

LOUISIANA GAS SHALES AND ECONOMIC IMPACTS

by
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The Louisiana gas shale resources have transformed the state energy outlook in a few short years. Louisiana shale formations are located in Northern, Northwest, and Central Louisiana.

- The Lower Smackover Brown Dense formation is an unconventional oil and gas reservoir found in Southern Arkansas and Northern Louisiana. The formation ranges in vertical depths from 8,000 to 11,000 feet and appears to be laterally extensive over a large area ranging in thickness from 300 to 550 feet. Industry says it is too early to tell how much of the hard-to-reach oil is recoverable, but some have speculated that the formation could hold more than 1 billion barrels of oil and some gas.
- The Haynesville-Bossier, or Haynesville, formation is a layer of sedimentary rock more than 10,000 feet below the surface of the Earth that runs through Northwestern Louisiana, Northeastern Texas, and the southwestern tip of Arkansas. This formation is an unconventional dry natural gas field that was once considered too costly to explore, but rising energy costs and newer technology and processes have changed that. Some industry experts believe the Haynesville shale could ultimately produce as much as 30 to 40 trillion cubic feet of natural gas. Chesapeake Energy is the major leaseholder and producer in the Haynesville, and others operators such as BHP Billiton Petro, EXCO, Encana, QEP Energy, and SWEPI LP have acquired significant positions and are increasing production. The Cotton Valley tight gas formation is located just above the Haynesville shale in Louisiana and Texas, and is also a major target for companies operating in this area. The depth of the Cotton Valley formation is roughly 7,800 to 10,000 feet. Although it is mainly a natural gas play, some oil has been produced in parts of the Cotton Valley.
- Central Louisiana is currently home to three important shale plays: The Tuscaloosa Marine Shale (TMS), the Louisiana Eagleford Shale, and the Austin Chalk. While the first two shale plays are in the early stages of development the results are positive, with the Indigo Minerals well producing 500 barrels per day. The Austin Chalk is a proven oil and gas producing zone. The TMS is an unconventional resource play that has been estimated to contain over 7 billion barrels of potential oil production and some gas production. It has been suggested that the TMS has some of the same characteristics and geological age as the Eagle Ford shale located in Southern Texas. The TMS potential area stretches across a large portion of Central Louisiana into the Louisiana Florida parishes and into Mississippi.

The Haynesville Shale area produced 2.07 trillion cubic feet (TCF) of dry natural gas in 2012 and a few thousand barrels of oil. This was about 70% of Louisiana natural gas production in 2012, excluding Louisiana Federal Gulf of Mexico areas. From the initial development of the Haynesville shale area in 2007 to October 2013, more than 2,500 wells were drilled in this area, of which, 2,318 wells are producers, and estimates are that only 25% of its resources have been uncovered. The Haynesville Shale area is one of three top producers of natural gas shale in the U.S.

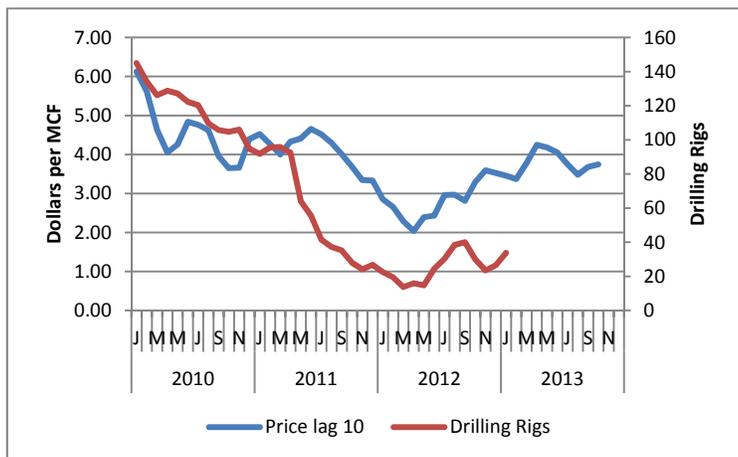
Some industry observers say the Haynesville play remains at a disadvantage since it produces mostly natural gas, and it has one of the highest costs of drilling among shale gas plays in the U.S. It has a

friendly and understanding regulatory environment, citizens in the area are relatively comfortable with horizontal drilling, abundant surface fresh water, and its wells have a higher Estimated Ultimate Recovery (EUR) than wells in other U.S. shale plays.

Meanwhile, the Brown Dense shale area, like the Tuscaloosa Marine shale, is projected to be able to produce both oil and gas. Because these areas are in a very early stage of development and production potential is not established, it is harder for them to compete for resources with more developed oil shale like the Balkan, Eagle Ford or Permian Basin. They lack the contractual obligation that contributed to the fast development of Haynesville. It means that these shale areas will have a slower developing schedule than other similar shale areas in the U.S.

David Hughes, a geoscientist and fellow at the Post Carbon Institute, in his Maryland talk, said that Haynesville production falls 52% in a well's first year and could drop to 95% by year three. These fast declines will not stop drilling; it means that, in order to keep the same amount of domestic natural gas flowing, drillers will need to drill faster and faster to compensate for the declines from each well and lower performance new wells as sweet spots become scarce.

What gas price will bring the operators back in full force in the play? A majority of analysts say \$5 gas



will bring them back, but it's not going to return instantaneously. As shown in the graph, it takes 8 to 10 months for drilling to respond to rising prices and the price needs to have long term stability. A sudden peak caused by weather or other disruptions will not do the trick. A new report from Barclays Capital said prices from \$4.50 to \$5 would be sufficient to get producers back in the field. Better yet, Barclays said, they would still be low enough to preserve a cost advantage in the U.S. relative to other manufacturing economies. It forecast prices at \$4.35 in 2015 and \$4.75 thereafter.

Barclays is projecting rising demand in power generation as natural gas continues to displace coal in that sector, in the industrial sector, in transportation, and in exports.

The average drilling cost per well is falling, historically an average Haynesville gas well costs \$9.9 million. Recently, Exco reported cost reduction to an average of \$7.8 million per well in De Soto Parish by improving its drilling times using new drilling bits, stimulation costs, and overall capital efficiency. Also helping spur the resurgence of drilling in gas shale despite low gas prices are new developments which are reducing costs, such as longer laterals through the fracking process (the average drilled lateral had been 7,100 feet, but this year it's lengthened to 10,000 feet), faster drilling methods, longer lasting drilling bits, better reservoir information, and other techniques.

U.S. shale gas made up around 30 percent of the country's total natural gas supply in 2011, and production of the fuel almost quadrupled between 2007 and 2011, according to the Department of Energy. The abundance of shale gas resources in the U.S. has revived U.S. manufacturing, especially the petrochemical industry. Huge capital investments are planned in the midstream and downstream energy-related chemicals value chains.

In Louisiana, the Haynesville gas production, the extensive natural gas pipeline infrastructure, and the redevelopment of conventional gas producing areas has raised the expectation that dozens of new manufacturing facilities will be built and several of the existent ones will be expanded in the southern part of the state, mostly along the Mississippi River from Baton Rouge to New Orleans and around Lake Charles, and companies such as Cheniere, Freeport-McMoRan and Sempra Energy plan to export liquefied natural gas (LNG) from expanded facilities in Cameron Parish or the Gulf of Mexico. These will create thousands of new permanent jobs and thousands more in temporary construction jobs. This growth will spark the startup of smaller companies, and others in the community, such as retail, realtors, homebuilders, restaurants, and grocery stores, will also benefit from it. The following is a list of announced facilities:

Gas to Liquid Fuels Facilities

- Sasol, a world leader in the commercial production of liquid fuels and chemicals from natural gas, announced in December 2012 the investment of \$16 billion to \$21 billion at its Westlake site in Calcasieu Parish,
- G2X Energy, a Houston company that is committed to converting low-cost natural gas into higher value transportation fuels, announced in January 2013 plans for a \$1.3 billion natural gas-to-gasoline facility at the Port of Lake Charles in Calcasieu Parish,
- Juniper GTL LLC, a Texas-based petrochemical company, announced in September it will invest \$100 million to convert a dormant steam methane reformer into a natural gas to liquids facility in the Westlake, Calcasieu Parish,

Gas to Chemical Feedstock/Product Facilities

- CF Industries, the second largest nitrogen fertilizer producer in the world and the third largest phosphate fertilizer producer among public companies, announced in November 2012 its plan to invest \$2.1 billion to expand the capacity of its facilities in Donaldsonville, Ascension Parish,
- South Louisiana Methanol LP announced in February 2013 it will build and operate a \$1.3 billion methanol producing facility at the Port of South Louisiana District in St. James Parish,
- Methanex Corporation, the world leader in the supply, distribution, and marketing of methanol, announced it will relocate 2 methanol plants from Chile, South America to Geismar and Gonzales in Ascension Parish. The combined projects represent a \$1.1 billion investment,
- EuroChem, a fertilizer company headquartered in Moscow, Russia, announced in July 2013 its intention to build a \$1.5 billion ammonia and urea production plant in either Iberville Parish or St. John the Baptist Parish.
- Axiall a leading chemical and building products company which operates major manufacturing facilities in Lake Charles and Plaquemine announced in December 2013 a possible investment of \$3 billion in cooperation with a partner to build a world-scale ethane cracker and related ethylene derivatives plant somewhere in Louisiana

LNG Facilities

LNG (liquefied natural gas) is natural gas, predominantly methane, that has been cooled to about -260°F at normal pressure to condense the gas into a liquid and shrinks its volume for easier storage or shipment. Louisiana is first in the U.S. in LNG import capacity (42.6% of U.S. import capacity) with terminals at Lake Charles, Sabine and Hackberry; these import terminals have been idle as a result of the natural gas shale boom. The picture of the U.S. gas supply, which turned a few years

back from scarcity into overabundance today, caused these companies to switch direction from planned to profit, from gasification of imported LNG to export domestic produced natural gas, by adding a natural gas liquefaction and export terminal to existing facilities at a cost of \$1.5 to \$10 billion, depending on its size. The following facilities are approved to export LNG from imported ones and also have received approval to export liquefied domestic gas to countries with a Free Trade Agreement (FTA) with the U.S.:

- Sabine Pass LNG terminal is located along the Sabine Pass River on the border between Texas and Louisiana in Cameron, Louisiana. Its import terminal commenced service in April 2008 and has a total send-out capacity of 4.0 Bcfd. It was the first U.S. LNG export terminal to receive approval to sell U.S. LNG to non-FTA countries on Sept. 12, 2012, and the only facility that has approval from FERC to build a gas liquefaction plant (as of Sept. 2013). The others have applied to FERC,
- Lake Charles LLC - Trunkline LNG import terminal commenced service in July 1981. It is located in the Lake Charles Harbor and Terminal District, Calcasieu, LA. When operating at peak capacity, it can send out natural gas at a maximum rate of 2.1 Bcfd. It became the third U.S. LNG export terminal to receive approval to sell U.S. LNG to non-FTA countries on Aug. 7, 2013,
- Cameron LNG terminal is located along the Calcasieu Channel in Hackberry Cameron, LA. Its import terminal commenced service in July 2009 and has a total send out capacity of 1.5 Bcfd.
- Freeport-McMoRan plans on existing gas processing facilities at Main Pass Energy Hub to be used as a gas deep-water port for liquefied natural gas. This facility will receive and store LNG, and condition natural gas for liquefaction and export, utilizing on-site floating liquefaction vessels. It does not have gasification capability.