Quote: Chesapeake Energy
“Based on its geoscientific, petrophysical and engineering research during the past two years and the results of three horizontal and four vertical wells it has drilled, Chesapeake believes the Haynesville Shale play could potentially have a larger impact on the company than any other play in which it has participated to date.”
Haynesville Geology

Geology of the Haynesville Shale

- The Haynesville Shale consists of organic-rich mudstone.
- The composition of the mudstone depends directly on the geographic location, and it can vary between calcareous mudstone to argillaceous mudstone.
- The Haynesville Shale was deposited in a basin located on the continental shelf covered by shallow water.
- The mudstone in the region accumulated across the basin and is the reason the play has played a profitable role for many oil and gas companies.

The Haynesville Shale, a black, organic-rich shale of Upper Jurassic age, underlies much of the Gulf Coast area of the United States. "Haynesville Shale" is a driller's term for shale rock units within the Haynesville Formation.

The Haynesville Formation is underlain by the Smackover Formation and overlain by rocks of the Cotton Valley Group. It was deposited about 150 million years ago in a shallow offshore environment.

Geologists have long known that the Haynesville Formation contained natural gas. However, because of its low permeability, the Haynesville was originally considered to be a gas source rock rather than a gas reservoir.

Source: geology.com
<table>
<thead>
<tr>
<th>Operator</th>
<th>Active Well Count</th>
<th>Gas Daily (Mcf/Day)</th>
<th>Gas Cum (Mcf)</th>
<th>Latest Gas (Mcf/Month)</th>
<th>Gas Daily per Well (Mcf/day/well)</th>
<th>Latest Gas per Well (Mcf/Month/Well)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chesapeake</td>
<td>673</td>
<td>1,334,373</td>
<td>2,464,133,914</td>
<td>31,310,603</td>
<td>1,983</td>
<td>46,524</td>
</tr>
<tr>
<td>Vine Oil &amp; Gas</td>
<td>204</td>
<td>580,266</td>
<td>744,446,892</td>
<td>14,402,277</td>
<td>2,844</td>
<td>70,599</td>
</tr>
<tr>
<td>Exco Operating Company</td>
<td>507</td>
<td>539,522</td>
<td>1,964,777,300</td>
<td>12,920,226</td>
<td>1,064</td>
<td>25,484</td>
</tr>
<tr>
<td>BHP Billiton</td>
<td>360</td>
<td>447,152</td>
<td>1,708,205,546</td>
<td>11,228,821</td>
<td>1,242</td>
<td>31,191</td>
</tr>
<tr>
<td>XTO Energy</td>
<td>220</td>
<td>326,167</td>
<td>845,913,290</td>
<td>8,810,036</td>
<td>1,483</td>
<td>40,046</td>
</tr>
<tr>
<td>Covey Park Gas</td>
<td>280</td>
<td>253,858</td>
<td>1,003,468,560</td>
<td>6,556,453</td>
<td>907</td>
<td>23,416</td>
</tr>
<tr>
<td>CCI East Texas Upstream LLC</td>
<td>195</td>
<td>219,605</td>
<td>424,415,722</td>
<td>5,324,192</td>
<td>1,126</td>
<td>27,304</td>
</tr>
<tr>
<td>Comstock Oil and Gas</td>
<td>131</td>
<td>171,619</td>
<td>405,789,408</td>
<td>4,177,912</td>
<td>1,310</td>
<td>31,892</td>
</tr>
<tr>
<td>Aethon Energy Operating LLC</td>
<td>108</td>
<td>150,671</td>
<td>286,157,546</td>
<td>3,188,094</td>
<td>1,395</td>
<td>29,519</td>
</tr>
<tr>
<td>GEP Haynesville</td>
<td>218</td>
<td>150,094</td>
<td>915,907,659</td>
<td>3,745,388</td>
<td>689</td>
<td>17,181</td>
</tr>
<tr>
<td>BP</td>
<td>21</td>
<td>84,440</td>
<td>43,176,333</td>
<td>2,693,761</td>
<td>4,021</td>
<td>128,274</td>
</tr>
<tr>
<td>QEP Energy Company</td>
<td>123</td>
<td>74,256</td>
<td>511,874,152</td>
<td>3,285,102</td>
<td>604</td>
<td>26,708</td>
</tr>
<tr>
<td>Sabine Oil and Gas</td>
<td>79</td>
<td>52,882</td>
<td>220,480,118</td>
<td>1,305,909</td>
<td>669</td>
<td>16,530</td>
</tr>
<tr>
<td>Indigo Haynesville LLC</td>
<td>128</td>
<td>44,243</td>
<td>358,433,774</td>
<td>1,173,376</td>
<td>346</td>
<td>9,167</td>
</tr>
<tr>
<td>Indigo Minerals LLC</td>
<td>30</td>
<td>29,078</td>
<td>77,407,107</td>
<td>817,593</td>
<td>969</td>
<td>27,253</td>
</tr>
<tr>
<td>R Lacy Services</td>
<td>2</td>
<td>11,485</td>
<td>3,158,294</td>
<td>304,997</td>
<td>5,743</td>
<td>152,499</td>
</tr>
<tr>
<td>Thunderbird Resources LP</td>
<td>38</td>
<td>11,271</td>
<td>84,004,469</td>
<td>334,823</td>
<td>297</td>
<td>8,811</td>
</tr>
<tr>
<td>Goodrich Petroleum Company</td>
<td>16</td>
<td>10,034</td>
<td>54,541,097</td>
<td>167,692</td>
<td>627</td>
<td>10,481</td>
</tr>
<tr>
<td>SND Operating</td>
<td>37</td>
<td>7,914</td>
<td>71,195,289</td>
<td>205,146</td>
<td>214</td>
<td>5,544</td>
</tr>
<tr>
<td>Sheridan Production Company</td>
<td>31</td>
<td>7,137</td>
<td>48,056,169</td>
<td>180,786</td>
<td>230</td>
<td>5,832</td>
</tr>
<tr>
<td>Samson Lonestar</td>
<td>34</td>
<td>6,735</td>
<td>69,707,816</td>
<td>192,147</td>
<td>198</td>
<td>5,651</td>
</tr>
<tr>
<td>Samson Contour Energy</td>
<td>19</td>
<td>6,575</td>
<td>57,167,082</td>
<td>191,325</td>
<td>346</td>
<td>10,070</td>
</tr>
<tr>
<td>Franks Operating Company</td>
<td>6</td>
<td>3,912</td>
<td>24,468,937</td>
<td>97,928</td>
<td>652</td>
<td>16,321</td>
</tr>
<tr>
<td>Eagle Oil &amp; Gas</td>
<td>11</td>
<td>3,312</td>
<td>40,147,783</td>
<td>89,262</td>
<td>301</td>
<td>8,115</td>
</tr>
<tr>
<td>Linn Operating</td>
<td>8</td>
<td>2,466</td>
<td>19,520,497</td>
<td>77,408</td>
<td>308</td>
<td>9,676</td>
</tr>
</tbody>
</table>

Source: Drilling Info
As of 3/13/17
Sorted by "Gas Daily"
Top 25
Current Drilling

• Figure __ shows a map of all the active drilling rigs currently in East Texas and North Louisiana.
• There appears to be a concentration of rigs in De Soto and Red River Parish in Louisiana as well as Nacogdoches and San Augustine county in Texas.
• There is a concentration of rigs along the Texas/Louisiana border north of Shelby county.
• INEXS’ research suggests that some of the areas currently being drilled will provide some of the highest production rates in the past 5 years of Haynesville production.

As of 3/9/2017
• Figure __ is a porosity thickness map of the Haynesville Shale that was developed in a 2015 study by The Oil & Gas Journal.

• The map suggests that the most prolific areas of the Haynesville are concentrated in De Soto parish.

• INEXS’ research (Figure __) suggests that there is a correlation between calculated EURs and porosity thickness in the Haynesville Shale.

• The EUR data suggests that recent drilling with improved completion techniques is the cause of substantially increased EUR in the basin. Most of the hot spots shown in Figure __ are wells that were drilled in the past 3 years.
Figure ___ is a heat map showing the calculated EUR (Mcf) per lateral foot for all wells drilled since 1/1/2010.

To construct this map, INEXS declined over 3,000 individual wells with Haynesville Shale production to determine the EUR of each well. Then INEXS used public perforation interval data to calculate lateral length estimates. The resulting value used for the map shown was calculated by dividing the EUR in Mcf by the lateral length.

This method provided INEXS with a map that outlines the areas with the highest expected EUR which correlates to the porosity thickness map shown in Figure ___.

Although Figure ___ and Figure ___ do show similar trends, there are still areas where the production expectations do not match the porosity thickness hot spots. In fact, some of the areas with the highest EUR do not exactly correlate with the porosity thickness (e.g. the common boundary of De Soto, Red River, and Caddo parish).

Figure ___ is the same EUR/Lateral ft. map with each of the wells with a determined EUR shown on top of the heat map.
• Figure __ shows the calculated EUR values for each well drilled since 1/1/2010 and their respective lateral lengths.
• There is an extreme concentration of wells with lateral lengths between 4,000’ and 4,600’ that have EUR values that range from 2 Bcf to 26 Bcf. It is difficult to determine whether or not this spread in EUR is attributable to geology or completion techniques without proppant data to support the latter.
• There also seems to be another wide distribution of EUR at the 5,200’ lateral length with EURs ranging from 2 Bcf to 33 Bcf. This is most likely due to acreage constraints in Louisiana seeing as a majority of the longest laterals in the basin are in Texas. (TX avg. = 5,266’ / LA avg. = 4,477’).
Figure __ shows a plot of calculated EUR/Lateral foot in chronological order based on completion dates.

There seems to have been a decrease in drilling activity over the years that coincides with changes in gas prices since 2010.

However, even though drilling activity seemed to slow down starting in 2013, the average EUR/Lat. Ft. has dramatically increased since then. (See Figure __)

This increased production trend is supported by the data in Figure __ that shows a steady increase in average lateral length every year since 2010.

However, lateral length cannot be the only factor contributing to this increase in EUR seeing as EUR/lateral foot did not increase from 2010 to 2013.

It is INEXS’ belief that proppant concentration is a major influence on EUR.
Figure __ is an EUR/Lat. Ft. map including all the projected EURs for wells that started production at any point between 1/1/2010 and 12/31/2013.

Using the same heat scale, Figure __ shows the EUR/Lat. Ft. for all wells that started production at any point between 1/1/2014 and 12/1/2016.

The difference between these maps suggests that the drilling and completion techniques have been improving YOY with the most beneficial improvements occurring in the past 3 years.

These maps also suggest that there are some very productive opportunities remaining over the next few years, as long as the correct drilling and completion techniques are used.
• To further support the data shown on Figures __ & __, this bar graph (Figure __) shows a dramatic increase in average EUR from the year 2013 to 2016.
• According to INEXS’ projections, average EUR in the Haynesville has more than doubled in the past 4 years alone.
• INEXS strongly believes this improvement in EUR is not only attributable to increased lateral lengths, but the main factor driving EUR enhancements is the increase in frac fluid volume and proppant concentration.
• As INEXS continues to research the correlation between proppant concentration and EUR, we hope to provide more insight on proper completion techniques that should be implemented in productive areas of the reservoir.
Completion Optimization Program

Designing completions to allow more rock to be contacted closer to the wellbore

**Version 1.0**
Initial Frac Design (2013 - 2014)
- 1,000 lbs/ft proppant
- 30 bbls/ft fluid
- 60-ft cluster spacing
- 240-ft stage spacing

**Version 2.0**
Initial Larger Design (Mid 2015 – 2016)
- 1,400 lbs/ft proppant
- 36 bbls/ft fluid
- 30-ft cluster spacing
- 150-ft stage spacing
- $0.5MM per well vs. initial frac design¹
- >150 wells placed on production

**Version 3.0**
Current Frac Design (Q1 2016 – Today)
- Up to 1,700 lbs/ft proppant
- Up to 50 bbls/ft fluid
- Down to 15-ft cluster spacing
- Down to 100-ft stage spacing
- +$0.5MM to $1.0MM per well vs. initial larger frac design¹
- >100 wells placed on production

¹ Assumes perforated lateral length of 9,000′

Source: Pioneer Investor Presentation 3/1/2017
Areas of Opportunity

- Since the purpose of this study was to help identify areas of opportunity, INEXS focused on areas with substantially better EUR (Figure __).
- Using public land data, INEXS was able to determine who owned the acreage in these areas of high production (Figure __).
• Figure ___ shows a zoomed in area of Figure ___ with all the horizontal wellbores layered on top.
• The wells with yellow ellipses around them were reported to be drilled in the Haynesville Shale.
• The ellipses themselves are a visual representation of what INEXS considers to be the drainage area of the wellbore, based on spacing information found in top operator investor presentations.
• INEXS was tasked with finding out how many opportunities currently remain in these areas of high production.
Areas of Opportunity

- Colored areas of the map are potential targets.
- Using lease data INEXS can identify who operates the most prolific areas.
Areas of Opportunity - Target Operators

- Figure __ is a visual representation of the amount of potential locations remaining by operator.
- The numbers shown on the y-axis are a calculated value based on the amount of undrilled acreage multiplied by the EUR/Lateral foot values shown on Figure __ on the previous page.

- Nov. 2012: Encana sells 30,000 acres to EDF trading
- Aug. 2015: Encana sells 163,000 net acres to Geosouthern
CHK Energy Haynesville Type Curve

CHK Energy Oil and Gas Type Curve (2012-2015)

766 Wells

Observations

- Wells produce gas primarily with very little oil
- Haynesville assets consistently perform well with steady decline, resulting in high gas EUR
- Completion methods significantly improve EUR along with extended reach laterals averaging 7,500 ft
- Type curve represents 99% of total active CHK Energy wells in the Haynesville

2012
- EUR = 5.6 Bcf
- PV10(1) = ($0.2 MM)

2013
- EUR = 6.8 Bcf
- PV10(1) = $1.3 MM

2014
- EUR = 11.6 Bcf
- PV10(1) = $8.0 MM

2015
- EUR = 13.1 Bcf
- PV10(1) = $10.6 MM

Source: Drillinginfo

(1) PV 10 Net Revenue after 25 years, $35.00 oil, $2.25 gas, 100% WI, $0.10 LOE/Mcf, 80% NRI, economic limit of 30 bbls/d

NOTE: # of wells reported will differ from data shown on bubble map and type curve due to lack of information on publicly available data
BHP Oil and Gas Type Curve (2012-2015)

349 Wells

Observations

- Wells produce gas primarily with very little oil
- Haynesville assets consistently perform well with steady decline, resulting in high gas EUR
- Completion methods significantly improve EUR along with extended reach laterals averaging 7,500 ft
- Type curve represents 99% of total active BHP wells in the Haynesville

**2012**
- EUR = 5.7 Bcf
- PV10\(^{1}\) = ($0.05 MM)

**2013**
- EUR = 7.0 Bcf
- PV10\(^{1}\) = $1.6 MM

**2014**
- EUR = 9.6 Bcf
- PV10\(^{1}\) = $5.3 MM

**2015**
- EUR = 12.0 Bcf
- PV10\(^{1}\) = $8.5 MM

Source: Drillinginfo

---

(1) PV 10 Net Revenue after 25 years, $35.00 oil, $2.25 gas, 100% WI, $0.10 LOE/Mcf, 80% NRI, economic limit of 30 bbls/d

NOTE: # of wells reported will differ from data shown on bubble map and type curve due to lack of information on publicly available data