

Natural Gas Production Report

Q2

April to June 2019

Production Trends

For the second quarter of 2019, recent data from the Pennsylvania Department of Environmental Protection (DEP) show that total natural gas production volume was 1,668.9 billion cubic feet (bcf) (see **Table 1**). This represents an increase of 14.5 percent from the second quarter of the prior year. Calendar year production is up 14.6 percent compared to the same period in 2018.

Table 1: Production Volume (bcf)

	Second Quarter			Calendar Year		
	2018	2019	Growth	2018	2019	Growth
Horizontal	1,456.3	1,667.2	14.5%	2,897.6	3,321.1	14.6%
Vertical	<u>1.8</u>	<u>1.7</u>	<u>-4.1%</u>	<u>3.8</u>	<u>3.3</u>	<u>-14.1%</u>
Total	1,458.0	1,668.9	14.5%	2,901.4	3,324.3	14.6%

Table 2 decomposes second 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 (40.3 percent). Wells spud in 2014 showed the largest decline in production (-22.9 percent) and production from wells spud in 2013 or earlier declined by 9.5 percent.

Table 2: Production Volume by Spud Year (bcf)

Spud Year	Second Quarter				Calendar Year			
	2018	2019	Growth	Share	2018	2019	Growth	Share
2019	n.a.	8.0	n.a.	0.5%	n.a.	8.2	n.a.	0.2%
2018	0.3	314.7	n.a.	18.9%	0.3	531.8	n.a.	16.0%
2017	281.4	357.6	27.1%	21.4%	477.2	755.6	58.2%	22.7%
2016	233.2	181.2	-22.3%	10.9%	483.4	379.8	-21.4%	11.4%
2015	161.8	135.7	-16.2%	8.1%	344.1	279.2	-18.9%	8.4%
2014	262.7	202.5	-22.9%	12.1%	538.9	416.9	-22.6%	12.6%
2013	166.3	143.9	-13.5%	8.6%	337.5	290.7	-13.9%	8.7%
2012	<u>350.6</u>	<u>323.6</u>	<u>-7.7%</u>	<u>19.4%</u>	<u>716.2</u>	<u>658.9</u>	<u>-8.0%</u>	<u>19.8%</u>
Total	1,456.3	1,667.2	14.5%	100.0%	2,897.6	3,321.1	14.6%	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 second quarter of 2018 and the second 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 second quarter of 2017 to the second quarter of 2019, horizontal production increased by 26.1 percent. There has been a quarter-over-quarter increase in horizontal production for twelve consecutive quarters.

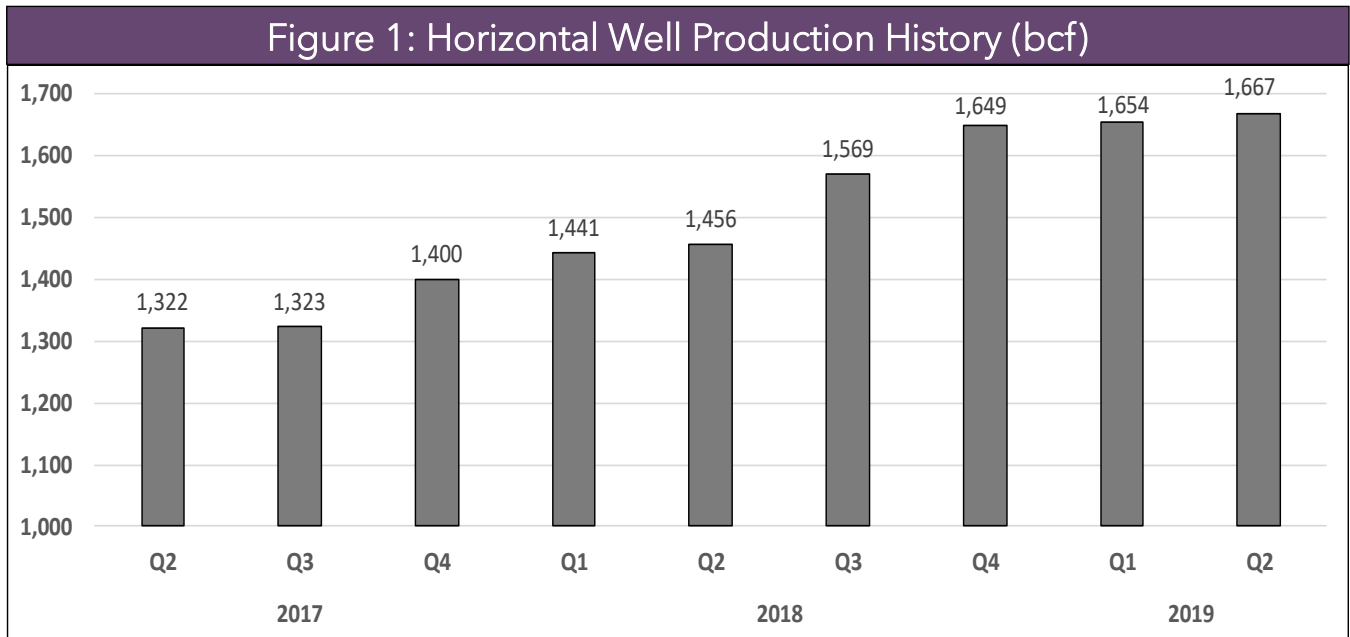
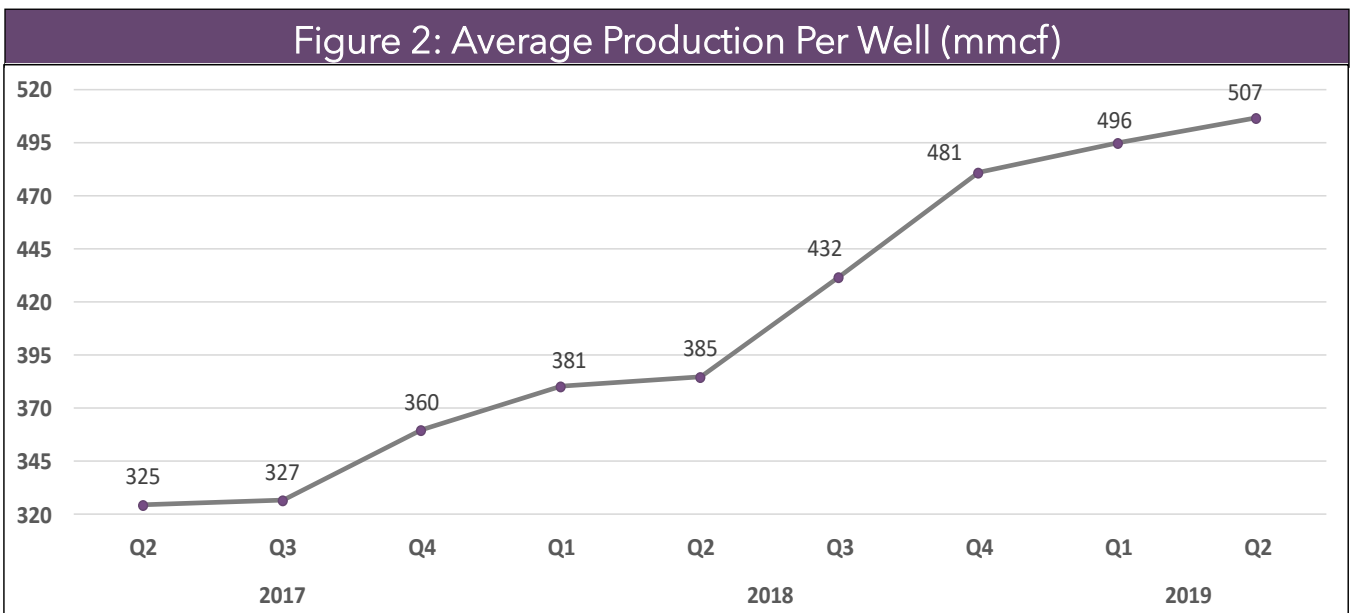


Figure 2 displays the average production per well for selected horizontal wells. Each data point in this figure represents horizontal wells that (1) were spud at least three quarters before the reporting period and no earlier than twelve quarters before that date and (2) produced above 90 mcf per day (i.e., did not qualify for stripper well status). After recording significant gains in 2018 (33.9 percent for the year), average production per well growth moderated in 2019 (5.4 percent through Q2).



Well Count Trends

Table 3 displays the number of wells in the second quarter of 2019 and provides a breakdown based on well type (horizontal vs. vertical) and production status. There were 8,897 producing horizontal wells in the second quarter, an 8.5 percent increase over the prior year. Total producing wells increased by 8.0 percent compared to the prior year. Total non-producing wells increased by 1.4 percent compared to the prior year.

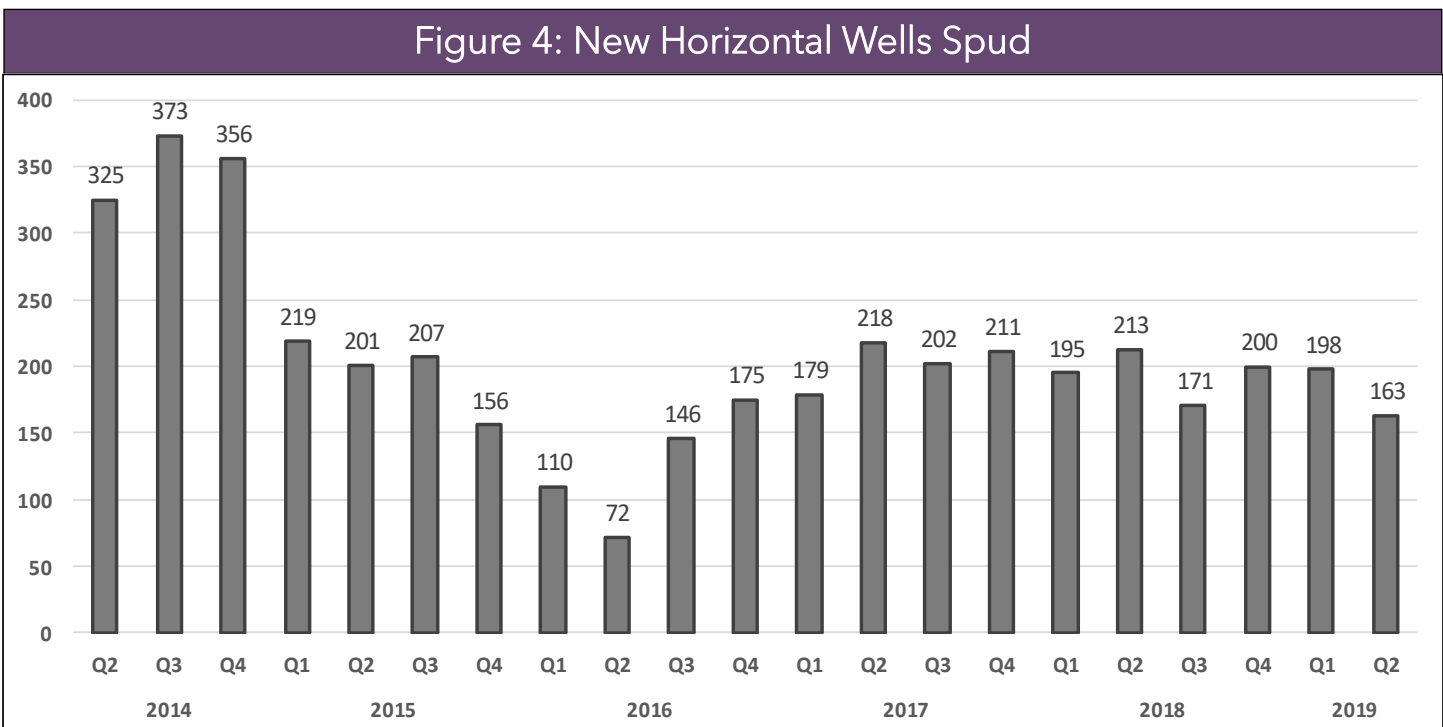
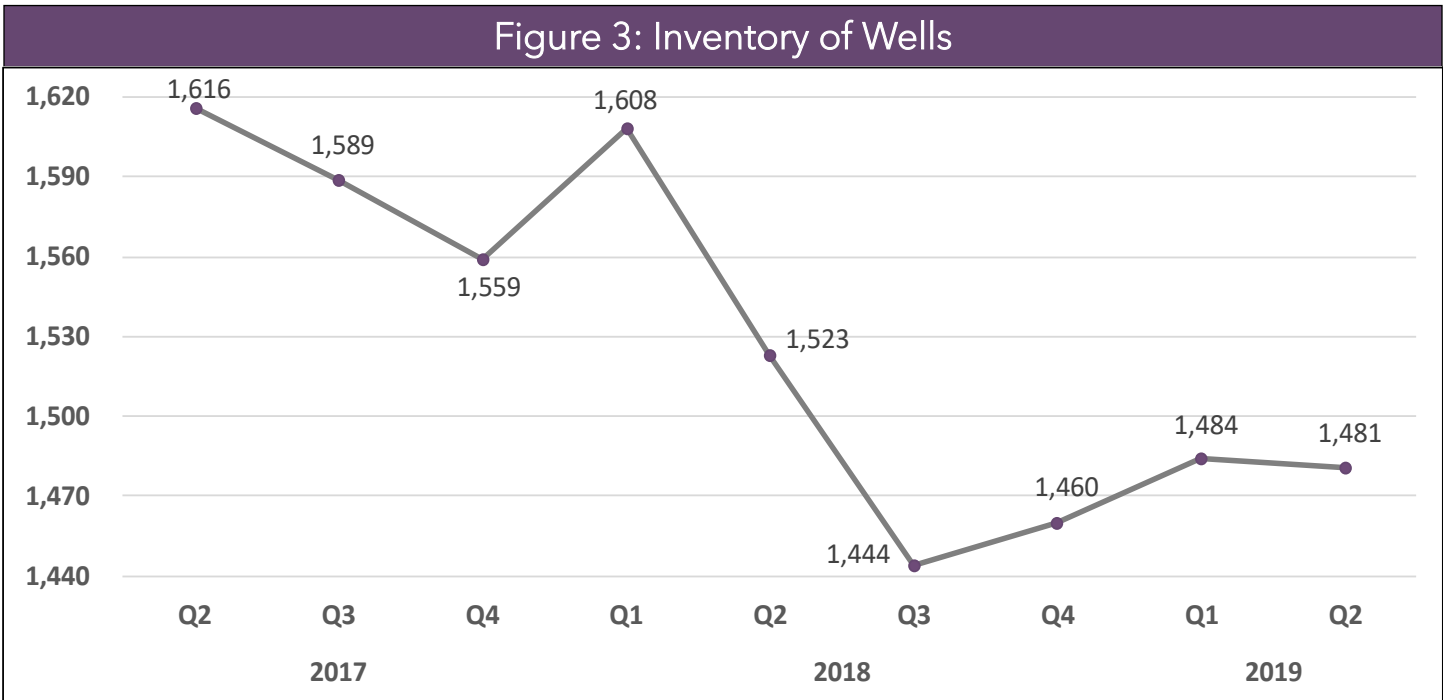
Table 3: Number of Wells, Second Quarter									
	<u>Producing</u>			<u>Non-Producing</u>			<u>Total</u>		
	2018	2019	Growth	2018	2019	Growth	2018	2019	Growth
Horizontal	8,197	8,897	8.5%	2,140	2,171	1.4%	10,337	11,068	7.1%
Vertical	<u>483</u>	<u>475</u>	<u>-1.7%</u>	<u>517</u>	<u>524</u>	<u>1.4%</u>	<u>1,000</u>	<u>999</u>	<u>-0.1%</u>
Total	8,680	9,372	8.0%	2,657	2,695	1.4%	11,337	12,067	6.4%

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 second quarter of 2017, total producing wells increased by 19.3 percent, while total non-producing wells increased by 1.1 percent.

Table 4: Quarterly Well Count History									
	<u>2017</u>			<u>2018</u>				<u>2019</u>	
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Producing Wells									
Horizontal	7,347	7,582	7,778	7,916	8,197	8,431	8,606	8,765	8,897
Vertical	<u>506</u>	<u>494</u>	<u>493</u>	<u>494</u>	<u>483</u>	<u>488</u>	<u>486</u>	<u>478</u>	<u>475</u>
Total	7,853	8,076	8,271	8,410	8,680	8,919	9,092	9,243	9,372
Non-Producing Wells									
Horizontal	2,175	2,141	2,156	2,209	2,140	2,077	2,102	2,141	2,171
Vertical	<u>490</u>	<u>503</u>	<u>504</u>	<u>505</u>	<u>517</u>	<u>512</u>	<u>514</u>	<u>520</u>	<u>524</u>
Total	2,665	2,644	2,660	2,714	2,657	2,589	2,616	2,661	2,695
Horizontal Detail									
Shut In	832	778	854	843	747	722	756	733	746
Spud, Not Completed	784	811	705	765	776	722	704	751	735
Plugged	536	546	590	593	610	621	639	646	665
Other	<u>23</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>12</u>	<u>3</u>	<u>11</u>	<u>25</u>
Total	2,175	2,141	2,156	2,209	2,140	2,077	2,102	2,141	2,171

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

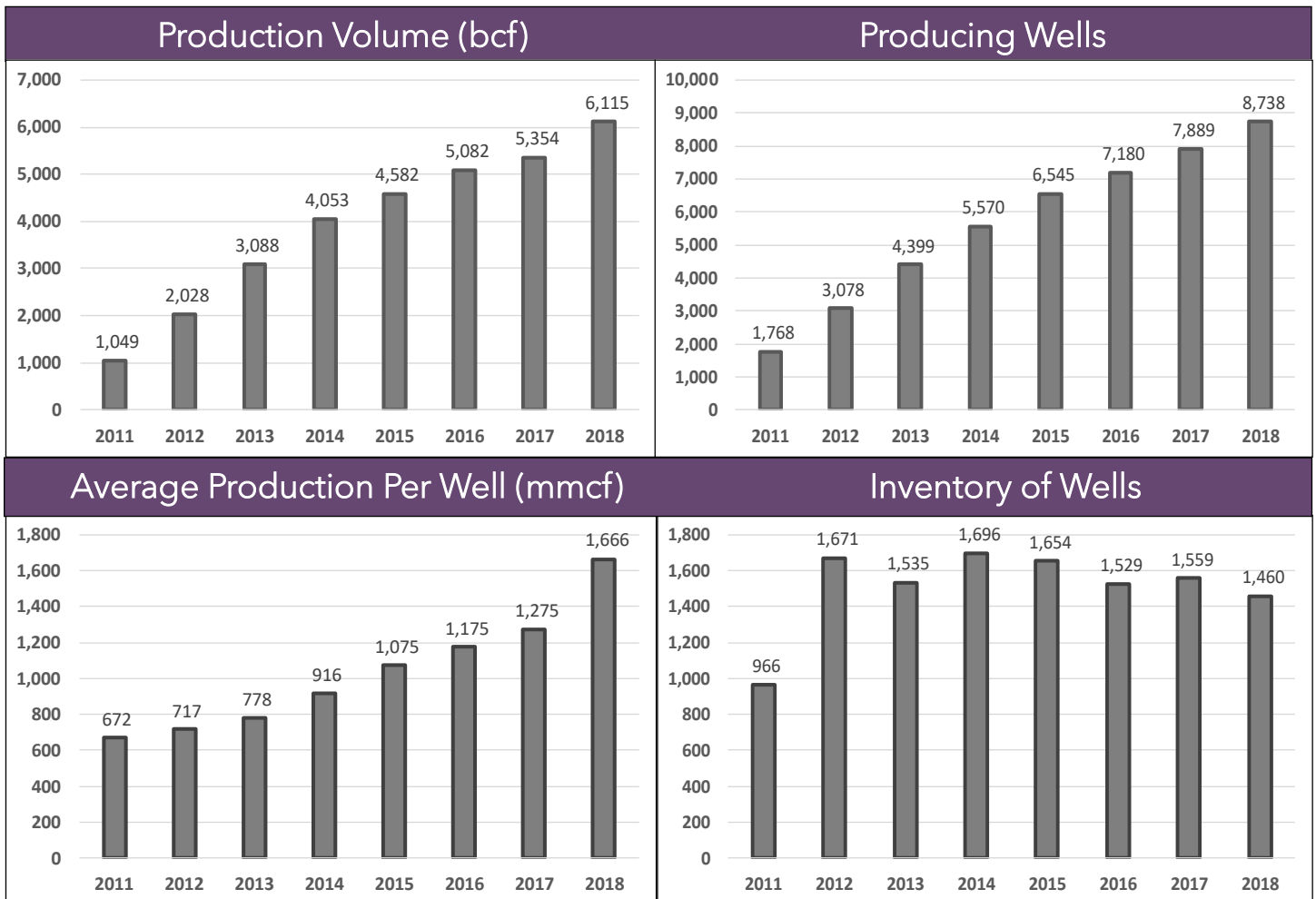
Figures 3 and 4 display recent trends in well counts. Figure 3 shows the quarterly history of the inventory of wells in Pennsylvania. Well inventory includes horizontal wells that are in the “Shut In” or “Spud, Not Completed” categories from Table 4. These are wells that are already spud and considered available to be brought into production in the future. The inventory of wells for the second quarter represents a decrease of 42 wells (2.8 percent) from the prior year. Figure 4 displays the number of new horizontal wells spud in each quarter over the last five calendar years. There were 163 new horizontal wells spud in the second quarter of 2019, a decrease of 50 wells (-23.5 percent) from the prior year. This figure represents the lowest number of new wells spud since the third quarter of 2016.



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 wells. 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.



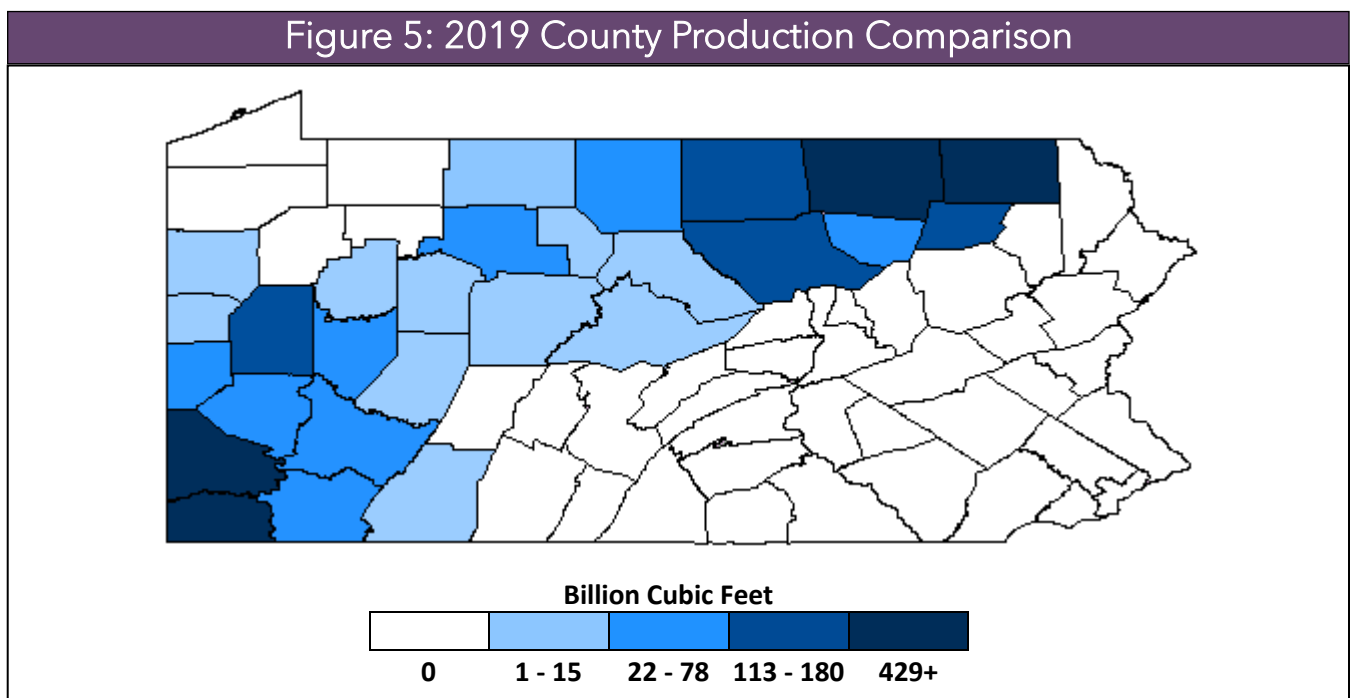
Notes: Producing Wells represents the number of wells that produced gas at any point during the year. Average Production Per Well represents horizontal wells that produced above the stripper well threshold of 90 mcf per day and were spud in any of the previous three years. Inventory of Wells represents 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 through the second 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.

Rank	County	Production Volume (bcf)				Number of Producing Wells			
		Calendar Year		2019 Metrics		Calendar Year		2019 Metrics	
		2018	2019	Share	Growth	2018	2019	Share	Growth
1	Susquehanna	701.1	822.1	24.8%	17.3%	1,246	1,399	15.7%	12.3%
2	Washington	568.0	586.6	17.7%	3.3%	1,434	1,509	17.0%	5.2%
3	Greene	348.8	493.4	14.9%	41.5%	896	1,051	11.8%	17.3%
4	Bradford	350.3	429.2	12.9%	22.5%	1,141	1,231	13.8%	7.9%
5	Lycoming	168.8	179.7	5.4%	6.4%	777	812	9.1%	4.5%
6	Tioga	141.0	155.8	4.7%	10.5%	626	666	7.5%	6.4%
7	Wyoming	183.3	145.2	4.4%	-20.8%	238	263	3.0%	10.5%
8	Butler	101.7	113.5	3.4%	11.6%	427	425	4.8%	-0.5%
9	Allegheny	43.7	78.4	2.4%	79.5%	92	119	1.3%	29.3%
10	Sullivan	68.3	76.5	2.3%	12.1%	117	126	1.4%	7.7%
11	All Other	222.6	240.7	7.2%	8.1%	1,202	1,291	14.5%	7.4%

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



State Comparison

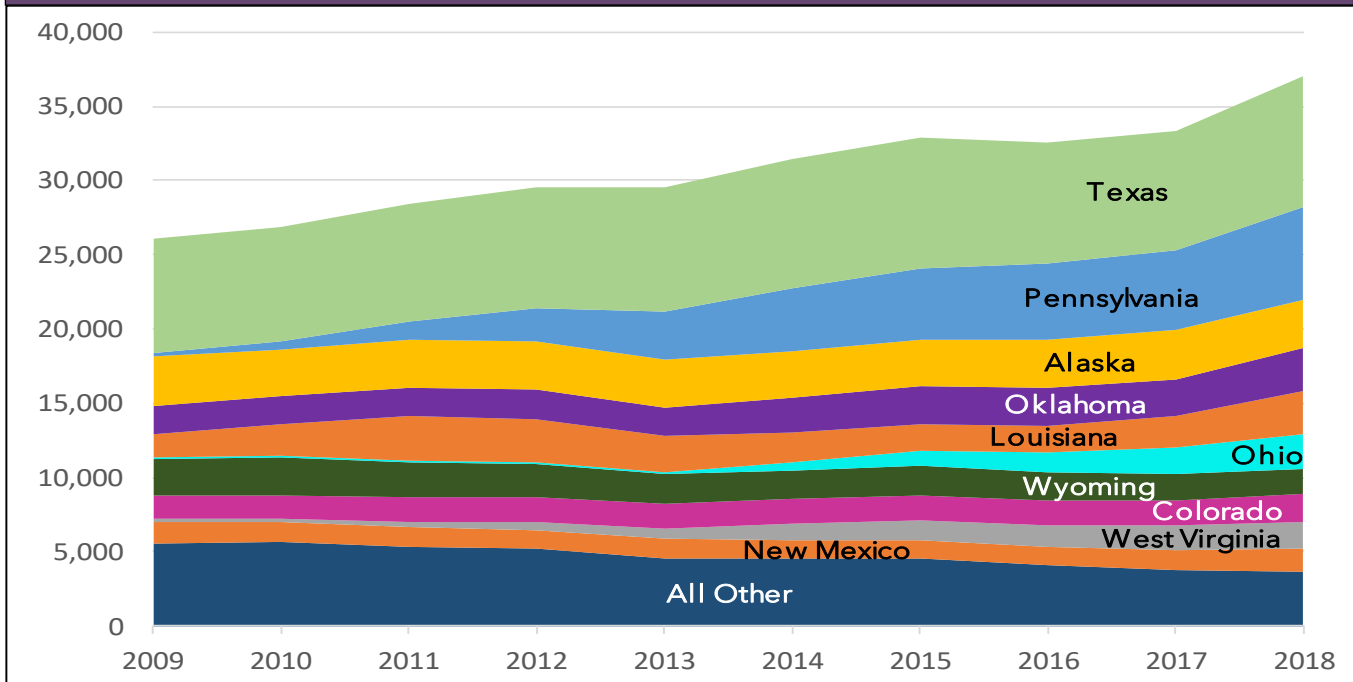
Table 6 provides a state comparison of gross natural gas production from all well types. Nationwide production grew by 10.9 percent in 2018, which was the largest year-over-year increase on record (since 1980). Through May 2019, nationwide production grew by 11.6 percent compared to the prior year, largely driven by significant gains in Texas and Pennsylvania. **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 2017	CY 2018	CY 2019	CY 2017	CY 2018	CY 2019
1	Texas	7,995.7	8,814.0	4,046.9	-2.0%	10.2%	17.4%
2	Pennsylvania	5,463.9	6,206.9	2,829.7	4.9%	13.6%	15.2%
3	Alaska	3,250.8	3,254.7	1,438.6	0.6%	0.1%	0.8%
4	Oklahoma	2,513.9	2,946.1	1,302.6	1.8%	17.2%	12.5%
5	Louisiana	2,147.6	2,829.7	1,249.1	19.8%	31.8%	12.8%
6	Ohio	1,772.9	2,385.1	1,022.2	23.4%	34.5%	11.0%
7	West Virginia	1,601.1	1,799.1	838.3	15.6%	12.4%	18.5%
8	Colorado	1,687.7	1,830.5	807.8	0.0%	8.5%	8.9%
9	New Mexico	1,324.9	1,524.4	733.2	3.3%	15.1%	24.7%
10	Wyoming	1,804.7	1,720.9	646.3	-2.4%	-4.6%	-11.2%
11	All Other	3,794.2	3,697.4	1,490.2	-7.3%	-2.6%	5.1%

Source: U.S. Energy Information Administration. Production does not directly correspond to DEP data. Data and growth rates for 2019 are through May.

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.
Non-Producing	A well with no production activity during the time period.
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 20, 2019.

Staff Acknowledgements

This report was produced by Jesse Bushman and Rachel Flaugh. Questions regarding this report can be directed to jbushman@ifso.state.pa.us