

# **ARKANSAS**

## ENERGY & ENVIRONMENT

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### GEOLOGICAL SURVEY

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**OPEN-FILE REPORT 2020-1000**

**ARKANSAS FOSSIL FUELS ACTIVITY UPDATE FOR 2019**

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**2020**

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### South Arkansas Oil and Associated Gas

South Arkansas has seen a decline in oil production for five consecutive years (Figure 1). In 2019, there were 4,561,223 bbls of crude oil produced in this region with 5,885,783 Mcf of corresponding associated gas (Figure 2). Cumulative oil production in south Arkansas as of the end of 2019 was 1,904,093,155 bbls. Approximately 31 drilling permits were issued, 32 wells completed, and 60 wells were plugged and abandoned in 2019.

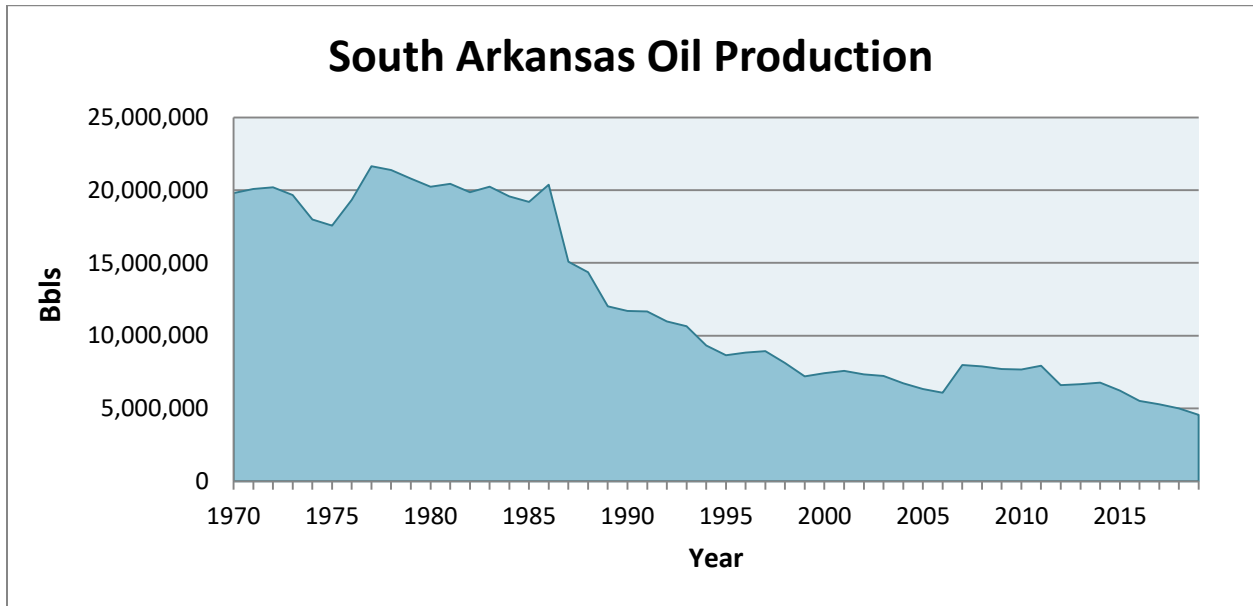


Figure 1. Annual oil production of south Arkansas (1970-2019).

### North Arkansas Conventional Gas

The western Arkoma Basin of Arkansas has long been a gas producing province with the bulk of the production coming from a stacked succession of Pennsylvanian sandstone reservoirs. Production of conventional gas for 2019 has declined by 12% to 58.3 Bcf (Figure 3). Cumulative production in the Arkoma Basin for all conventional gas wells and tight gas sands of the B-44 gas field producing region is approximately 7.33 Tcf as of the end of 2019. Only one drilling permit was issued and no gas wells were completed, while 85 gas wells were plugged and abandoned in 2019. Figure 4 illustrates that gas production in north Arkansas has had some modest increases since the mid-1980s, with a sharp increase in 2005 mostly associated with development of the Fayetteville Shale gas play.

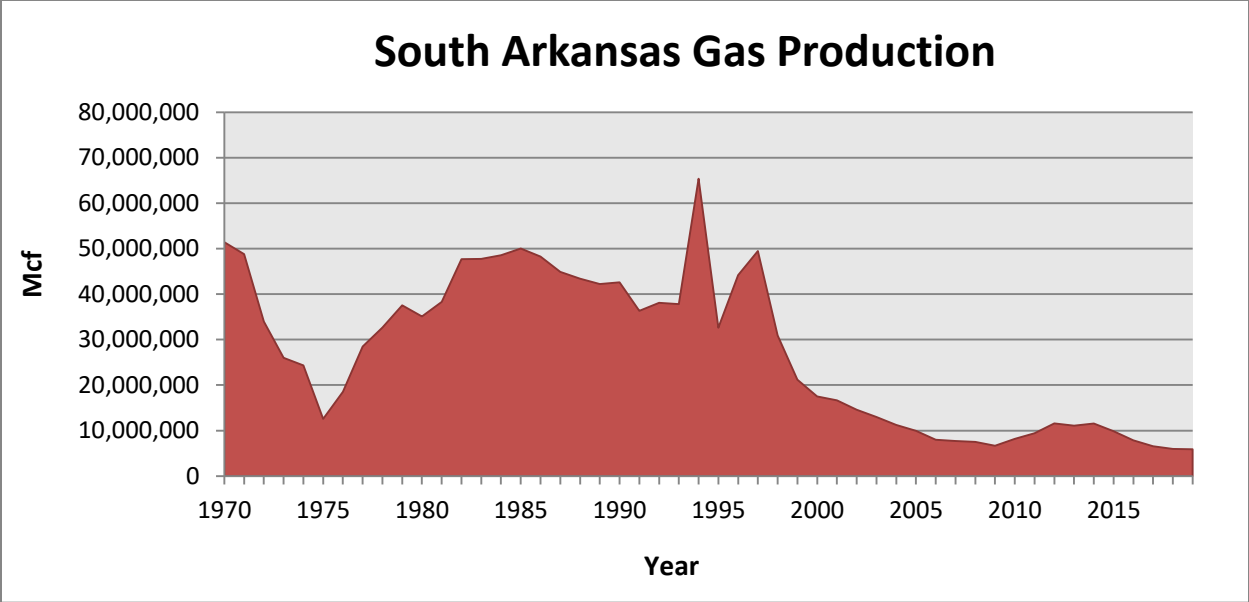


Figure 2. Annual gas production of south Arkansas (1970-2019).

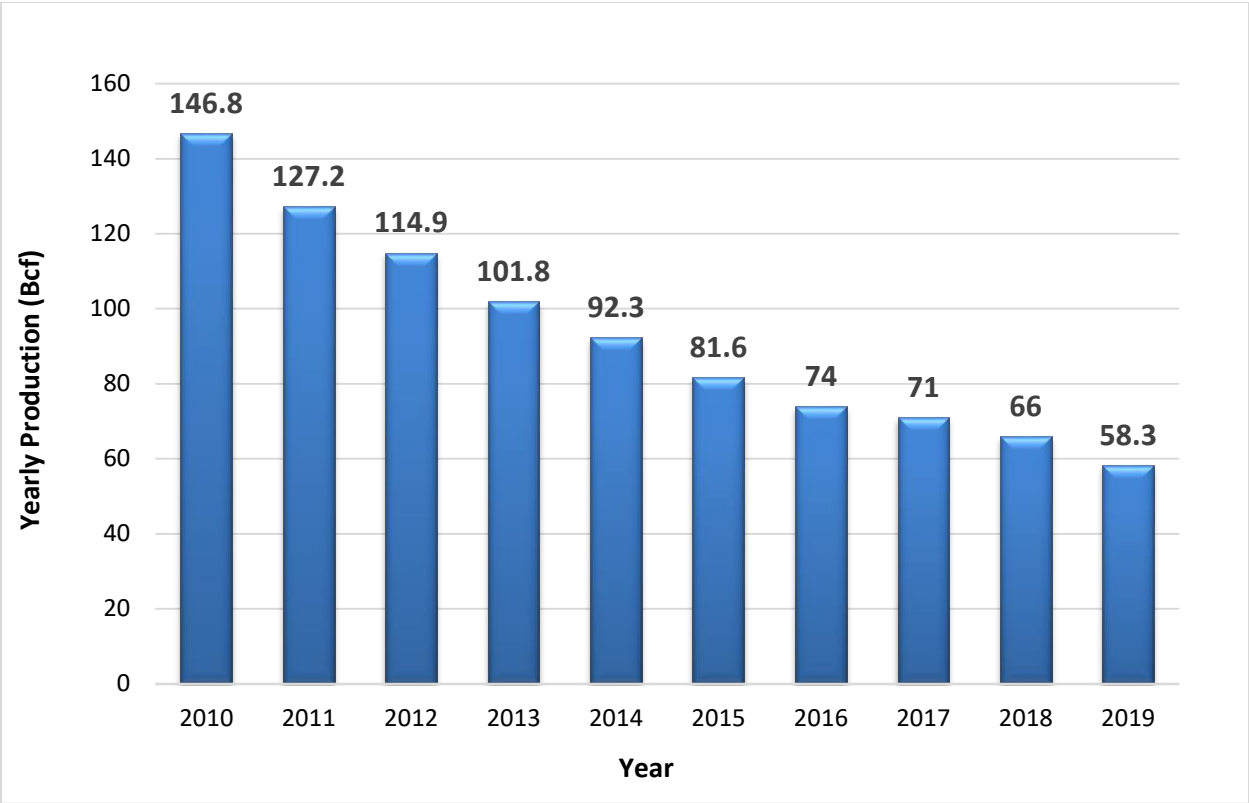


Figure 3. Annual conventional gas production of north Arkansas (2010-2019).

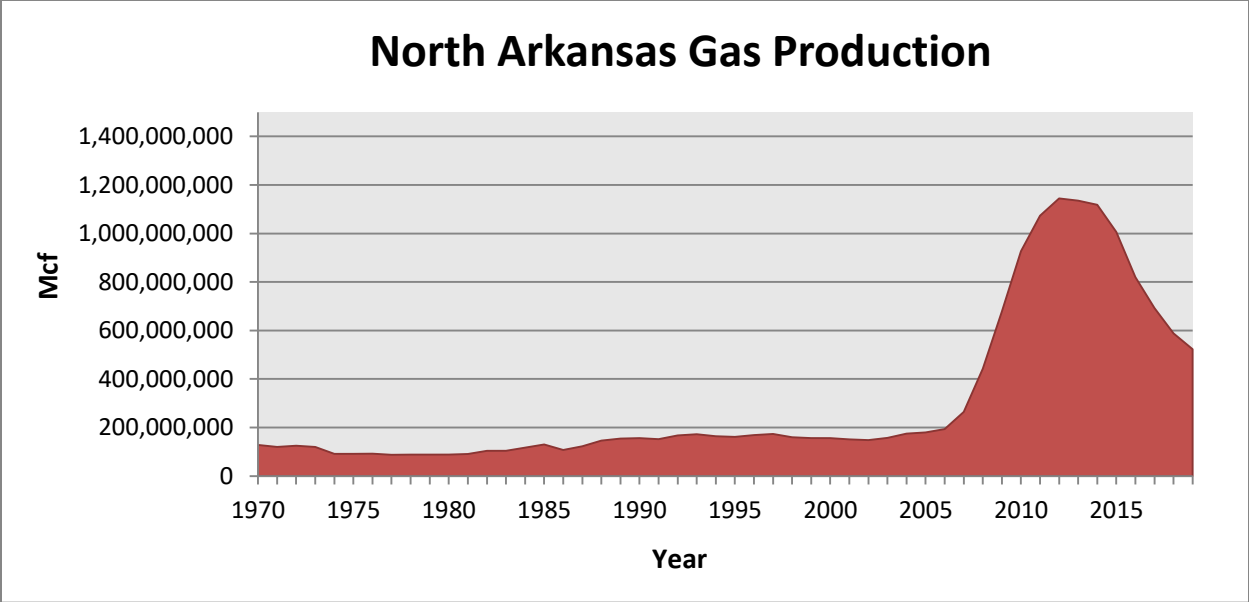


Figure 4. Annual gas production of north Arkansas (1970-2019).

**Fayetteville Shale Gas Play**

The Upper Mississippian Fayetteville Shale play is a regional shale-gas exploration and development program within the central and eastern Arkoma Basin of Arkansas. Approximately 2.5 million acres have been leased in the Fayetteville Shale gas play (Figure 5). Production of thermogenic gas from the Fayetteville began in 2004 and continues to the present.

The U.S. Energy Information Administration (EIA) reported in 2013 that the Fayetteville Shale contained 31.96 Tcf of technically recoverable gas resource, of which 27.32 Tcf was attributable to the core producing area (eastern area) and 4.64 Tcf for the remainder of the producing area (western area). A study by the Bureau of Economic Geology at the University of Texas at Austin found the play holds 38 Tcf in technically recoverable resources, of which a cumulative 18.2 Tcf are economically recoverable reserves by 2050. EIA also reported that the proven gas reserves of the Fayetteville Shale in 2017 were 7.1 Tcf, an increase over the 2016 estimate of 6.3 Tcf.

Most Fayetteville Shale wells are drilled horizontally and have been fracture stimulated using slickwater or cross-linked gel fluids. Fayetteville Shale gas production generally ranges over a depth between 1,500 to 6,500 feet. The thickness of the Fayetteville Shale varies from 50 feet in the western portion of the Arkoma Basin of Arkansas to 550 feet in the central and eastern regions.

Due to a decline in drilling activity driven by lower natural gas prices, Fayetteville Shale gas production has decreased since peaking in 2013. In 2019, approximately 465 Bcf of gas was produced in the play, a 11% decline over the last year. Estimated cumulative production of gas as of 2019 has totaled 8.95 Tcf (Figure 6). Initial production rates of horizontal wells in 2017

averaged about 5.3 MMcf/day. For more Fayetteville Shale information, please refer to the Arkansas Oil and Gas Commission's web link at <http://www.aogc.state.ar.us/sales/default.aspx>.

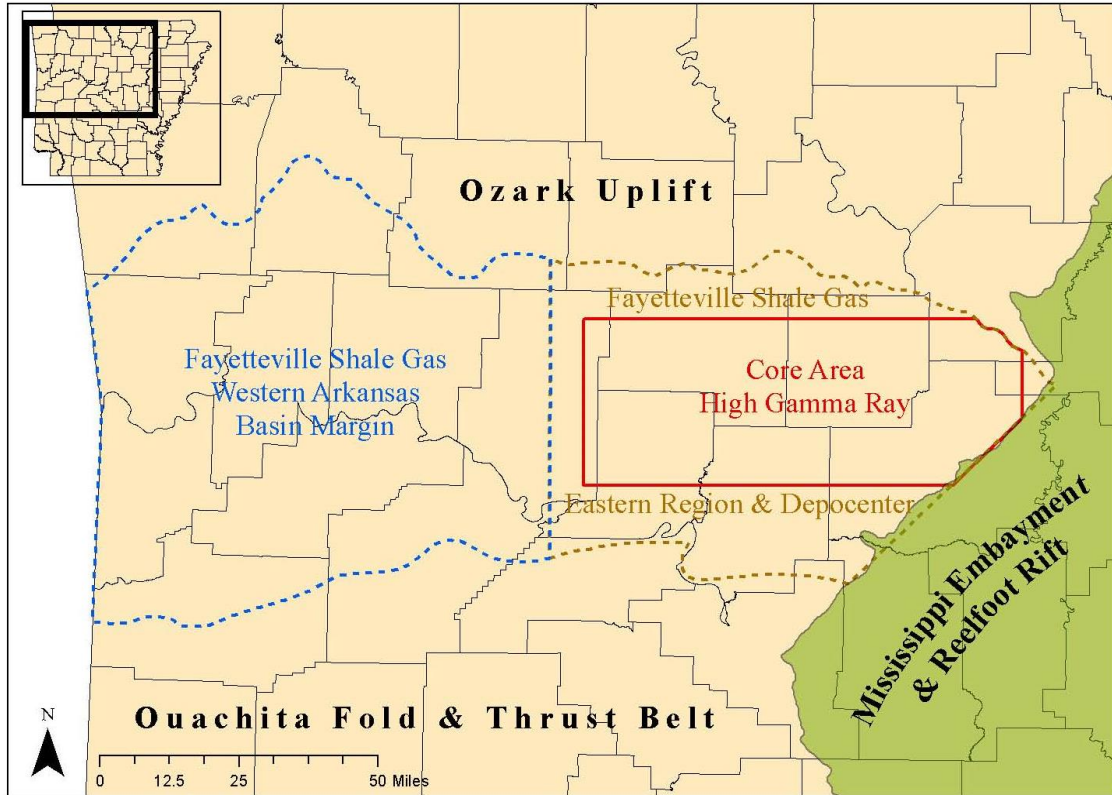


Figure 5. Primary area of the Fayetteville Shale exploration and development in Arkansas.

In the entire year of 2019, no drilling rigs worked in the Fayetteville Shale gas play (Figure 7), demonstrating a rapid downward trend in well completion since 2015 (Figure 8). Approximately 39 gas wells were plugged and abandoned.

The Arkansas Geological Survey (AGS) has completed two extensive geochemical research projects on the Fayetteville Shale and has provided this information to the oil and gas industry and the public to assist with exploration and development projects. The results of these studies were published by the AGS as Information Circular 37 (Ratchford et al., 2006) and Information Circular 40 (Li et al., 2010), which integrated surface and subsurface geologic information with organic geochemistry and thermal maturity data.

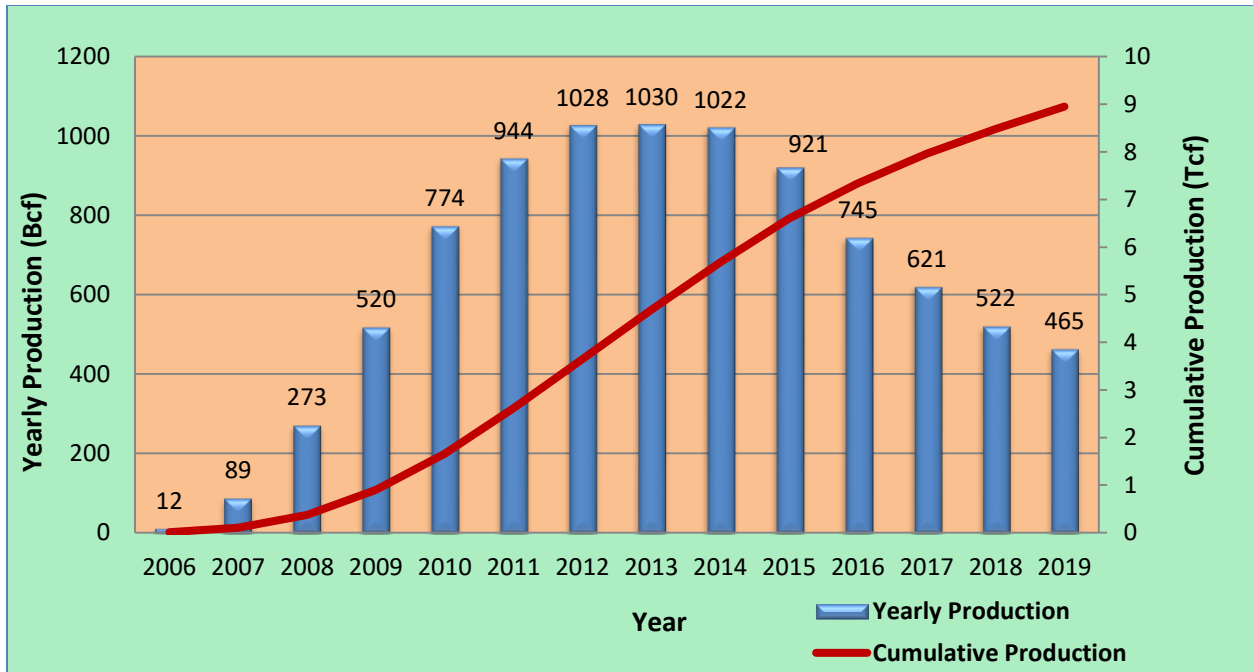


Figure 6. Annual and cumulative gas productions of the Fayetteville Shale gas play.

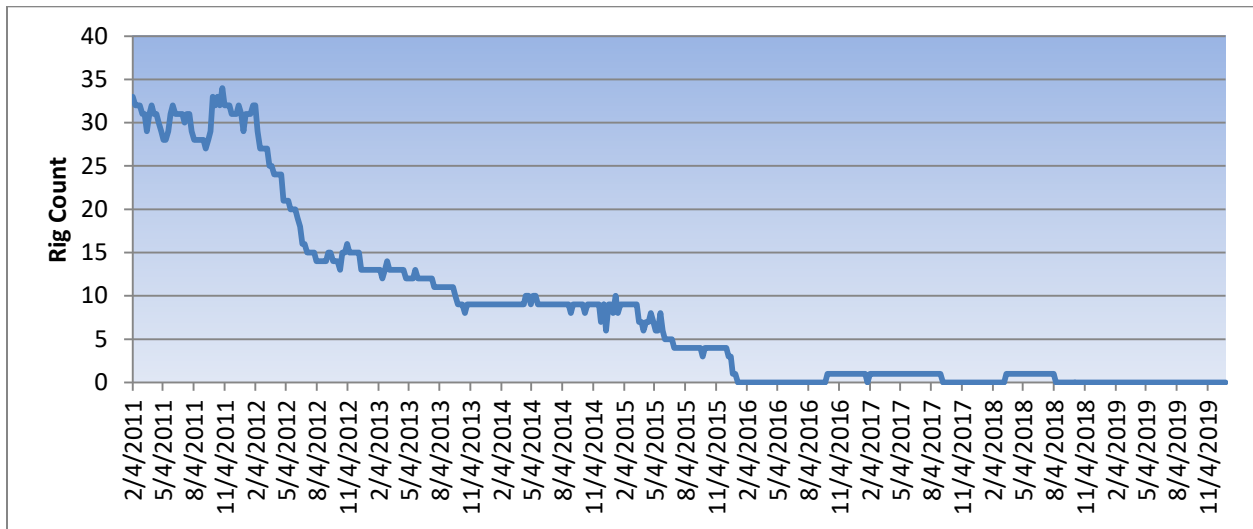


Figure 7. Weekly drill rig numbers in the Fayetteville Shale gas play (2011-2019).



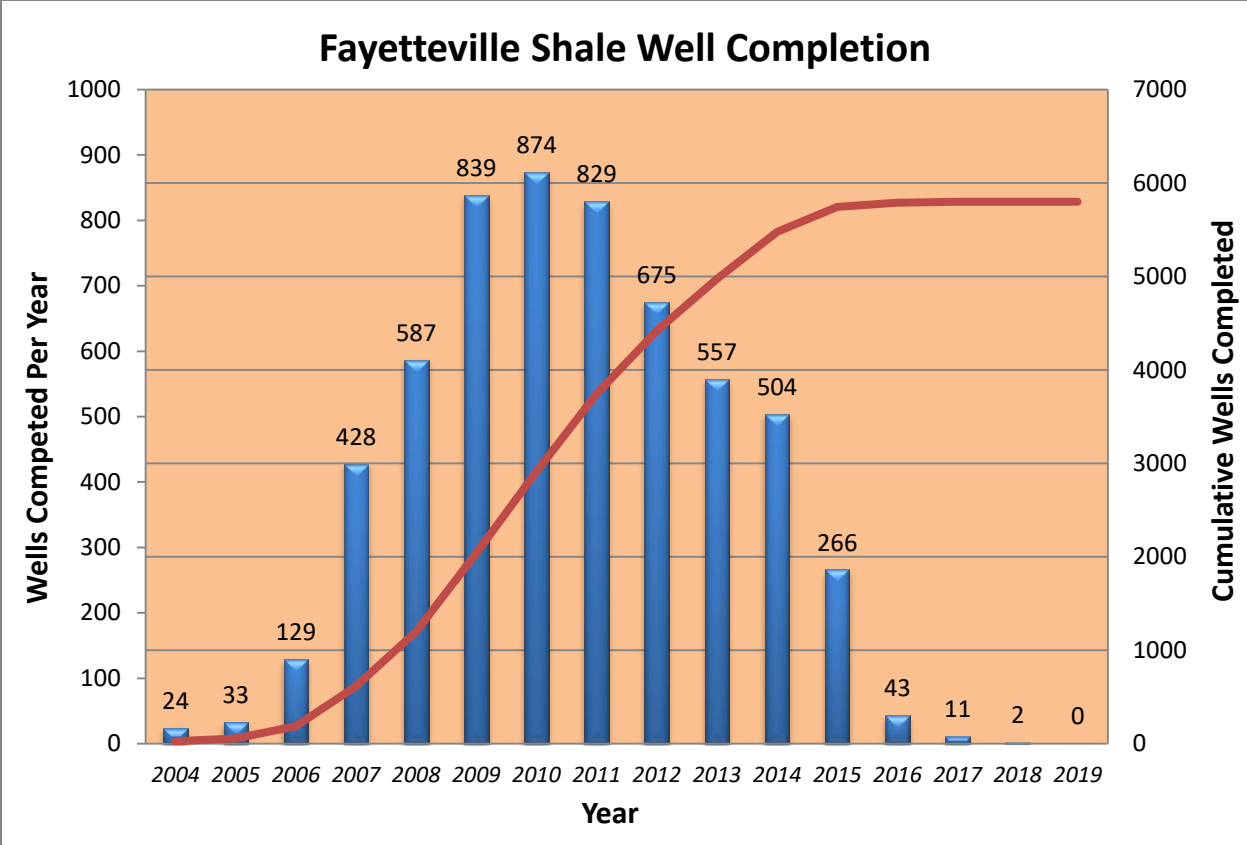


Figure 8. Fayetteville Shale well completion numbers.

**Lithium From Smackover Formation**

The abundance of lithium in southern Arkansas has been studied for decades (Collins, 1974, 1976). Lithium concentrations of 370-424 mg/L occur in Smackover Formation brines (Moldovanyi and Walter, 1992). The demand for lithium has skyrocketed in recent years as it is a key component in hybrid and electric vehicles and energy storage systems. Standard Lithium Ltd., headquartered in Vancouver, Canada, currently has 2 projects in south Arkansas: one with global specialty chemicals company LANXESS Corporation and another with TETRA Technologies, Inc.

In May 2018, Standard Lithium Ltd. signed an MOU agreement with LANXESS and its US affiliate Great Lakes Chemical Corporation (GLCC) in order to test and assess the extraction of lithium from brine already processed (“tail-brine”) at three LANXESS bromine extraction facilities in southern Arkansas. These three facilities (South, Central, and West) will produce and convey lithium chloride solutions via pipeline to the Central location in order to be processed into lithium carbonate (Figure 9).

A Resource Report was published in November 2018, followed by a Preliminary Economic Assessment in August 2019. The total resource estimate for the LANXESS Project is estimated at 3,140,000 tonnes lithium carbonate equivalent (LCE), with a planned production of 20,900 tonnes per year. Although the planned project operation time is 25 years, this resource estimate could extend production beyond this timeline.

Additionally, in November 2018 the Arkansas Oil and Gas Commission (AOGC) approved a joint application from Great Lakes Chemical Corporation and Arkansas Lithium Corporation, a new subsidiary of Standard Lithium Ltd., to operate a pilot plant in El Dorado, Arkansas. During the summer and into the fall of 2019, Standard Lithium Ltd. constructed a demonstration-scale lithium extraction plant in Ontario, Canada, which was broken down into modules and shipped to a LANXESS brine processing facility at their South Plant. Initial installation was completed in October 2019, and in December 2019 they completed installation of a semi-permanent structure to enclose the Plant and ancillary laboratory, as well as an office and control room. Since the beginning of 2020, utility and service connections were completed and the Plant entered the commissioning phase. An announcement in May 2020 expressed the successful completion of the commissioning phase and the start-up of this Plant. The project team will continue full-time operation of the Plant as well as conducting systematic optimization exercises in order to improve the performance of the Plant.

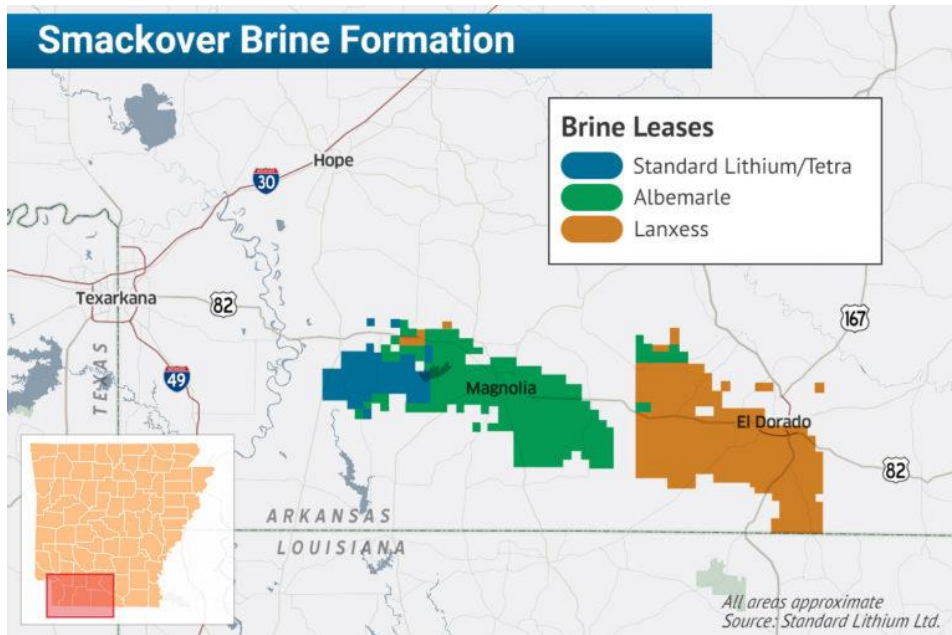


Figure 9. South Arkansas brine leases (<https://www.standardlithium.com/projects/arkansas-smackover>).

## Coalbed Methane

The development of Arkansas coalbed methane (CBM) resources began in 2001 and has yielded an approximate cumulative production of 32,280,544 Mcf as of year-end 2019. Since the production peak in 2007, the sales of CBM have continually declined. Out of 50 active wells, 48 of them contributed 768,323 Mcf to the total sales of 2019. Figure 10 shows the CBM production trend since 2001. EnerVest Operating LLC acquired all CBM wells in 2009 from CDX Gas LLC, who was previously the only producer of this resource in Arkansas until it filed bankruptcy in late 2008. Another active operator, Ross Exploration Inc., commenced CBM production in Arkansas in 2009 and possesses 3 producing wells to date. Most of the producing wells are Z-pinnate horizontal wells. The wells are completed in the Pennsylvanian Lower Hartshorne Coal and over 560,000 feet of horizontal lateral has been drilled in Arkansas. On average, approximately 15,000 feet of horizontal lateral is drilled for each of CDX’s Z-pinnate wells in the Lower Hartshorne Coal. The AGS routinely updates a map which reflects producing and permitted horizontal and vertical coalbed natural gas wells and can be downloaded from the AGS website at: [https://www.geology.arkansas.gov/docs/pdf/maps-and-data/fossilfuel\\_maps/csng-lower-hartshorne-coal.pdf](https://www.geology.arkansas.gov/docs/pdf/maps-and-data/fossilfuel_maps/csng-lower-hartshorne-coal.pdf)

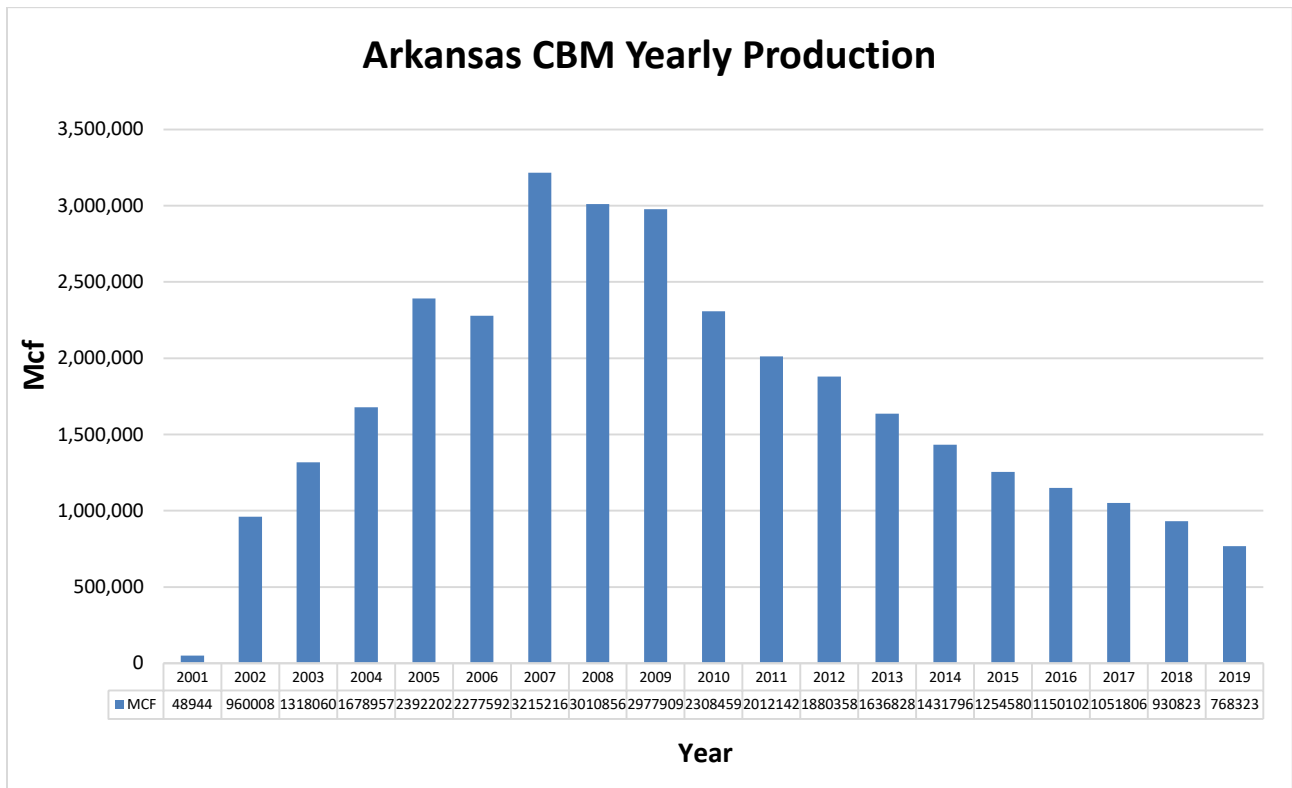


Figure 10. Annual production of coalbed methane in Arkansas.

## Coal

Arkansas has not had any coal production for two consecutive years since 2018. The Comer Coal Mine stopped surface coal production in 2018 and currently only leases to a sandstone quarrying operation. The underground mine operated by Sebastian Mining in southern Sebastian County discontinued mining in 2017 and has filed for bankruptcy. The surface Stryton Mine No. 1 also discontinued production in 2017 and is currently closed. All of the mines in Arkansas sold their coal to the AES Shady Point coal-fired power plant in eastern Oklahoma. Figure 11 shows the coal production trend since 2000.

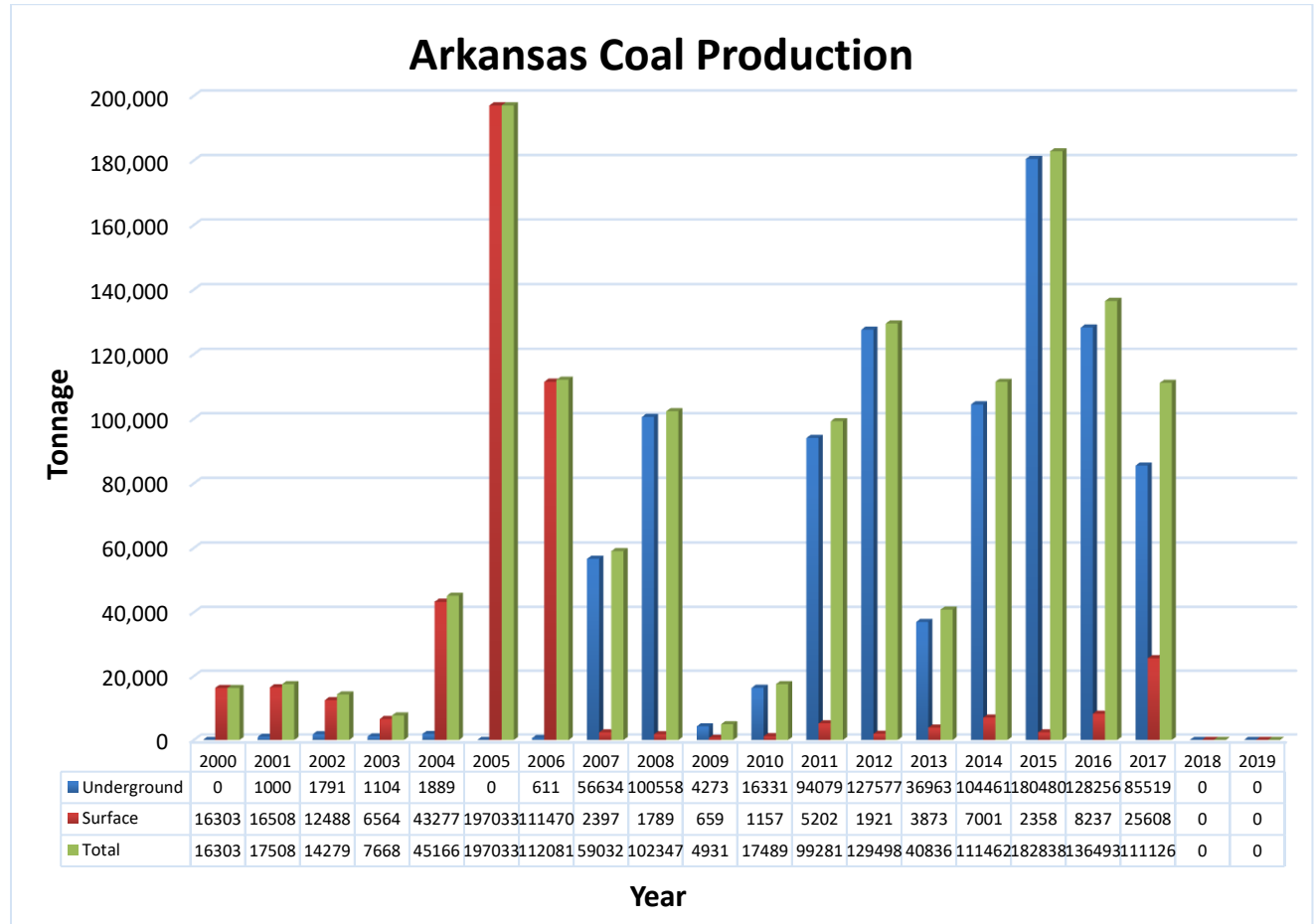


Figure 11. Annual coal production of Arkansas.

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