

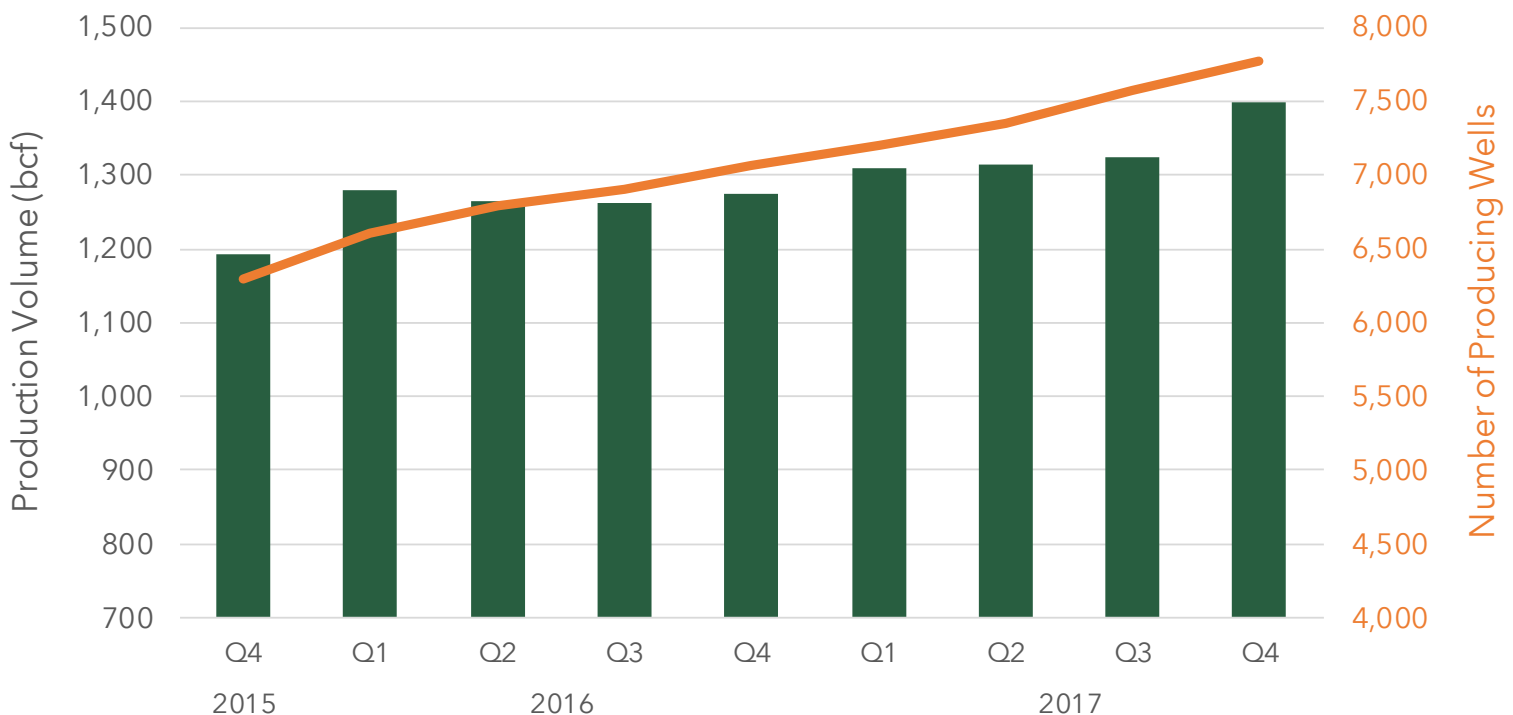
Natural Gas Production Report

OCTOBER TO DECEMBER

FOURTH QUARTER - 2017

- ▶ **PRODUCTION UP 9.8% FROM PRIOR YEAR**
+5.3% for the calendar year
- ▶ **PRODUCING WELLS UP 9.2% FROM PRIOR YEAR**
+9.1% for the calendar year

Quarterly Production and Well Counts



Natural Gas Production Report

Q4

Quarterly Trends

For the fourth quarter of 2017, recent data from the Department of Environmental Protection (DEP) show that total natural gas production volume was 1,401.8 billion cubic feet (bcf) and the number of producing wells was 8,268. Compared to the fourth quarter of 2016, total production grew by 9.8 percent, while the number of producing wells increased by 9.2 percent.

Table 1: Production Volume (bcf)

	Fourth Quarter			Calendar Year		
	2016	2017	Growth	2016	2017	Growth
Horizontal	1,273.8	1,399.9	9.9%	5,081.7	5,353.9	5.4%
Vertical	<u>3.0</u>	<u>1.9</u>	<u>-35.6%</u>	<u>12.6</u>	<u>9.5</u>	<u>-24.4%</u>
Total	1,276.8	1,401.8	9.8%	5,094.2	5,363.4	5.3%

Table 2: Number of Wells

	Fourth Quarter			Calendar Year		
	2016	2017	Growth	2016	2017	Growth
Producing Wells						
Horizontal	7,069	7,775	10.0%	7,180	7,891	9.9%
Vertical	<u>502</u>	<u>493</u>	<u>-1.8%</u>	<u>522</u>	<u>513</u>	<u>-1.7%</u>
Total	7,571	8,268	9.2%	7,702	8,404	9.1%
Non-Producing Wells						
Horizontal	2,058	2,162	5.1%	1,947	2,046	5.1%
Vertical	<u>484</u>	<u>494</u>	<u>2.1%</u>	<u>464</u>	<u>474</u>	<u>2.3%</u>
Total	2,542	2,656	4.5%	2,411	2,520	4.5%
Horizontal Detail						
Shut In	823	865	5.1%	718	757	5.4%
Spud, Not Completed	722	716	-0.8%	721	715	-0.8%
Plugged	487	572	17.5%	482	568	17.8%
Other	<u>26</u>	<u>9</u>	<u>-65.4%</u>	<u>26</u>	<u>6</u>	<u>-76.9%</u>
Total	2,058	2,162	5.1%	1,947	2,046	5.1%

Notes: The number of producing wells in each quarter does not directly correspond to the calendar year total because some wells did not produce in every quarter. The calendar year number represents wells that were producing in any quarter of that year. For non-producing wells, the calendar year number represents wells that produced no gas for that entire year. "Other" includes wells with miscellaneous designations such as abandoned. All characterizations of wells are based on information submitted by the operator or DEP.

Tables 3 and 4 decompose fourth quarter and calendar year production volume from horizontal wells by spud year. Most of the production gains in the fourth quarter and calendar year were from wells spud in 2016. Wells spud in 2015 and 2016 comprised more than one quarter of total production during both periods. For wells spud in 2014 and earlier, production declined in the fourth quarter (-18.9 percent) and calendar year (-17.4 percent).

Table 3: Fourth Quarter Production, by Spud Year

Spud Year	Production Volume (bcf)			Number of Wells			Producing Wells		
	2016	2017	Growth	2016	2017	Growth	2016	2017	Growth
2017	n.a.	107.5	n.a.	n.a.	810	n.a.	n.a.	185	n.a.
2016	22.7	260.5	1,046.6%	503	503	0.0%	41	378	822.0%
2015	230.1	203.7	-11.5%	783	783	0.0%	500	629	25.8%
2014	352.8	283.9	-19.5%	1,348	1,348	0.0%	1,130	1,190	5.3%
2013	231.7	177.7	-23.3%	1,188	1,188	0.0%	1,069	1,074	0.5%
2012	152.2	127.2	-16.4%	1,311	1,311	0.0%	1,058	1,055	-0.3%
2011	<u>284.3</u>	<u>239.4</u>	<u>-15.8%</u>	<u>3,994</u>	<u>3,994</u>	<u>0.0%</u>	<u>3,271</u>	<u>3,264</u>	<u>-0.2%</u>
Total	1,273.8	1,399.9	9.9%	9,127	9,937	8.9%	7,069	7,775	10.0%

Notes: Horizontal wells only. This table displays 2016 and 2017 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 2016 and the fourth quarter of 2017. Spud year 2011 includes all wells spud in 2011 or earlier.

Table 4: Calendar Year Production, by Spud Year

Spud Year	Production Volume (bcf)			Number of Wells			Producing Wells		
	2016	2017	Growth	2016	2017	Growth	2016	2017	Growth
2017	n.a.	134.4	n.a.	n.a.	810	n.a.	n.a.	186	n.a.
2016	24.0	617.2	2,475.1%	503	503	0.0%	41	378	822.0%
2015	639.3	952.3	49.0%	783	783	0.0%	504	634	25.8%
2014	1,498.1	1,250.1	-16.6%	1,348	1,348	0.0%	1,136	1,203	5.9%
2013	1,050.1	789.6	-24.8%	1,188	1,188	0.0%	1,085	1,091	0.6%
2012	675.7	555.8	-17.7%	1,311	1,311	0.0%	1,065	1,076	1.0%
2011	<u>1,194.6</u>	<u>1,054.6</u>	<u>-11.7%</u>	<u>3,994</u>	<u>3,994</u>	<u>0.0%</u>	<u>3,349</u>	<u>3,323</u>	<u>-0.8%</u>
Total	5,081.7	5,353.9	5.4%	9,127	9,937	8.9%	7,180	7,891	9.9%

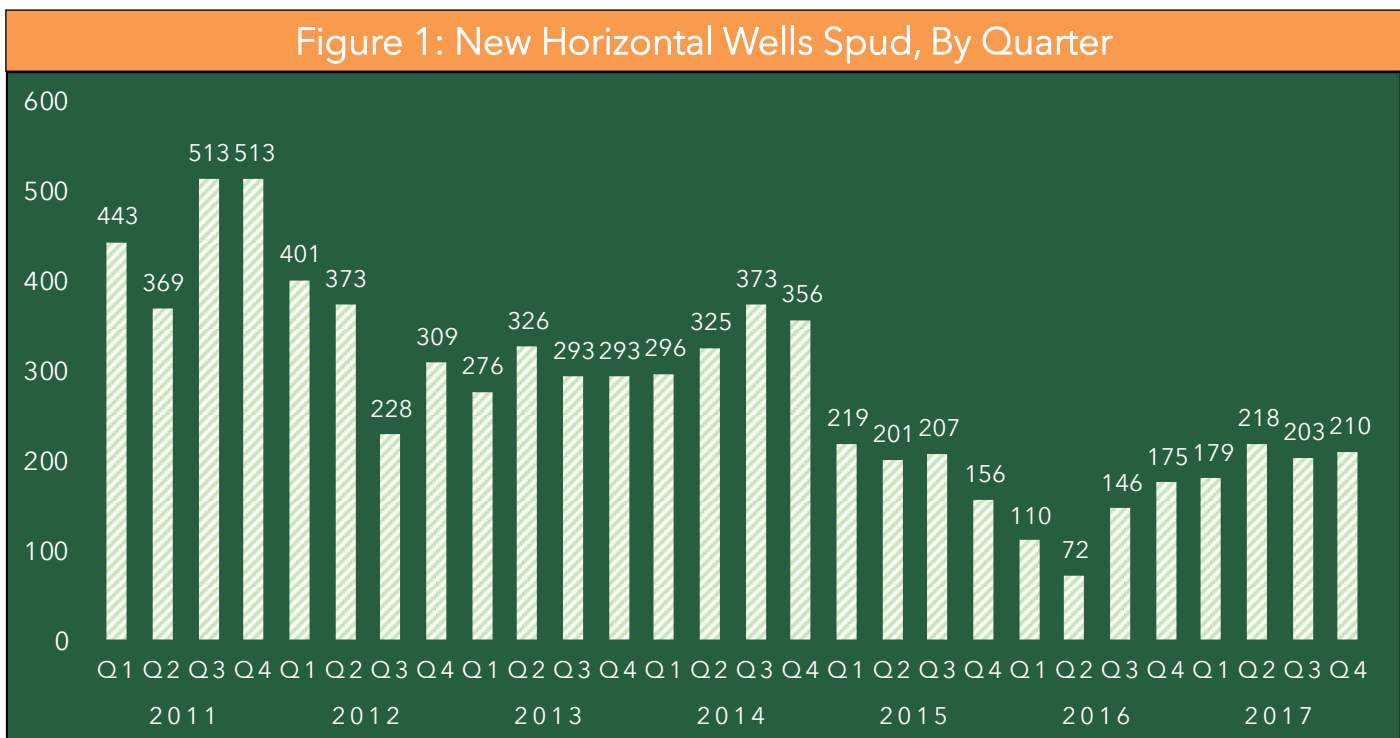
Notes: Horizontal wells only. This table displays 2016 and 2017 production based on the year wells were spud. For example, wells with spud year 2014 were spud during calendar year 2014, and their production is shown for calendar year 2016 and calendar year 2017. Spud year 2011 includes all wells spud in 2011 or earlier.

Table 5 displays production volume, total well counts, producing well counts and average production per well over the last nine quarters. Production volume displayed strong growth in the fourth quarter after modestly increasing in the first three quarters of the year. The number of producing wells has grown steadily over the last eight quarters.

Table 5: Historical Quarterly Production Volume and Well Counts										
	2015		2016				2017			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Production Volume (bcf)	1,192.1	1,280.5	1,264.4	1,263.0	1,273.8	1,309.2	1,321.9	1,323.0	1,399.9	
Annual Growth Rate	n.a.	12.8%	14.5%	9.8%	6.9%	2.2%	4.6%	4.8%	9.9%	
Number of Wells	8,623	8,733	8,805	8,951	9,127	9,305	9,523	9,726	9,937	
Annual Growth Rate	n.a.	8.4%	6.6%	5.7%	5.8%	6.6%	8.2%	8.7%	8.9%	
Producing Wells	6,295	6,605	6,794	6,898	7,069	7,206	7,348	7,582	7,775	
Annual Growth Rate	n.a.	15.4%	14.2%	13.0%	12.3%	9.1%	8.1%	9.9%	10.0%	
Avg. Prod. per Well (mmcf)	290.8	304.4	302.0	299.7	306.7	317.0	324.9	326.9	359.5	
Annual Growth Rate	n.a.	13.3%	16.0%	6.7%	5.5%	4.1%	7.6%	9.1%	17.2%	

Notes: Horizontal wells only. Average production per well represents 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.

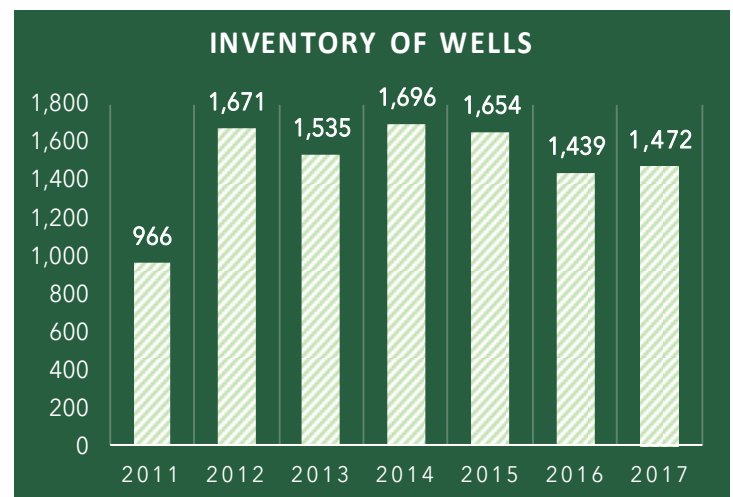
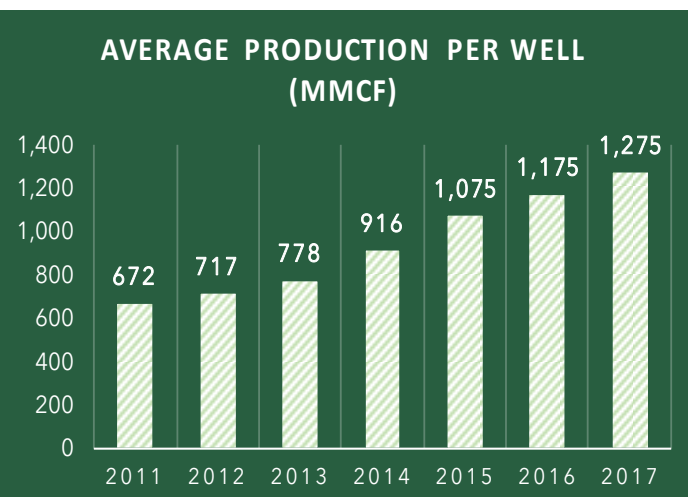
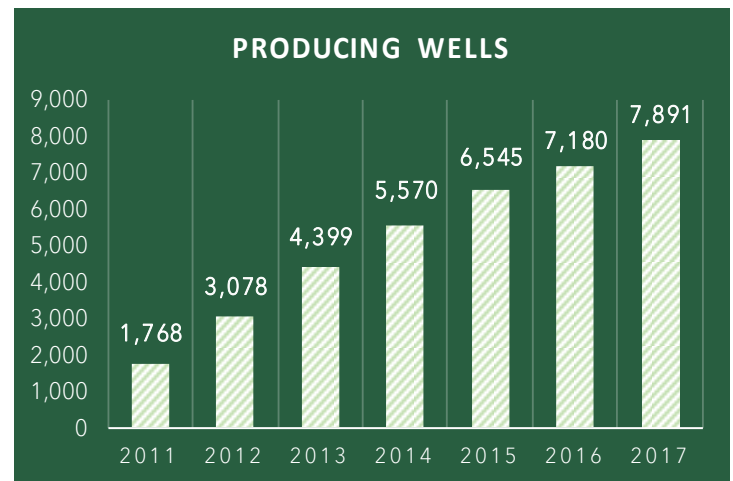
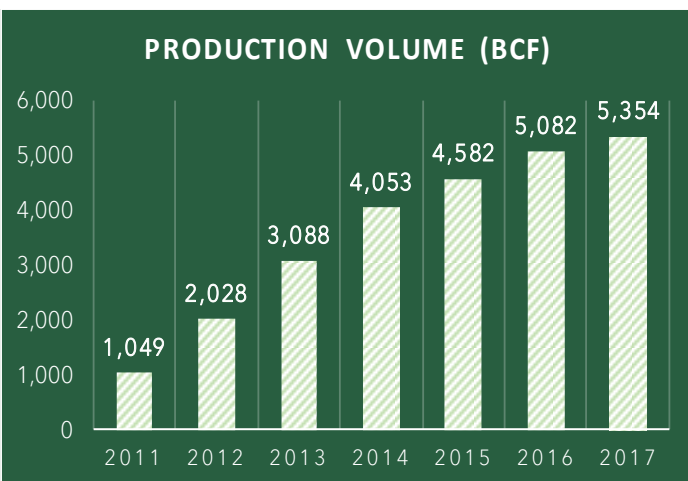
Figure 1 displays the number of new horizontal wells spud in each quarter since 2011. There was a slight increase in new wells spud for the fourth quarter of 2017. There were 810 new horizontal wells spud in 2017, which was an increase of 307 wells (61.0 percent) from 2016.



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, total 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 38.6 percent. The number of producing wells in 2017 was 7,891, which was 9.9 percent higher than 2016. From 2011 to 2017, the number of producing wells grew at an average annual rate of 32.4 percent. Average production per well in 2017 was 1,275 mmcf, a cumulative increase of 89.7 percent since 2011. The inventory of wells in 2017 was 1,472, an increase of 2.3 percent from the prior year. From 2011 to 2017, the inventory of wells increased at an average annual rate of 8.3 percent.



Notes: Producing wells represents the number of wells that produced gas at any point during the year. Average production per well represents 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

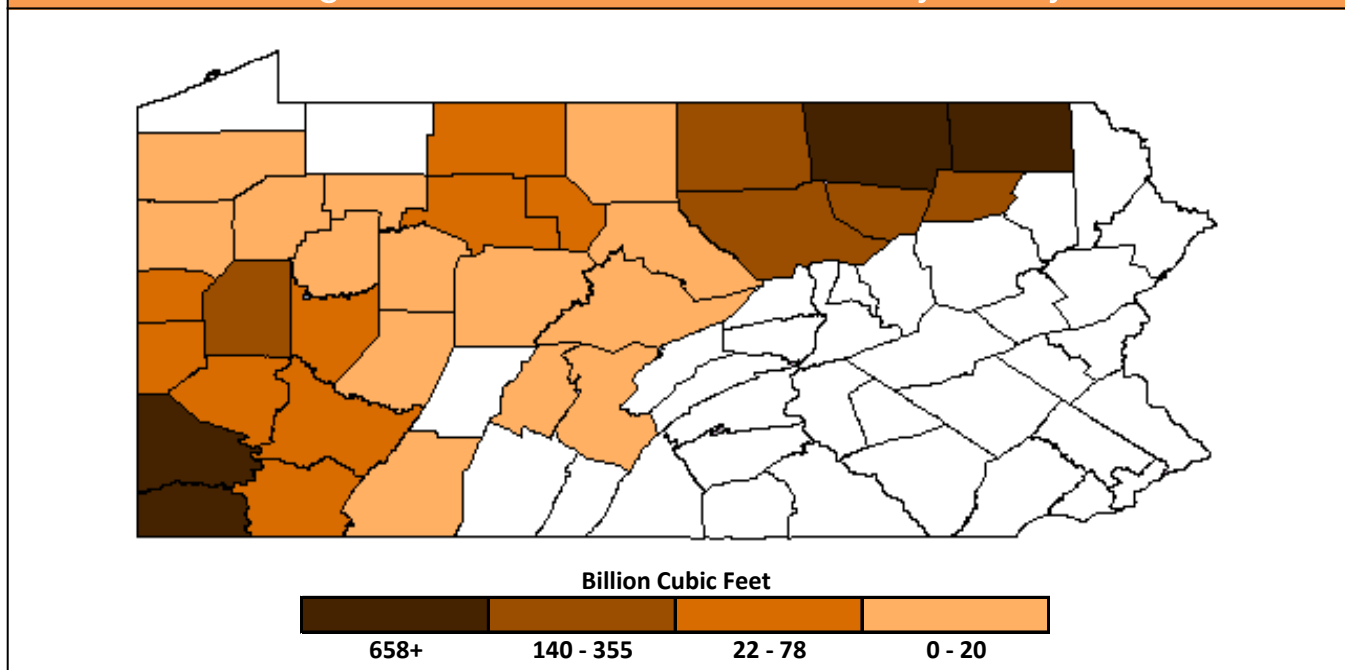
Table 6 shows county-level production volume and producing well counts for the calendar year. Four counties (Susquehanna, Washington, Bradford and Greene) comprised two thirds of statewide production. Among those in the top ten, all counties except Bradford, Greene, Lycoming and Fayette registered production gains. Figure 2 displays a geographic map of calendar year production by county.

Table 6: Calendar Year Production, by County

Rank	County	Production Volume (bcf)				Number of Producing Wells			
		Calendar Year		2017 Metrics		Calendar Year		2017 Metrics	
		2016	2017	Share	Growth	2016	2017	Share	Growth
1	Susquehanna	1,210.8	1,304.9	24.4%	7.8%	1,049	1,194	15.1%	13.8%
2	Washington	838.7	945.5	17.7%	12.7%	1,200	1,370	17.4%	14.2%
3	Bradford	709.3	708.0	13.2%	-0.2%	1,055	1,084	13.7%	2.7%
4	Greene	691.4	658.1	12.3%	-4.8%	764	857	10.9%	12.2%
5	Wyoming	278.0	354.9	6.6%	27.7%	195	232	2.9%	19.0%
6	Lycoming	418.7	344.2	6.4%	-17.8%	755	762	9.7%	0.9%
7	Tioga	194.1	220.6	4.1%	13.7%	573	625	7.9%	9.1%
8	Butler	169.8	185.0	3.5%	8.9%	350	404	5.1%	15.4%
9	Sullivan	106.1	139.7	2.6%	31.7%	87	109	1.4%	25.3%
10	Fayette	79.0	78.3	1.5%	-0.9%	186	189	2.4%	1.6%
11	All Other	385.8	414.7	7.7%	7.5%	966	1,065	13.5%	10.2%

Note: Horizontal wells only.

Figure 2: Calendar Year Production, by County



State Comparison

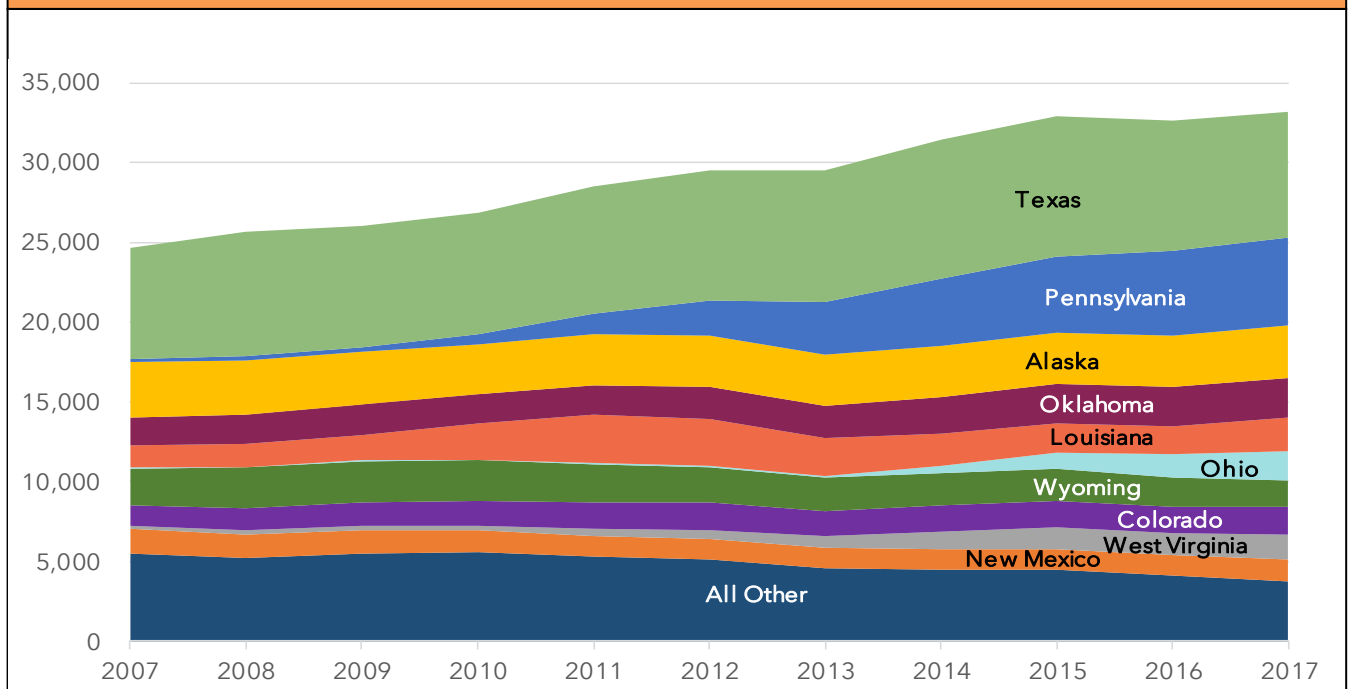
Table 7 displays a state comparison of gross production from all well types. Among the top-ten producing states, Louisiana, Ohio and West Virginia recorded the largest year-over-year production gains for 2017. Pennsylvania, Alaska, Oklahoma and New Mexico recorded modest increases. Three states (Texas, Wyoming and Colorado) registered declines. Figure 3 displays the composition of total U.S. production by state, over the last decade.

Table 7: State Production Comparison (bcf)

Rank	State	Production Volume			Annual Growth Rate		
		CY 2015	CY 2016	CY 2017	CY 2015	CY 2016	CY 2017
1	Texas	8,799.5	8,133.8	7,932.5	1.6%	-7.6%	-2.5%
2	Pennsylvania	4,813.0	5,313.3	5,458.0	13.0%	10.4%	2.7%
3	Alaska	3,175.3	3,230.0	3,277.6	0.2%	1.7%	1.5%
4	Oklahoma	2,499.6	2,468.3	2,513.9	7.2%	-1.3%	1.8%
5	Louisiana	1,813.2	1,752.3	2,135.2	-7.9%	-3.4%	21.9%
6	Ohio	1,007.3	1,439.9	1,781.6	96.6%	43.0%	23.7%
7	Wyoming	1,995.9	1,848.1	1,719.9	-0.1%	-7.4%	-6.9%
8	Colorado	1,688.7	1,701.7	1,684.0	2.8%	0.8%	-1.0%
9	West Virginia	1,315.2	1,375.1	1,605.0	23.3%	4.6%	16.7%
10	New Mexico	1,296.8	1,284.7	1,334.4	2.4%	-0.9%	3.9%
11	All Other	4,510.1	4,088.3	3,771.4	-0.5%	-9.4%	-7.8%

Notes: Data for 2017 through November. December estimated by IFO.
Source: U.S. Energy Information Administration. Production does not directly correspond to DEP data.

Figure 3: 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.