

# Hugoton Natural Gas Area of Kansas

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## Introduction

The Hugoton field is the largest natural gas field in North America and the second largest in the world. The Hugoton is only one of many gas fields in southwest Kansas (fig. 1) that have been important to Kansas since their development in the 1930s. The major gas fields of this area — Hugoton, Panoma, Bradshaw, Greenwood, and Byerly — have produced almost 27 trillion cubic feet of gas (enough gas to supply every household in Kansas for 364 years, based on 1994 gas consumption rates). The Hugoton and associated gas fields are part of a large, bowl-shaped structure that underlies most of southwest Kansas. This region is referred to as the Hugoton natural gas area.

The Hugoton natural gas area provides gas and oil to Kansas and the nation, generating significant revenues and providing jobs and income in at least 13 counties in southwest Kansas. Economically, the Hugoton area is Kansas's most important natural resource. It will continue to be an important resource for Kansas in the future, but it must be understood, managed, and developed in a way that will maximize its benefit to Kansans. This circular explains the history and geology of the Hugoton gas area, its importance to the state, and how foresight and stewardship will affect its future.

## Geology

Geologists refer to southwest Kansas as the Hugoton basin or Hugoton embayment, a northern shelf-like extension of a larger and deeper subsurface feature in Oklahoma and Texas known as the Anadarko basin. The Hugoton embayment is a large (about 12,000 square miles; 31,080 square kilometers), southward-plunging trough bounded by uplifted areas on the west, north, and east.

In the ancient past, the Hugoton natural gas area was low and often covered by seas that repeatedly inundated and retreated from the shallow arm (or embayment) of the deeper Anadarko basin, leaving interbedded deposits of carbonate (limestone and dolomite) and shale. Thousands of feet of sediment accumulated over millions of years of geologic time. Sedimentary rocks thicken toward the middle of the basin and southward to about 9,000 feet (2,740 meters) near the Kansas-Oklahoma border. Oil and gas wells drilled in the deepest part of the Hugoton in

Kansas are over 5,000 feet (1,520 meters) deep, deeper than wells drilled in other parts of the state. As the Anadarko basin deepens into Texas and Oklahoma, some wells are over 20,000 feet (6,090 meters) deep.

Natural gas and oil are produced from several different rock layers (fig. 2) and many individual fields. Most of the gas is produced from two rock units, the Chase and Council Grove Groups, that were deposited during the Permian Period, about 280 million years ago. These same units crop out in the Flint Hills of eastern Kansas. The Hugoton, Byerly, and Bradshaw fields produce gas from the Chase Group. Council Grove Group production is restricted to the Panoma field that is underneath and geographically overlapped by the Hugoton field (fig. 3). Rocks that are deeper and older than these units also produce significant amounts of oil and some gas in the Hugoton area, but many of these deeper zones have not been thoroughly tested. The potential for finding significant quantities of oil and gas is good, especially in the older Pennsylvanian and Mississippian rocks.

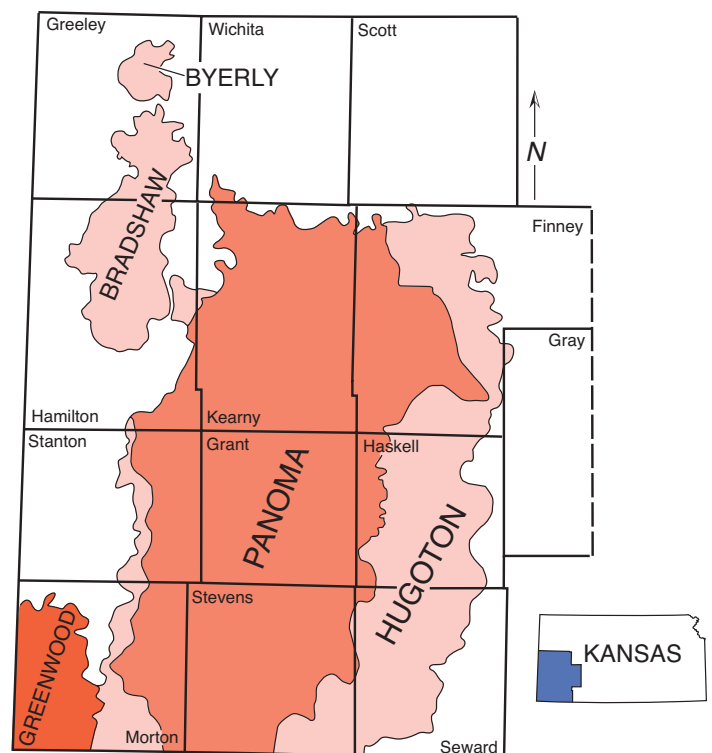


Figure 1. The Hugoton natural gas area in Kansas.

Period	Group	Field
Permian	Sumner	
	Chase	Hugoton Byerly Bradshaw
	Council Grove	Panoma
Pennsylvanian	Admire	
	Wabaunsee	Greenwood
	Shawnee	

Figure 2. Geologic units that produce gas in the Hugoton area.

Gas has accumulated in porous reservoir rocks, mostly Permian limestone and dolomite. Figure 3 illustrates a west-east cross section through the Hugoton field. The rocks of the Chase and Council Grove Groups are tilted slightly downward toward the east (and southeast) because of the uplift of the Rocky Mountains to the west. Gas moving from the deeper Anadarko Basin through porous rocks always seeks a higher level (geologists say it moves updip) until it is stopped or trapped. The updip trap on the west and north sides of the field is a stratigraphic-type trap — that is, a trap created by a change in the type of rock. Porous limestones and dolomites interfinger into red shales and siltstones (which were washed eastward from the Rocky Mountain uplift); these shales and siltstones form

a barrier that effectively stops the migration of gas. The field is pinched off to the east where the impermeable rocks of the Sumner Group meet the underlying groundwater (fig. 3). The top seal is provided by the overlying Sumner Group, a very tight barrier of anhydrite and shale.

### History

Gas in the Hugoton embayment was discovered in 1922 in Seward County, three miles west of Liberal. Because this well did not produce oil, it was considered to have little value and remained unused for several years. In 1927, gas was discovered at the Independent Oil and Gas Company's Crawford No. 1, about 2,600 feet (790 meters) below the surface southwest of Hugoton, Kansas, in Stevens County (Furbush, 1959). This is now considered the center of the Hugoton producing area. By the end of 1928, five wells had been drilled in the field and the first pipeline was transporting gas to local markets. In 1929, Argus Pipe Line Company started construction of a pipeline to furnish gas to Dodge City, Kansas (Hinton, 1952). Construction of major pipelines in the 1930s encouraged further drilling in the area. Today, approximately 11,000 wells produce gas and oil in the Kansas portion of the Hugoton area, and thousands of miles of pipeline carry Hugoton gas to many parts of the U.S.

In the interest of conservation, efficiency, and fairness, Kansas oil and gas production has been regulated since the 1930s. Regulations governing well spacing and rates of production continue to change as new technology and more information become available.

In 1983, the Deep Horizons Bill, which encouraged deeper exploration below the shallower gas-producing zones in the Hugoton area, was passed by the Kansas Legislature. For many years, wells were drilled on 640-acre

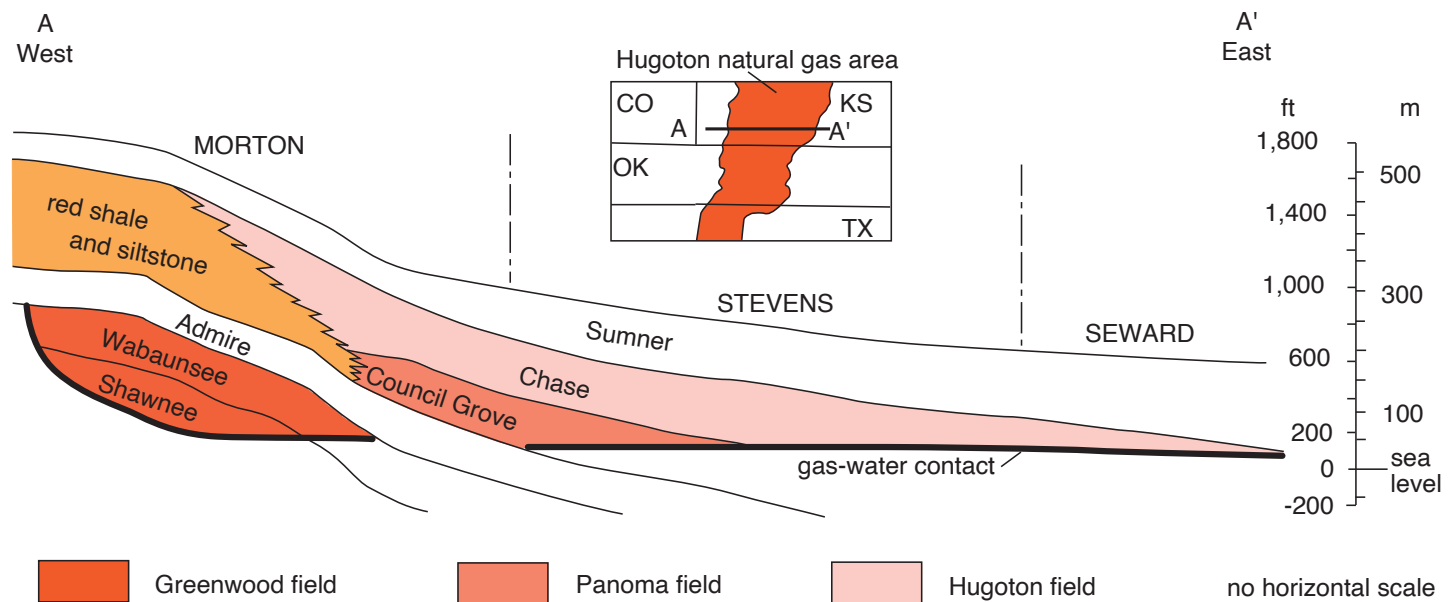


Figure 3. Schematic west-east cross section through the Hugoton natural gas area (modified from Parham & Campbell, 1993).

(2.59-square kilometers) spacing units, or approximately one well per square mile. In 1986, the Kansas Corporation Commission (KCC) ruled that the Chase Group rocks in the Hugoton field were not being efficiently drained of gas and that more wells were needed to improve production. At that time, the Commission estimated that an additional 3.5 to 5 trillion cubic feet of gas, or roughly 10 to 15 years of additional production (at 1985 rates), could be recovered from the Chase Group in the Hugoton field. The Deep Horizons Bill, in conjunction with the KCC ruling, encouraged drilling and has led to increased gas production and the doubling of oil production from southwest Kansas (fig. 4 and fig. 5).

### Importance to the State

The Hugoton gas area contributes significantly to the Kansas economy, both in terms of revenue and jobs. Since its discovery, the Kansas portion of the Hugoton gas area has produced almost 27 trillion cubic feet of gas. In 1995 alone, southwest Kansas fields produced 639 billion cubic feet (BCF) of natural gas, or 90% of the total gas produced in Kansas (fig. 4). In the same year, these fields produced 10 million barrels of oil (MBO), about 23% of the state's annual oil production (fig. 5). The combined worth of this gas and oil is estimated at \$1.3 billion.

During that same year, the Hugoton area provided about \$80 million in severance taxes to the state and probably an equal or greater amount from ad valorem, sales, and income taxes on royalty owners, companies, and employees. The state also receives other taxes that result from the activities of the oil and gas industry. These include indirect taxes on the goods and services purchased by the oil and gas industry and the taxes paid by downstream industries, those involved in refining, distribution, and manufacturing of hydrocarbon-based commodities, such as plastic and fertilizer. The oil and gas industry also pays property taxes to the counties.

Gas and oil production in the Hugoton area has been increasing, and the long-term producibility is the best in the state. Hugoton gas and oil production have both doubled in the last decade, resulting in production valued at \$1.5 billion, which translates into \$90 million in additional severance tax money to the state. This production increase is in sharp contrast to the steady production declines in the rest of the state and nation. Gas and oil production from the Hugoton area of southwest Kansas is important, if not critical, to the economic health of the region and the state.

### Future of the Hugoton Gas Area

Published information on the Hugoton area is rare considering its geographic size, the amounts of gas and

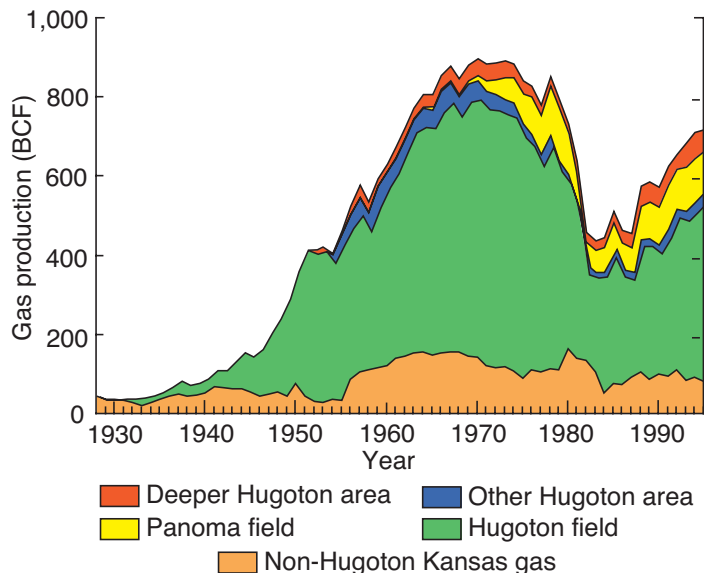


Figure 4. Gas production in Kansas (BCF = billion cubic feet of gas).

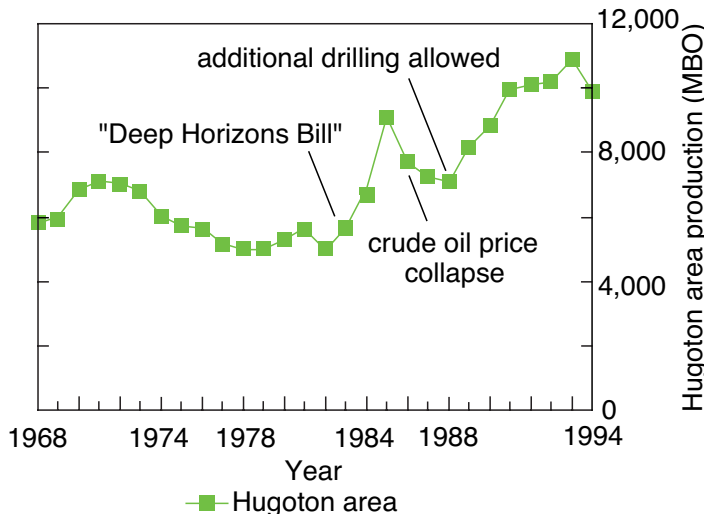


Figure 5. Oil production in Kansas (MBO = million barrels of oil).

oil produced, and the revenues generated. Despite the Hugoton's long history of production, no comprehensive study has guided how best to explore, produce, and regulate gas and oil in the Hugoton area. Relatively little is known of the basic architecture of the reservoirs or the fundamental geologic controls on the migration, trapping, and production of gas and oil.

For years, geologists thought the reservoirs that produced gas from the giant fields were relatively continuous, or homogeneous. Modern studies now show the rocks can contain barriers restricting the flow of gas both vertically and horizontally, causing many of the reservoirs to be isolated into individual compartments. Understanding how the reservoir is divided is important for efficient recovery of gas and oil. The ultimate goal is to

drill the minimum number of wells that will recover the maximum amount of available gas or oil.

The urgency for policy based on strong scientific knowledge is highlighted by declining trends in reservoir pressure. Reservoir pressures that are higher than the surface pressure force gas to the surface, much like letting air out of a balloon. Because of development, the average reservoir pressure in the Hugoton area has declined from over 400 pounds per square inch (psi) to under 100 psi today. At the current rate of decline (fig. 6), pressures will soon approach their economic limit — that is, the cost of bringing the gas to the surface will exceed the value of the gas. As reservoir pressures continue to decline, intelligent energy policies and new technologies must be developed to assure continued production.

Knowledge and a technical base are required for intelligent stewardship, generation of new opportunities, and continued improvement in recovery strategies. A better understanding of the Hugoton area would allow more efficient exploitation of this resource. State policy-makers, operators, regulators, and mineral owners need accurate information to make informed decisions about regulations, drilling and production programs (for example, infill drilling and drilling of deeper horizons), and how to recover the most gas and oil from the Hugoton area. The Kansas Geological Survey is proposing a comprehensive study that will provide the geological information that is needed for intelligent decision-making.

The Hugoton area in Kansas contains an estimated 10 to 15 trillion cubic feet of natural gas. Even a small increase in annual and ultimate production of gas and oil from the Kansas portion of the Hugoton area will result in many millions of dollars of economic activity and tax revenues. Savings from more efficient production practices and access to smaller, currently unknown reservoirs could extend the field's life. Both the public and private sectors will benefit from efficient and increased production of oil and gas from the Hugoton area.

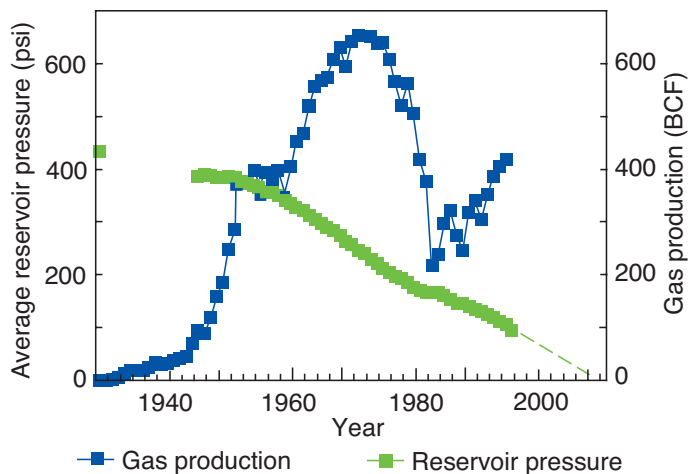


Figure 6. Declines in reservoir pressure in the Hugoton natural gas area (BCF = billion cubic feet of gas) (modified from David Williams, Kansas Corporation Commission).

Kansans should be aware that the oil and gas resources of the state require continuous stewardship. Just as we manage our valuable groundwater resources, we must protect and manage the Hugoton natural gas area. Periodic review of energy policies and development of new technologies must continue in order to maintain the environment for conscientious and beneficial exploration, development, and production.

## References

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