U.S. Shale Gas - Trends and Expansion*

By
David Reimers

Abstract

High prices and increased success in exploration and production are the incentives behind the sharp increase in shale gas exploration in the U.S. Without doubt the Barnett has the most recent completions and a continuous increase in production. However, other gas shales in the U.S. are proving to be highly productive, and these plays are expanding and the center of sharply increased activity in several areas of the county. Drilling in shale gas plays in the U.S. has increased from over 2900 completions in 2004 to over 3400 in 2005, with 2006 completions totaling over 3600. Permits for shale gas drilling also have increased in 2006 and 2007. What are the expanding shale gas plays in the U.S.? Based on 2006 activity, gas shales in several basins are showing increased activity, including the Fayetteville Shale in the Arkoma Basin, the Lewis and Mancos shales in the Uinta and San Juan basins, and the Devonian and Antrim shales in the Eastern U.S. basins. The Barnett shale continues to have increased activity. Total cumulative gas production from the Barnett shale is now over 2800 bcf. An analysis of completion maps and graphing of production figures illustrate the expansion and success of gas shale exploration and development in the U.S. The shale gas activity in the U.S. indicates that such production will continue to be an increasing source of unconventional gas in the U.S. and a model for international shale gas exploration.
U.S. Shale Gas
Trends and Expansion

David D. Reimers
2007 U.S. Completions
2007 U.S. Shale Completions
2007 U.S. Shale Completions

Western U.S.

Eastern U.S.

Fayetteville

Oklahoma

Barnett

Other Emerging Shales

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Northeast U.S. Area
2007 Northeast Shale Completions
2007 Northeast Shale Completions
Stratigraphy
Northeast U.S. Shale Production

North East U.S. Shale Completions

- 2002: 811
- 2003: 932
- 2004: 1808
- 2005: 2017
- 2006: 1247
- 2007 est: 1255

NE US Gas Production

- 2002: 500.00 bcf
- 2003: 600.00 bcf
- 2004: 500.00 bcf
- 2005: 600.00 bcf
- 2006: 400.00 bcf
- 2007 est: 500.00 bcf

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Shale Completion Formations 2002-2007

Shale Completions

- UTICA
- TRENTON-BLACK RIVER
- CHATTANOOGA
- BLACK SH
- TRENTON
- QUEENSTON /SH/
- CLEVELAND SH
- NEW ALBANY /SH/
- CLINTON SH
- ELLSWORTH
- SUNBURY
- OHIO /SH/
- MARCELLUS
- HURON
- ANTRIM /SH/
- DEVONIAN

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Shale Completion Formations 2002-2007
(without Devonian and Antrim)

Shale Completions minus Antrim / Devonian Shales

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Marcellus – Huron Shales

Marcellus - Huron Shale Completions

<table>
<thead>
<tr>
<th>Year</th>
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<tr>
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<td>10</td>
<td>0</td>
</tr>
<tr>
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</tr>
<tr>
<td>2007</td>
<td>90</td>
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Antrim Shale Production
Antrim Production (monthly rate vs. time) (with well count)
West Virginia Devonian Shale Production
2007 Shale Permits
New Albany Structure map
North East U.S. Shale Production
Northeast U.S. Shale Conclusions

• Northeast total U.S. completions continue to increase
• Northeast shale completions are level
• Resulting in level gas production
Oklahoma Shales 2007 and Before

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<tr>
<td></td>
<td>Morrow</td>
<td>Morrow</td>
</tr>
<tr>
<td>Mississippian</td>
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<td>Springer</td>
</tr>
<tr>
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<td></td>
<td>Caney</td>
</tr>
<tr>
<td></td>
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<td>Woodford</td>
</tr>
<tr>
<td>Silurian</td>
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<td>Hunten</td>
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</table>

Central U.S. Shale Completions 2002-2007

- All Woodford/Caney Wells
- 2007 Woodford/Caney Wells

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2007 Oklahoma Horizontal Shale Completions
Woodford Production Chart

Oklahoma Shale Gas production

- Woodford
- Caney

Gas Production

Water

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Central U.S. Shale Conclusions

- Woodford Shale completions continue to increase
- Woodford production also shows continued increase
Western U.S. Area
2007 U.S. Shale Completions
Stratigraphy
Stratigraphy

West

AGE
Eocene

Stratigraphic Units

Green River

Wasatch

Hobble / Almy

Fort Union

Hanna / Ferris

Palaeocene

Upper Cretaceous

Mesaverde Group

Lance

Fox Hills

Lewis

Almond

Baxter

Mancos

Frontier

Aspen

Mowry

East
Western U.S. Shales 2007
Western U.S. Shales
Western U.S. Shales
Horizontal Bakken
Bakken Stratigraphy and Lithology
Lewis
Top of Lewis Structure Map
Bakken Production

Bakken Completions 2003-2007

# wells

0 100 200 300 400 500

2003 2004 2005 2006 2007 est

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Lewis Production

Lewis Completions 2003-2007

# wells

2003 2004 2005 2006 2007 est

0 20 40 60 80 100 120 140

Lewis Completions 2003-2007

Monthly Rate

10,000 100,000

10 100 1,000 10,000


Time

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Baxter Production

Baxter Completions 2003-2007

Monthly Rate

Time

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2006 Operators

Mancos 2006 Operators

Bakken 2006 Operators

Lewis 2006 Operators

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Shale Completions – Last 6 Months
Western U.S. Shale Conclusions

• U.S. Western shale completions have declined over the past 2-3 years
• Result is a slight decrease in production from these shales
• Permits in 2007-08 seem to represent a renewed interest in these shales, but most of the activity is in the Bakken
The Fayetteville Shale is a black, fissile, concretionary, clay shale. Dark grey, fine-grained limestones commonly interbed with the shales. The Fayetteville ranges in thickness from 10 to 400 feet and rests conformably on the Batesville Formation.
Fayetteville Shale Completions
Fayetteville Completions by Year
Fayetteville Completions by Year
Fayetteville Completion Chart by Year
Fayetteville Production Chart

Fayetteville Shale Gas Production

Gas Production

Well Count

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Petra Fayetteville Structure Map
Fayetteville Logs
2007 Fayetteville Permits
Fayetteville Shale Conclusions

• The Fayetteville Shale in Arkansas continues to show sharp increases in drilling – over 200 % increase in 2007

• And a resulting sharp increase in gas production – over 28 bcf in 2007 – an increase of 189% over 2006
Barnett Shale Area
# North Central Texas Stratigraphic Chart

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<td></td>
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<td>Atoke / Bend</td>
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<td>Montoya Limestone</td>
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</tbody>
</table>
Barnett Shale Completions to Date
Barnett Shale Completions 2000-2007

Expanding Area
2007 Expansion Area
Barnett Horizontal Wells


- Year
- # wells
- Horizontal
- Vertical

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25 wells in West Texas – New Mexico

25 Barnett wells in the Permian Basin

20 vertical
5 horizontal
Barnett Shale Production Chart

Barnett Shale Production

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Barnett Top Five Operators

Barnett Shale Operators

- DEVON
- CHESAPEAKE
- XTO
- EOG
- BURLINGTON

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Barnett Shale Conclusions

• Completions up 15% in 2007

• 2007 Completions - 1766 wells

• Total gas production has surpassed 3700 bcf

• Expansion tends to be in the south-western part of the Barnett active area
Companies moving into this area include:

- TXCO
- EnCana
- Anadarko
Bossier Shale
**Bossier Shale**
**Cubic Energy, GMX Resources, Penn Virginia**

*Cubic Energy, Inc.* ("Cubic" or the "Company") announces today the results of specialized log analysis of the Bossier/Haynesville shale formations in the Company's Gloria's Ranch LLC 16 No. 1 well (Section 16 T15N-R15W) and in the Daniels 3 No. 1 well (Section 3 T15N-R15W).

The reservoir characteristics of the Bossier/Haynesville shale formations in the Gloria's Ranch LLC 16 No. 1 and in the Daniels 3 No. 1 are very similar to the productive reservoir characteristics of the Barnett Shale, Fayetteville Shale and the Woodford Shale gas plays.

Log analysts identified two zones in the Gloria’s Ranch LLC 16 No. 1. The lower zone is located between **11,350’ and 11,600’** in depth and calculates an estimated 93 BCF of Total Shale Gas and 72 BCF of Free Shale Gas per square mile of reservoir. The upper zone is located between 10,550’ and 10,760’ in depth and calculates an estimated 54 BCF of Total Shale Gas and 43 BCF of Free Shale Gas per square mile of reservoir.

Log analysts identified two geologically equivalent zones in the Daniels 3 No. 1. The lower zone is located between **11,400’ and 11,600’** in depth and calculates an estimated 84 BCF of Total Shale Gas and 70 BCF of Free Shale Gas per square mile of reservoir. The upper zone is located between 10,570’ and 10,770’ in depth and calculates an estimated 52 BCF of Total Shale Gas and 39 BCF of Free Shale Gas per square mile of reservoir.

**GMX Resources**
To continue research in our 20 acre pilot project, we have just finished coring 397 feet; consisting of 72 feet of the Taylor Lime, all 313 feet of the Taylor Sands, and 12 feet of the Bossier Shale. We are **currently coring 60 feet more of Upper Bossier Shale** and will conduct several studies on the cores to enhance our stimulation treatments as well as to better understand the amount of gas-in-place in our Taylor Reservoir.

**Penn Virginia**
**Lower Bossier Shale**
- Reserve potential of 800 bce
- Depth in range of 11,000 feet (approximately 500 below Cotton Valley Sands
- PVOG has drilled 15 vertical wells to test this formation
- Plan is to drill a horizontal well in 2008

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Other Emerging Shales

Floyd – Northern Mississippi and Alabama

Niobrara – Central U.S.

Haynesville – North Louisiana
U.S. Gas Shale Trends - Conclusions

- Increasing drilling – completions up >10% since 2006 and up >75% since 2000
- Increasing production – Barnett > 3700 bcf
  Fayetteville > 8.1 bcf
- New shales being tested
U.S. Shale Gas
Trends and Expansion
David D. Reimers

Thank you!