status over the last nine quarters. It also provides detail for non-producing horizontal wells. Since the second quarter of 2016, total producing wells have increased by 18.8 percent. Total non-producing wells have increased by 6.8 percent in the same period.

Table 4: Quarterly Well Count History

	<u>2016</u>			<u>2017</u>				<u>2018</u>	
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Producing Wells									
Horizontal	6,794	6,897	7,070	7,204	7,347	7,582	7,778	7,916	8,194
Vertical	<u>507</u>	<u>492</u>	<u>501</u>	<u>495</u>	<u>506</u>	<u>494</u>	<u>493</u>	<u>489</u>	<u>478</u>
Total	7,301	7,389	7,571	7,699	7,853	8,076	8,271	8,405	8,672
Non-Producing Wells									
Horizontal	2,001	2,044	2,046	2,091	2,166	2,132	2,147	2,205	2,139
Vertical	<u>486</u>	<u>501</u>	<u>492</u>	<u>498</u>	<u>487</u>	<u>500</u>	<u>501</u>	<u>505</u>	<u>516</u>
Total	2,487	2,545	2,538	2,589	2,653	2,632	2,648	2,710	2,655
Horizontal Detail									
Shut In	859	871	820	843	833	780	851	853	742
Spud, Not Completed	650	681	709	727	783	809	719	768	777
Plugged	467	470	485	487	522	532	566	572	604
Other	<u>25</u>	<u>22</u>	<u>32</u>	<u>34</u>	<u>28</u>	<u>11</u>	<u>11</u>	<u>12</u>	<u>16</u>
Total	2,001	2,044	2,046	2,091	2,166	2,132	2,147	2,205	2,139

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

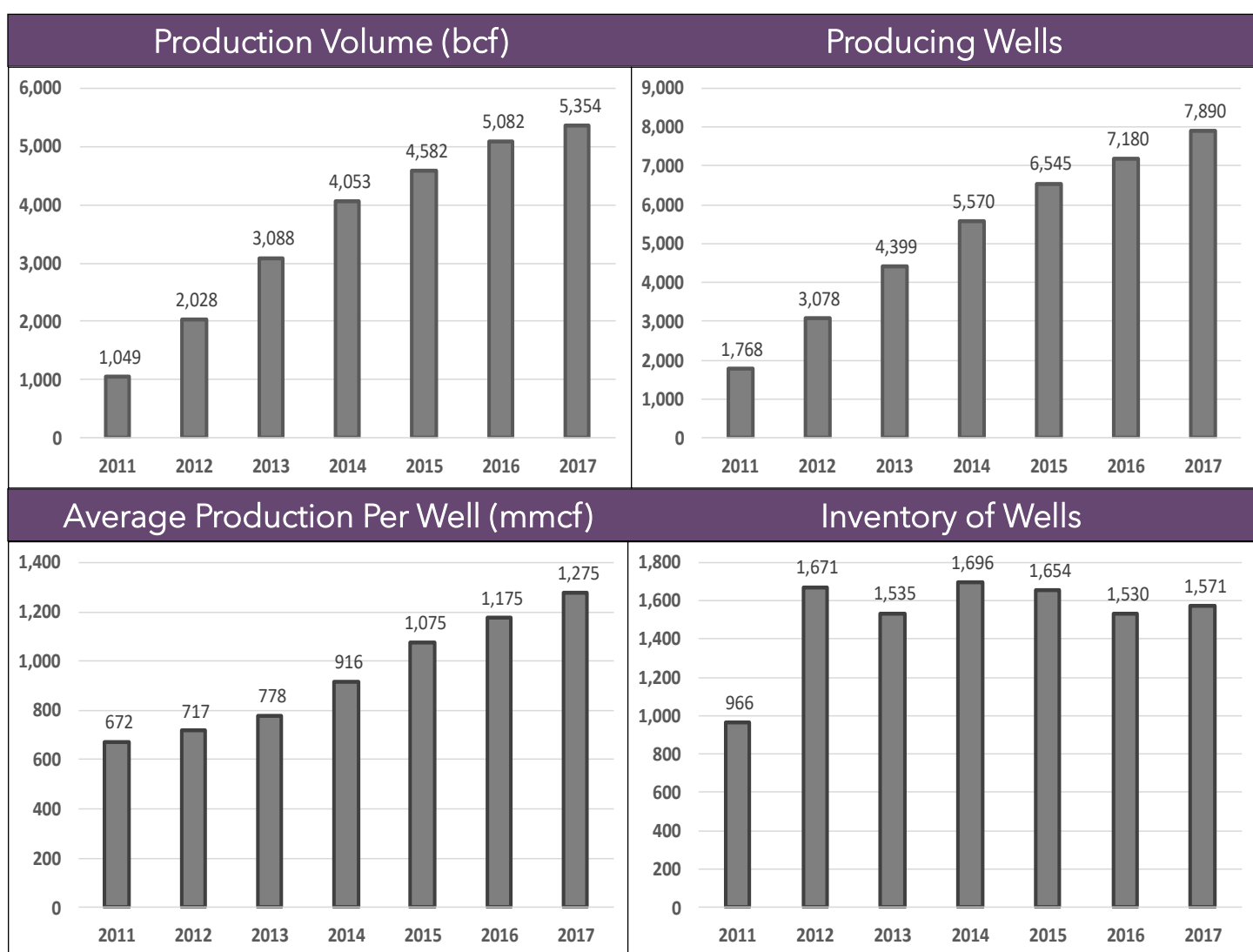
Figures 3 and 4 display recent trends in well counts. Figure 3 shows the quarterly history of the inventory of wells in Pennsylvania. Well inventory is comprised of horizontal wells that fall into the “Shut In” or “Spud, Not Completed” categories. These are wells that are already spud and considered available to be brought into production in the future. The inventory of wells decreased by 102 (-6.3 percent) over the previous quarter. Figure 4 displays the number of new horizontal wells spud in each quarter over the last five calendar years. For the second quarter of 2018, there were 212 new horizontal wells spud, which is an increase of 16 wells from the previous quarter, but a decrease of six wells from the same period in 2017.



Annual Trends

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

For 2017, production volume was 5,354 bcf, an increase of 5.4 percent from the prior year. From 2011 to 2017, production volume increased at an average annual rate of 31.2 percent. The number of producing wells in 2017 was 7,890, which was 9.9 percent higher than 2016. From 2011 to 2017, the number of producing wells grew at an average annual rate of 28.3 percent. Average production per well in 2017 was 1,275 million cubic feet (mmcf), a cumulative increase of 89.7 percent since 2011. The inventory of wells in 2017 was 1,571, an increase of 2.7 percent from the prior year. From 2011 to 2017, the inventory of wells increased at an average annual rate of 8.4 percent.



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

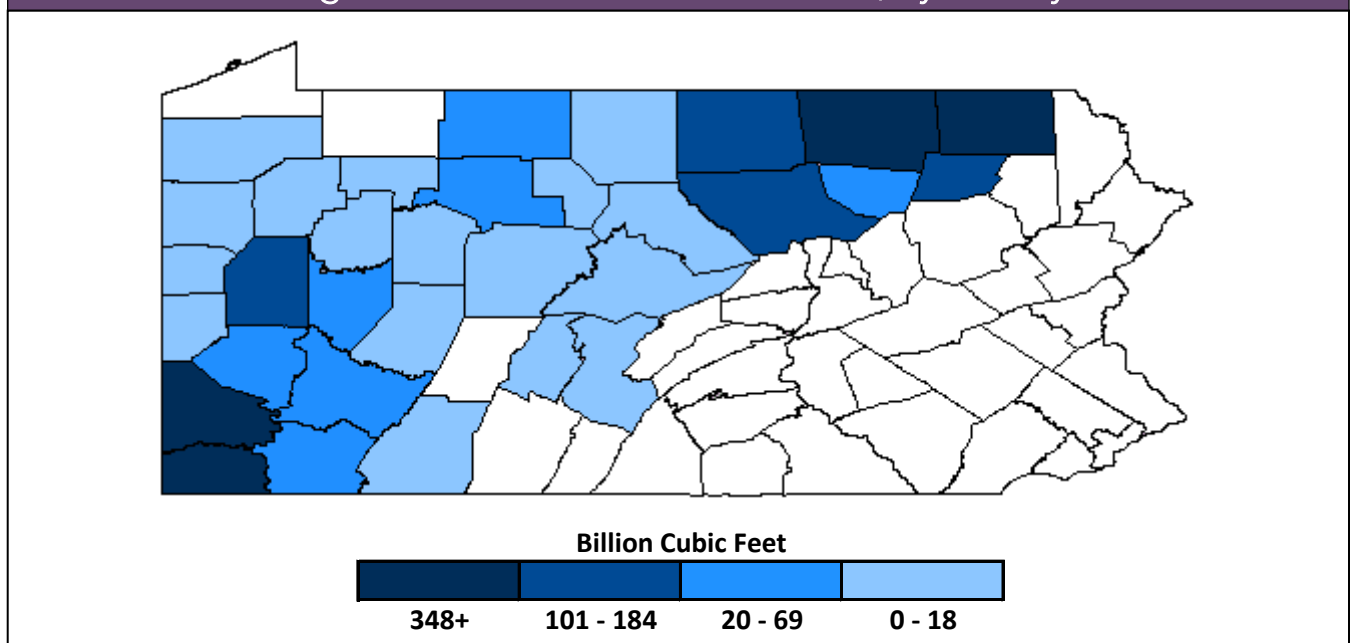
Table 5 shows county-level production volume and producing well counts for the first two quarters of the calendar year. Four counties (Susquehanna, Washington, Bradford and Greene) comprised two-thirds of statewide production. Among those in the top ten, all counties except Bradford and Lycoming registered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

Table 5: Calendar Year Production, by County

Rank	County	Production Volume (bcf)				Number of Producing Wells			
		Calendar Year		2018 Metrics		Calendar Year		2018 Metrics	
		2017	2018	Share	Growth	2017	2018	Share	Growth
1	Susquehanna	649.2	701.2	24.2%	8.0%	1,122	1,247	15.2%	11.1%
2	Washington	433.0	568.0	19.6%	31.2%	1,255	1,442	17.5%	14.9%
3	Bradford	367.7	350.3	12.1%	-4.7%	1,042	1,141	13.9%	9.5%
4	Greene	332.9	348.8	12.0%	4.8%	800	899	10.9%	12.4%
5	Wyoming	162.2	183.3	6.3%	13.0%	209	239	2.9%	14.4%
6	Lycoming	185.3	168.6	5.8%	-9.0%	756	780	9.5%	3.2%
7	Tioga	103.5	139.9	4.8%	35.2%	578	624	7.6%	8.0%
8	Butler	88.3	101.7	3.5%	15.2%	364	432	5.3%	18.7%
9	Sullivan	65.4	68.3	2.4%	4.3%	97	117	1.4%	20.6%
10	Allegheny	31.0	43.7	1.5%	41.0%	73	93	1.1%	27.4%
11	All Other	201.7	221.7	4.3%	16.1%	1,111	1,205	13.5%	8.5%

Note: Horizontal wells only. Data shown pertains to the first two quarters of the calendar year.

Figure 5: Calendar Year Production, by County



State Comparison

Table 6 provides a state comparison of gross 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 five months of 2018 while Alaska 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.

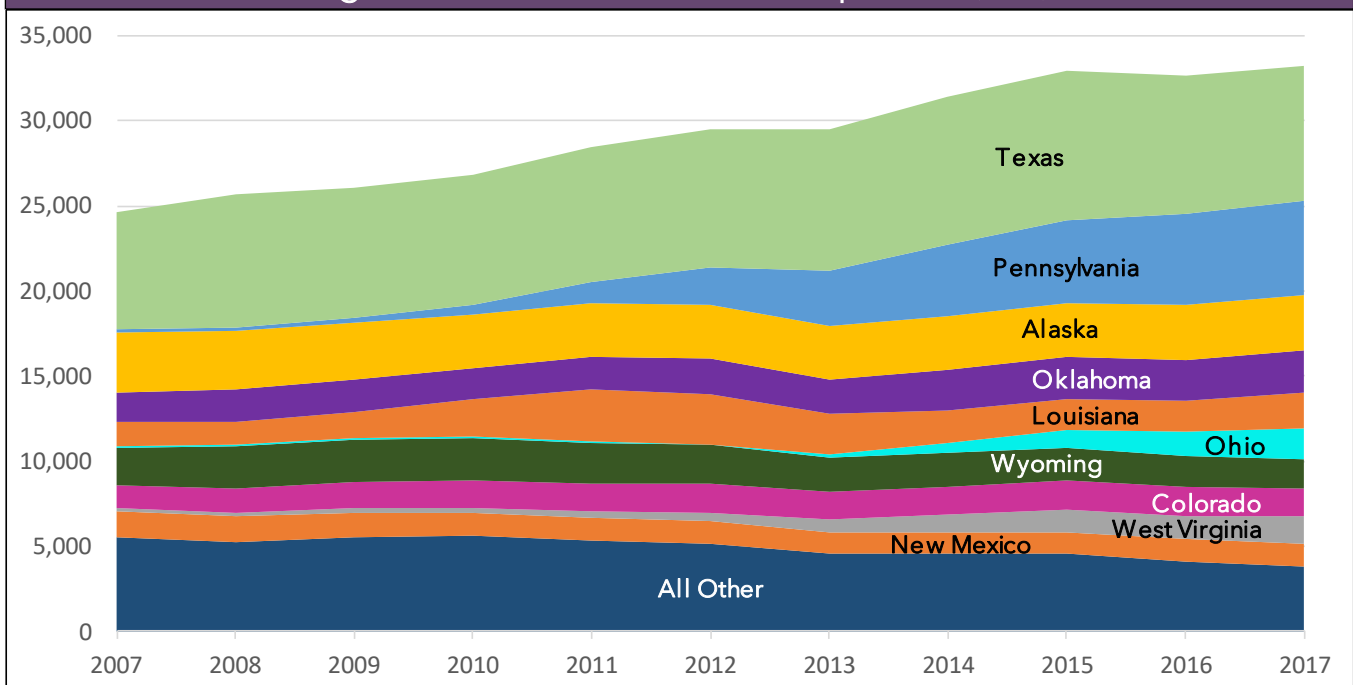
Table 6: State Production Comparison (bcf)

Rank	State	Production Volume			Annual Growth Rate		
		CY 2016	CY 2017	CY 2018	CY 2016	CY 2017	CY 2018
1	Texas	8,133.8	7,918.8	3,439.2	-7.6%	-2.6%	8.0%
2	Pennsylvania	5,313.3	5,463.8	2,456.3	10.4%	2.8%	9.4%
3	Alaska	3,230.0	3,250.8	1,426.6	1.7%	0.6%	-2.2%
4	Oklahoma	2,468.3	2,513.9	1,156.3	-1.3%	1.8%	16.5%
5	Louisiana	1,752.3	2,128.9	1,108.9	-3.4%	21.5%	41.3%
6	Ohio	1,439.9	1,786.6	921.1	43.0%	24.1%	41.3%
7	Wyoming	1,848.1	1,715.7	728.0	-7.4%	-7.2%	4.2%
8	Colorado	1,701.7	1,689.5	742.4	0.8%	-0.7%	7.5%
9	West Virginia	1,375.1	1,601.1	706.0	4.6%	16.4%	14.5%
10	New Mexico	1,284.7	1,335.9	588.3	-0.9%	4.0%	10.6%
11	All Other	4,088.3	3,772.9	1,483.3	-9.4%	-7.7%	-7.6%

Note: CY 2018 includes production for the first five months of the year 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 August 30, 2018.