Game Changer or Hole Filler?

Onshore (Lower 48 US) Oil
Historical Production and Forecast

- Williston-Bakken
- Valverde Basin
- Permian Basin
- Delaware Basin
- Hugoton Embayment
- Uinta Basin
- San Joaquin Light
- San Joaquin Heavy
- Other Onshore
Defining Game Changer – Shale Gas

Source: IHS CERA.

- January 2007: 49.2 Bcf per day
- Hurricanes Katrina, Rita
- July 2008: 56.3 Bcf per day
- Shut-ins due to low prices
- February 2009: 57.4 Bcf per day
- April 2010: 58.1 Bcf per day

30,594 Gas Wells ~ 17,000

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Houston Dec 09, 2010
Price as the Lead Enabler

Crude Oil (Left scale)  Natural Gas (Right scale)

($/barrel, WTI)  ($/million Btu, Henry Hub)
Emerging Oil Plays - It’s Not All Shale

- Cardium, Viking
- Bakken, Three Forks
- Utica
- Marcellus
- Barnett
- Tuscaloosa
- Heather
- Niobrara Mowry
- Cane Creek Wasatch Green River
- Monterrey
- Niobrara
- Granite Wash
- Bone Spring/Avalon Woodford Spraberry
- Eagle Ford

Play Status

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<th>Exploration</th>
<th>Emerging</th>
<th>Maturing</th>
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<td>9. Cane Creek</td>
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Activity Shifts to Older Areas

Number of Wells by Play since 2009

- Permian-Wolf Berry
- Val Verde-Wolf Berry
- Permian-Clear Fork
- Williston-Bakken
- Appalachian-Devonian
- San Joaquin-Diatomite
- Permian-San Andres
- Delaware-Yeso
- Uinta-Green River
- Kansas-Lansing
- San Joaquin-Kern River
- Cherokee-Squirrel
- Permian-Grayburg
- San Joaquin-Tulare
- GC Louisiana-Miocene
- GC Texas-Frio
- Kansas-Arbuckle
- San Joaquin-Antelope

- Conventional Wells
- Unconventional Oil Wells

0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0%
0 500 1,000 1,500 2,000 2,500
%
ofTotal
# ofWells
0
1,500
3,000
4,500
6,000

ty since 2009
The Grandfather – Bakken

26,000 acres $450 / acre

Bakken, Three Forks Glacier Co., MT ~ 1,000 Bo/d potential?

U.S. Rec. Resource
USGS
Bakken 3.65 Bboe
3 Forks N.D. 1.87 Bboe

Production
US 173,030 B/d
ND 93,400 B/d
Can 94,869 B/d
Bakken
Defining Reservoirs

Sanish Field

Horizontal Borehole Targets

GR/Caliper
Density/Neutron Porosity

LODGEPOLE FM

Upper Shale Mbr

Middle Mbr

BAKKEN 135 FT

Limestone, Siltst (var arg)

Arg, Dolomite

Sandstone/Limestone

Shale

Lower Shale Mbr

THREE FORKS FM

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Bakken - Learning Curve
Annual Per Well Reserve Additions

Whiting - Parshall Field
Dual 10,000 ft. laterals
Bakken = 850 Mboe
Permian Basin
Wolfberry- Bone Springs- Wolffork

Top 1/3 Prod > 93 b/d
Wolfberry

Map Source: Archer Petroleum

Top - Well Rate

Top 1/3 Prod > 93 b/d
Permian Bone Spring / Avalon Shale Play
Northern Delaware Basin

EOG Lomas Rojas 26-1
IP 710 b/d, 1.7 MMcf/d
(EUR (est.) = 400 Mbo, $6.5 MM/well)

Recoverable oil
~ 745 Mboe sq. mi.
Concho: EUR 200 - 400 Mboe

Granite Wash - Revisiting an Old Friend

TX Mature Wash Horizontal
4.2 Bcfge (wet) – 3.8 Bcfg (dry)

Linn Energy 50-1H Black
IP 27 MMcfd, 3,190 Bc, 6,700 BNGL

Colony Wash
2009 Horizontal Wet Gas
= 8X Vertical Wells
4.6 bcfge (wet) – 3.6 bcfg (dry)
Niobrara
Wattenberg Reborn

Niobrara DJ Basin oil potential:
Noble 20 – 30 MMb/section (In-place)
4,800 sq. mi. play area
Possible 4.8 – 6.9 Bb recoverable @ 5%

Niobrara Production 2009
384 Mbo 240 wells
274 Mb cond
1,803 b/d

Powder River
Chesapeake Spillman Draw
1st four months
261 Bo/d + 189 Mcf/d + 238 Bw/d

Silo Field (1981)
Cum + 10.05 MMbo + 8.7 Bcf

EOG 2-01H Jake
IP 1,770Bo/d – 368 Mcf/d
6 months: Average 277 B/d

Noble Energy:
Gemini: 60 days: Avg. 1,000 B/d; ~ 500 Mbo
4,000 ft lateral, 16 frac stages, $3.5 MM)

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L. Tuscaloosa Marine Shale
Net High Resistivity Isopach – N-S X-Section

U. Cretaceous
5,900 sq. mi.; 50 ft. > 5.0 ohm sh.
48 Bbo in place; 7 Bbo recoverable
Horizontal: 2 wells; avg. 198 Bopd

Source: Basin Research Institute LSU

= 130 – 140 ft
= 90 – 110 ft.
= 20 – 60 ft.
Western Canada Spotlight

Bakken production (Can)
2009 = (82,460 b/d) + 12,403 b/d
4,014 wells – 20.5 bopd

U.S. Recoverable Resource
Bakken USGS = 3.65 Bboe
3 Forks N-Dak = 1.87 Bboe

Cr. Colorado Group
Dev. Duvernay

S. Alberta Basin
Bakken – 3 Forks
13 – 15 Mmbo / sq. mi. (in-place)

Cardium ss

Viking ss
29 horiz IP ~ 43 bopd

Amaranth
109 horiz IP ~ 108 bopd
Cardium

- Cardium = 10% of WCSB oil resource
- 10.1 Bbo in place
- 660 MMbo recoverable
- 117 Horiz wells IP ~ 60 bopd
- Penn West 2 wells IP > 1,000 bopd
Replacing Legacy Production

North American Oil Production (Older Plays)

Daily Production Since Initial Development
Eagle Ford

Giddings - Oil
Central - Oil
Briscoe - Oil
Briscoe - Gas
Hawkville - Gas

Horizontal Wells
Gas – 124 (2010: 70)
Oil - 69 (2010: 46)
Dry – 6 (2010: 6)
Drilling - 283
Permitted - 208

Gas Wetness
1200-1250 BTU
50-120 bc\mcf
The Mighty Marcellus

Appalachian Plateau

Valley & Ridge

Structural complexity
Marcellus Consolidation Underway

![Marcellus Resoucre Play Net Acreage Positions graph](chart)

- Company: Shell, Chevron, ExxonMobil

**Graph Details:**
- **X-axis:** Company
- **Y-axis:** Acres (000)
- **Title:** Marcellus Resoucre Play Net Acreage Positions

**Legend:**
- Chesapeake Energy
- Range Resources
- Talisman Energy
- Seneca Resources Corp
- East Resources Inc
- Statoil
- Chief Oil & Gas
- Atlas Energy Resources
- EOG Resources
- Infinite Oil & Gas Inc
- EXCO Resources Inc
- Anadarko Petroleum Company
- XTO Energy Inc
- CNX Gas Corp
- Unit Corp
- Cabot Oil & Gas
- Ultra Petroleum
- Others
Marcellus Infrastructure
Slowing the Pace

Susquehanna Region (dry gas)

Greene County Region (wet gas)
Implications

- Game Changer or Hole Filler?
- Imports Replacement?
- Changing the Refiners Diet?
- Where to Next?
Will New Liquids Change the Picture?

Imports

Growth in Net Oil Imports Slows

- Demand (Left scale, million b/d)
- Net Imports (Left scale, million b/d)
- Net Import Share (Right scale, percent)
Where to Next?

[Map showing various shale formations across the United States]
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