

There Really Is Oil & Gas In Tennessee

Prepared for the
Tennessee Oil & Gas Association

By Bill Goodwin
615-944-0832, wdgoodwin70@gmail.com



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Some 14 of Tennessee counties 95 counties now have or have had oil and gas production. Geologists believe that several other Tennessee counties also have potential for oil and/or gas production but have not been adequately explored.

This report focuses on an area of interest, which includes Fentress, Morgan and Scott Counties.

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History of Oil Production in Tennessee

Oil was discovered in Tennessee in 1866 as an offshoot to the very first oil discovery in Pennsylvania. Many Pennsylvania drillers flocked to Tennessee and the state production was booming until oil was discovered in Texas and the majority of oil exploration activity focused on Texas.

Some 1,104,436 barrels of crude oil was produced in the state from 1866 until 1968 when the state issued 13 drilling permits, but no oil was produced until 1970 when the West Oneida field was booming.

Oil production peaked in 1982 when more than 1,000 drilling permits were issued and over 1,000,000 barrels of oil produced. Now production is about 250,000 barrels a year

Virtually No Major Oil Company Drilling-Tennessee is one of the very few states in which no major company has ever operated. Several majors developed large lease positions and a few drilled wildcat wells but none ever established a foothold in the state.

With the combination of inexpensive leases, little competition for leases and services, shallow drilling and an excellent producing well to dry hole ratio, Tennessee was the perfect place for promoters. Many “made their money on top of the ground” and made little effort to develop properties.

Drilling made money for the promoters, who had little interest or ability to produce. That is one of the reasons there are some 3,000 abandon wells in Tennessee, many with commercial potential, if properly stimulated and competed.

Estimated Crude Oil Reserves in Fentress, Morgan & Scott Counties

Formation	County	Acres	Potential	Acres/Potential	Bbl./Acre	Potential Oil Reserves
Monteagle	Fentress	319360	15%	43104	1000	43,104,000
	Morgan	334080	75%	256800	1000	256,800,000
	Scott	342400	70%	233856	1000	233,856,000
						-
Ft. Payne	Fentress	319360	3%	9580.8	3150	30,179,520
	Morgan	334080	20%	66816	3150	210,470,400
	Scott	342400	40%	133632	3150	420,940,800
						-
Chattanooga Shale	Fentress	319360	0%	0		-
	Morgan	334080	0%	0		-
	Scott	342400	0%	0		-
						-
Ordovician *	Fentress	319360	15%	95808	3000	287,424,000
	Morgan	334080	15%	100224	3000	300,672,000
	Scott	342400	15%	102720	3000	308,160,000
						2,091,606,720

Monteagle and Ft. Payne gas reserves based on portion of county with gas production or known potential gas reserves assigned to wells by previous Tennessee Gas Reserve Studies.

* Ordovician has very limited oil production in the area of interest. Oil production history in the Ordovician West and East of Area of Interest used to estimate possible gas reserves.

History of Tennessee Natural Gas Production

There has been limited natural gas production in Tennessee since 1866. According to state records, from 1866 through 1969, natural gas production was 51 MMCF. (Million cubic feet of gas)

In one year, with the discovery of the Oneida West field in Scott County, (Now, the majority of which is owned by Monteagle Oil & Gas LLC) natural gas production jumped to nearly 63 MMCF. From 1970 to 1977, gas production was little more than a byproduct of the oil production and the price was as low as \$.19 per MCF.

In 1978, the price for natural gas produced in Tennessee was up to \$1.43 per MCF in Tennessee and production increased to 467,762 MCF.

Natural gas production increased each year and peaked in 1984 with 5,022,717 MCF and an average price of \$3.50. Production in 1985 was 4,383,233 MCF with an average price \$2.48.

Over the next 18 years production stayed in the 3 to 4 MMCF range with price averaging \$.1.50 per MCF. The price of natural gas began increasing and then peaked in 2005 at \$9.49 per MCF. Producers responded, bringing more wells on line, but the production increase didn't catch up with price. By the time the state was producing 5,026,288 MCF in 2009, the price had dipped to \$4.02 per MCF.

From 2010 through 2016, natural gas production in the state has stabilized in the 5 MMCF range with prices dipping into the \$2 range.

Natural Gas Sales Limited By Lack of Market

The only sustaining market for locally produced in the Area Of Interest), the major gas production region, was through the distribution lines of the local utility district, Citizens Gas Utility District..

Neither the gas producers nor the utility management has been completely satisfied with this arrangement. For the producers, the prices they received from their gas are substantially below posted market prices.

Wells were often shut-in by the utility company for a variety of reasons, by the utility without notice.

For the utility district, locally produced gas often meant liquids in the line, varying BTU levels, and wells that froze up in the winter when gas was needed the most.

Both sides tolerated the problems because for producer's it was the only market they had. For the utility district, it meant a less expensive source of gas for their customers. Citizens Utility District uses about 10 million mcf per day in the winter. It is all a "heat load" with very little industry usage, so there is little gas needed in the summer months.

Citizens Gas sold excess locally produced gas into the East Tennessee Natural Gas interstate pipeline near Deer Lodge and collects NYMEX price for this gas that it bought for substantially less.

For many years, producers were paid for the excess BTU in their gas. Most Tennessee gas is in the 1250 plus BTU range while pipeline quality gas is in the 1000 BTU range. Until 2004 local producers received a 20% premium price for their gas because of the high BTU, and higher heating value.

Then, without notice, Citizens quit paying the BTU bonus, but continued to collect for the higher BTU gas when sold into the interstate pipeline. Shortly thereafter the biggest problem gas producers had was getting rid of that high BTU gas.

In 2008 the Federal Energy Regulatory Authority changed the rules on basis for acceptable BTU into interstate pipelines. The Federal Energy Regulatory Authority (FERC) decided that any gas with a BTU higher than 1100 was unsafe and should not be transported in interstate pipelines or sold to customers.

Citizens began shutting in most local production due to high BTU, citing the FERC mandate of 1100 BTU requirement.

Now to sell locally produced gas, it has to be blended with lower BTU pipeline gas, a costly process. And many shut in high BTU wells remained shut in because there was no way to get the lower BTU gas into some areas to blend the high BTU gas.

In 2010, Tennessee gas producers were being paid about \$4.00 per MCF for their gas. Additional gathering lines were build and plans were underway for a gas stripping plant, which would lower the high BTU of Tennessee gas to FERC accepted limits and provide additional income from selling the liquids stripped from the gas. Then the price dropped to less than \$ 3.00 and has remained below nearly every month since.

There is very little gas being produced in Tennessee today. The potential is there but the market price limits continued producing of existing wells and has curtailed any new exploration.

Estimated Potential Natural Gas Reserves in Fentress, Morgan & Scott Counties

Formation	County	Acres	Potential	Acres Potential	MCF/Acre	MCF Potential Gas Reserves
Monteagle	Fentress	319360	20%	57472	3000	172,416,000
	Morgan	334080	80%	273920	3000	821,760,000
	Scott	342400	70%	233856	3000	701,568,000
Ft. Payne	Fentress	319360	10%	31936	5000	159,680,000
	Morgan	334080	30%	102720	5000	513,600,000
	Scott	342400	40%	133632	5000	668,160,000
Chattanooga Shale	Fentress	319360	50%	159680	4997	797,920,960
	Morgan	334080	100%	334080	4997	1,669,397,760
	Scott	342400	100%	342400	4997	1,710,972,800
Ordovician	Fentress	319360	30%	95808	3000	287,424,000
	Morgan	334080	30%	100224	3000	300,672,000
	Scott	342400	30%	102720	3000	308,160,000
Total MCF TCF 8.1						8,111,731,520

Monteagle and Ft. Payne gas reserves based on portion of county with gas production or known potential and gas reserves assigned by wells in previous studies

Chattanooga Shale reserves based on calculations provided in Dr. Gary Bible study for state Of Tennessee to determine potential severance tax revenue.

Ordovician has very limited gas production in the area of interest. Gas production history from the Ordovician formation east and west of area of interest used to estimate.

Tennessee Producing Formations

The area of interest is situated on the east flank of the Nashville Dome and south of the Cincinnati Arch on the Cumberland Plateau in the Central Appalachian Basin.

The Appalachian Basin is the nation's oldest producing region. Production to date has been estimated to exceed 43 million cubic feet of natural gas equivalents. According to published reports, the basin still has an estimated 95 to 158 trillion cubic remain oil and gas reserves.

Monteagle Limestone-Mississippian age, consisting of 200-250 feet of massive limestone with shale beds. It contains chert and has fossil-fragmental and oolitic porous zones. Porosity is vulgar and normally occurs in 5 to 30 feet near the middle of the formation. It is a consistent oil and gas producing formation. The average barrels of recoverable reserves is in the 20,000 barrels per well range. Most petroleum engineers assign 60 MMCF gas to Monteagle wells. This is based on volumetric calculations. However, many Monteagle gas wells have produced five times this amount of gas due to natural fracturing. Other Monteagle gas wells in the area are still producing commercial quantities of gas after 30 years.

The Monteagle is also known by operators as "save your ass gas." Many, many operators searching for oil in the deeper Ft. Payne, discovered gas in the Monteagle. While it was not as valuable as the oil they sought and it would take time to build collection systems, it was better than a dry hole.

St. Louis Limestone-A Mississippian age limestone formation, usually about 80 feet thick. Will produce oil when porous zones are present, but this is seldom seen in this area.

Fort Payne Limestone-This Mississippian age formation consists of massive limestone with considerable chert. It is also fossiliferous, especially in crinoid's fragments. The thickness is 10 to 150 feet. It is a very prolific producer of oil with a small amount of associated gas cap. The formation produces little or no water in associations with the hydrocarbons. The porous zones are called

reefs and range in thickness from 5 to 30 feet. They appear to be developed in a northeast-southwest direction along terrace or minor anticlinal folds.

Chattanooga Shale-This Devonian age formation is usually 30 to 60 feet thick and lies just below the Fort Payne. The Chattanooga shale is jet black with minor gray shales and small amounts of pyrite. It is quite radioactive and has a distinct signature on the Gamma Ray geophysical logs.

To the north, this shale thickens to several thousand feet and is the source of the majority of gas production in eastern Kentucky. It is characterized by relative low flow rates with large recoverable reserves over a long period of time. Shale wells have been reported to have produced for more than 100 years.

On the Plateau, while a few Chattanooga Shale wells produce naturally, for a short time it was a drilling target until the gas prices dropped. For a short period of time, new stimulation techniques and high natural gas prices combined to make the shale an attractive target. During that period, Chattanooga Shale wells were being stimulated with nitrogen and sand, resulting in wells with IPs of 30 to 70 mcfpd.

Trenton, Sunnybrook, Stones River- These Middle Ordovician formations consist of thick-bedded limestone with minor interbedded shales. The combined thickness can be up to 1,500 feet. Some porous zones appear to consist of fractures with secondary crystallation. Often there are numerous sections of porosity 10 to 20 feet thick.

These Ordovician formations are the major source of oil off the Plateau to the west, where wells of up to 1,700 barrels of oil a day have been discovered at depths of less than 2,000 feet.

These formations have seldom been penetrated in Fentress, Morgan and Scott counties. There have been several blow outs of Ordovician wells in the area that came in at several thousand barrels of oil for a few days, then quit producing for unknown. In each case, when efforts were made to produce the

wells later, they produced only a small amount of gas. These wells are all located in the southeastern region of Morgan County.

Knox-This lower Ordovician formation is a massive, dolomitic limestone, which has seldom been completely in Fentress, Morgan and Scott counties. The thickness is in excess of 2,000 feet. The top of the Knox is a regional unconformity with the porosity and permeability related to surface leaching. There is no know oil or gas production from Knox wells in this area of interest. However, the Knox produces oil from shallower depths to the West and gas and oil from deeper depths to the East.

Oil and gas was discovered in Hancock County in 2001, which is about 100 miles east of the Fentress, Morgan, Scott counties area.

More than 40 commercial wells had proven net reserves to the operator that were estimated to be 35.5 bcf of gas and 319,400 barrels of oil.

The faulting in this area likely increases in magnitude with depth, which should increase the possibility of greater structural closure on the deeper formations. The major deeper zones, which are virtually untested in this area. In fact, there has been little drilling in these zones throughout Tennessee.

Rose Run (Middle Knox) at about 5,000 feet; the Copper Ridge at about 6,400 feet and the Roane Sand at 8,200 feet. The basement complex is expected at 8,500 to 10,000 feet.

Basement-A basement test, permitted to 7,500 feet, was spudded in mid-August 2007 in the High Point area of Morgan County. The location is near the site of a well that blew out in Trenton in 2000, caught fire and put oil into a national park. The well has been declared a dry hole and plugged.

A stratigraphic column for the area of interest is attached. Generally speaking, the rocks get deeper in Tennessee moving east, illustrating the depths of the formations in Fentress, Morgan and Scott Counties (Exhibit 14)

Conclusion

A 2005 industry-government study of the Appalachian Basin describes the basin as “Our “most drilled but least explored basin.”

The report: *MATURE REGION, YOUTHFUL POTENTIAL, Oil and Natural Gas Resource in the Appalachian and Illinois Basins*, was published The Interstate Oil & Gas Commission (IOGCCD) and the Department of Energy’s Office of Fossil Energy and National Energy Technology Laboratories.

After more than a century, the Appalachian and Illinois basin still contain at least as much oil and natural gas as have been produced to date,” the study predicts.

The report continues, “Applying new technology and concepts is resulting in a wide range of new activities in the basins, citing horizontal drilling, multi-state stimulations, advanced geophysical analyses and drilling cost reductions are enabling operators to take a new look at the shale and the Trenton, which extends through both basins.

The gas reserves estimated for the area of interest for this study, Fentress, Morgan and Scott Counties, reflect the conclusions reached in *the MATURE REGION, YOUTHFUL POTENTIAL* 2005 industry-government report of the Appalachian Basin, the basin still contains at least as much oil and natural gas as has been produced to date.

Editor’s Note: More information available from author of this report, William “Bill” Goodwin, 615-944-0832 or email: wdgoodwin70@gmail.com.