

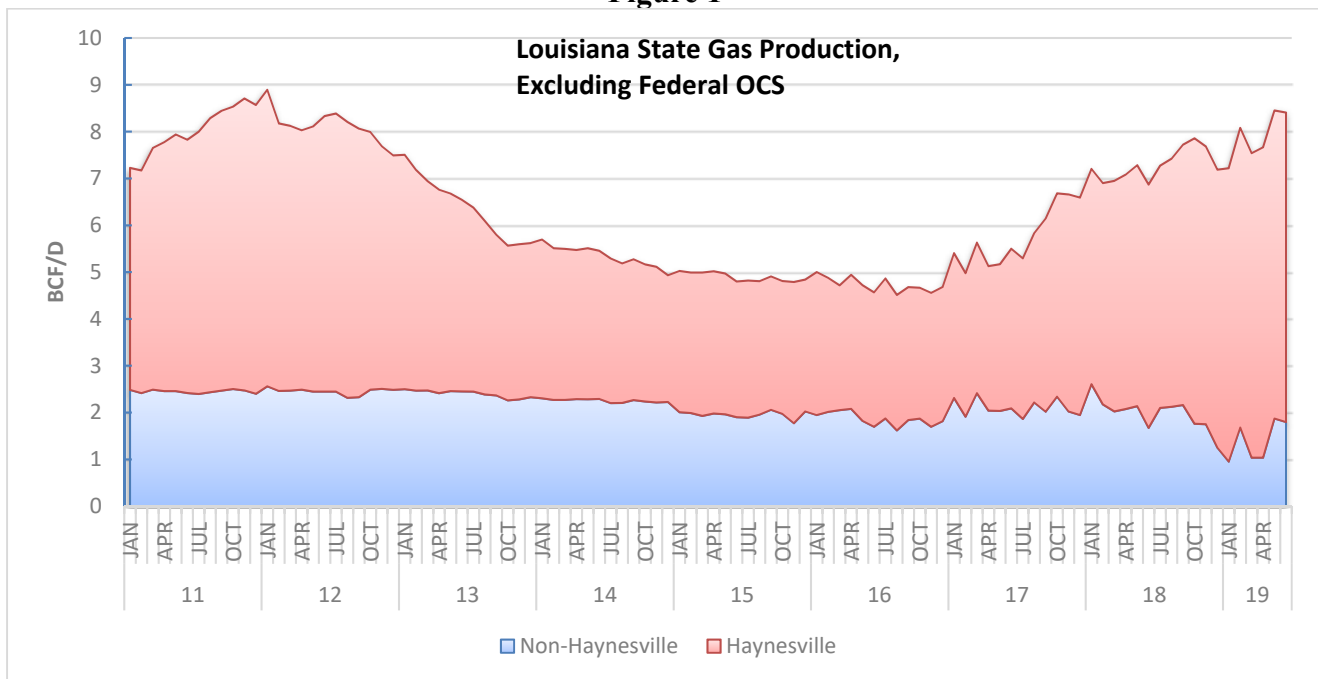
LOUISIANA STATE GAS PRODUCTION

by
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Louisiana has been producing natural gas since the early 1900's. State gas production peaked in 1970 at 15.3 Billion Cubic Feet per day (BCF/d) and then declined until 2005, bottoming out at 3.3 BCF/d. This trend then reversed, thanks to production from Haynesville Shale exploration and production, and 2019 has seen the largest production from the Haynesville since 2012.

The Haynesville shale play is a layer of sedimentary rock more than 10,000 feet down in Northwestern Louisiana, Southwestern Arkansas, and Eastern Texas, with some of the play stretching well across the north central portion of Louisiana. Energy producers explored the shale play and drilled for crude oil and natural gas based on their potential for a large supply of oil or gas trapped within some portions of the shale play. Shale plays were once considered too costly due to the large amounts of ground water required to explore, but with the advent of technologically advanced equipment, less expensive technology in horizontal drilling, 3-D seismic, more efficient processes, and the ability to recycle water, moved the economic limit for production in the Haynesville to where it can be profitable.

Figure 1



Louisiana gas production average daily rate from 2010 to the present is shown in Figure 1. The Louisiana Haynesville Shale was producing more gas than the rest of the state by March 2010. In December 2011, Louisiana Haynesville production reached a record high of 6.5 BCF/d. In early 2013, as natural gas prices started to decrease, natural gas production in the Haynesville region was surpassed by production in the new developments in Marcellus and Utica Shale plays. These plays are located 6,000 to 6,500 feet below the surface, thus are cheaper to develop than the Haynesville wells. In late 2016, there was a renewed interest in the Haynesville, even with natural gas prices languishing between \$2 and \$3. Since then, the area has seen even great withdrawals than the boom period of the early 2010, surpassing those levels and propelling Louisiana to its highest natural gas production levels ever.

Figure 2

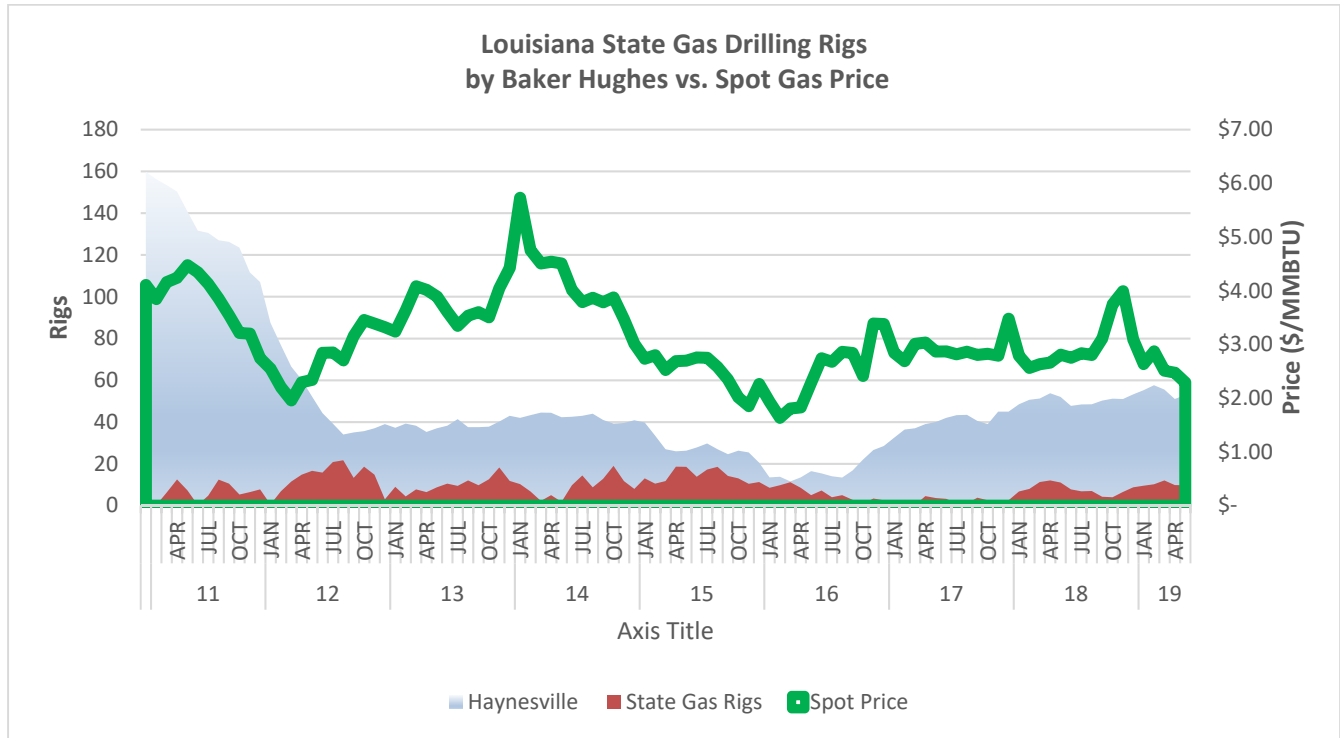


Figure 2 shows the relationship between gas prices and drilling rigs in Louisiana State excluding the federal OCS areas. Historically the data were highly correlated, lagging around 6 months, but from 2013 thru 2016, this relationship was broken. In those years, natural gas production in the Haynesville remained constant despite a declining number of drilling rigs. The increased production was due to the following improvements in drilling technology.

- Longer laterals: In the late 80's, small diameter 1,000 meters drilled crossing was a considerable achievement, but with development of bigger and better rigs, improvement in drill bits and better information on drilled rock strengths, laterals are now pushing lengths in excess of 5,000 meters.
- Directional drilling: Usage of geo-steering, a new technology in horizontal-directional drilling, keeping the wellbore in a particular section of a reservoir to minimize gas or water breakthrough, and maximize economic return; and the ability reach a larger area from one surface drilling location.
- Increased drilling rates and drilled pipe diameters: The new design in rotary steering systems and mud motors maximize rates of penetration and minimize downtime, and the high torque capability of new rigs, let them use larger diameter drill pipes and hole opening equipment.

Since late 2016, the correlation between price and drilling rigs recoupled. The recent increase in drilling activity has increased Louisiana gas production in the Haynesville to its highest output since 2012. This production increase reflects an increase in demand from new industrial activities, expansion of existent gas plants, increasing gas usage in electric generations, and LNG exports, with Louisiana being a leader in each category.