International Shale Development: Can “Made in America” Spread Globally?

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What needs to be in place to spark shale, tight oil development?

The US and to some degree Canada are uniquely positioned for a take-off in shale gas and tight oil production

- A rich resource base that is fairly well understood
- A large, efficient services sector, with ample drilling capacity
- A benign if not facilitative regulatory environment, dominated by state rather than federal oversight
- A benign fiscal environment
- Private ownership of mineral resources, with private sector negotiating of share of exploitation via acreage leasing and royalty arrangements
- An efficient and large capital market, with an appetitive for providing capital in risky E&P and sharing in the rewards
- A large number of small independent companies, with cost of entry very low given the capital markets, with a dominating swashbuckling wildcatting mentality
- But it really wasn’t so easy to get it started: Meet the Frackers

Source: EIA, Citi Research
It wasn’t so easy to get it started; meet “The Frackers”

Everything was tried, since 1973…

- Multiple nuclear detonations didn’t do the job – three 30-kiloton detonations in Colorado, even more and bigger in the Soviet Union

- High prices in the last decade stimulated innovation, driving experimenting with the water mix with sands, horizontal drilling, 3-D seismic with entrepreneurship sparked by high >$10/mmbtu natural gas, high >$100/bbl oil

- The shale revolution is an old-fashioned made-in-America story of a bunch of wildcatters wanting to strike it rich… It’s not easily replicable…


George Mitchell

Harold Hamm

Aubrey McClendon

Tom Ward
What’s required for sustainability and profitability?
What are the doubts on sustainability/profitability

Despite the progress of the past half decade, there remains a persistent “Doubting Thomas” mentality

Six big issues beyond efficiency gains continue to raise doubts:

- Is the shale revolution replicable elsewhere
- Capex continues to exceed cash flow – will this ever end?
- Asset write downs have been exorbitant – some large companies are getting out
- Decline rates remain high – are plateau production levels sustainable?
- Environmental issues remain open – is there a disaster on the horizon?
- Price levels could be problematic – will natural gas prices support more expansion of production? Will future oil prices undermine project economics?
Replicating the unconventional revolution is a problem, but it may be easier than conventionally thought
Three big factors make this a “Made in America” phenomenon

Others will need to find “functional equivalents” of the big three

1. A large number of greedy entrepreneurs
   • 10,000 companies, mostly with cash flow too limited for E&P risk
   • Wildcatting culture of risk-taking and experimentation
   • Decision-making at the drilling level

2. Financial services sector willing to put up risk capital (another greed factor at work)
   • Nearly a century of history of private capital supporting wildcatting in exchange for part of the rents

3. Private ownership of mineral rights
   • US is the only country in the world with private ownership
   • Landowners have stakes in drilling success – gain cash for leases, work requirements fosters drilling, royalty carry provides long stream of cash flow
But “functional equivalents” exist

Shale revolution’s spread could have unexpected geopolitical impacts – a turn away from resource nationalism?

- “Anglo” oil producing countries have wildcatting assets (independents) – Canada (now producing 350-k b/d, 10% of total Canadian and N. American shale), Australia (should be producing soon)

- Some larger companies mastering agility of independents (including US Big 3 – Chevron, ConocoPhillips and Exxon; some European super majors – Shell, Total); engaging JV’s abroad. Russia producing 120-k b/d in Bazhenov; Sinopec, PetroChina also on the move

- Government motivation can create low tax environment – as mineral owner can be facilitative rather than restrictive (Argentina doubled output to ~25-k b/d between 4Q’13 and 1Q’14 and might reach 60- to 100-k b/d by year-end)

- Services sector can spread the revolution globally

Source: EIA, Citi Research
Mexican shale/tight oil development now looks probable

Constitutional, fiscal and regulatory/legal reform are pushing the Mexican Eagle Ford to the fore

- Resource base (TRR’s) significantly greater than across the US border – 9.4-bil bbls on US side, 10.8- on Mexican side; total Mexican TRR >13.1-bil bbls

- Government is highly motivated to find ways to boost production, given resource base – targeting 500-k b/d from onshore, including unconventional by 2018

- Mexican private sector is poised to enter the sector – local firms have a better understanding of security issues there than foreign companies; some are already operating in the Eagle Ford

Source: EIA, Citi Research
Still, spread outside N. America is a precautionary tale

- Regulatory hurdles are enormous because of fears in and out of N. America (UK has become facilitative by licensing at a snail’s pace)

- Even in US two regulatory factors are worrisome from an environmental perspective – inadequate regulations at the state level, difficult to regulate, police 10-k firms (earthquake activities, methane emissions, aquifer issues)

- Government concerns about ‘unjust enrichment’ of private sector loom large as obstacle in Europe, potentially Latin America

- Geology alone not sufficient to generate US-style revolution: need legal framework, developed infrastructure, services industry and accommodating credit conditions

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**Top 10 Technically Recoverable Shale Oil & Gas Reserves**

<table>
<thead>
<tr>
<th></th>
<th>Shale Gas (Tcf)</th>
<th>Shale Oil (Bln Barrels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>1161</td>
<td>75</td>
</tr>
<tr>
<td>China</td>
<td>1115</td>
<td>US</td>
</tr>
<tr>
<td>Argentina</td>
<td>802</td>
<td>China</td>
</tr>
<tr>
<td>Algeria</td>
<td>707</td>
<td>Argentina</td>
</tr>
<tr>
<td>Canada</td>
<td>573</td>
<td>Libya</td>
</tr>
<tr>
<td>Mexico</td>
<td>545</td>
<td>Australia</td>
</tr>
<tr>
<td>Australia</td>
<td>437</td>
<td>Venezuela</td>
</tr>
<tr>
<td>South Africa</td>
<td>390</td>
<td>Mexico</td>
</tr>
<tr>
<td>Russia</td>
<td>285</td>
<td>Pakistan</td>
</tr>
<tr>
<td>Brazil</td>
<td>245</td>
<td>Canada</td>
</tr>
<tr>
<td>Others</td>
<td>1536</td>
<td>Others</td>
</tr>
</tbody>
</table>

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**US Moving Towards Being the World’s Biggest Oil Producer (Oil Production, m b/d)**

![Graph showing oil production trends for various countries](image-url)
What about the other doubts about shale?
US capex still robust, efficiency is rising, but cash flow negative

Capital spending surged in 2012, efficiency gains in 2013-2014

Results of oil & gas operations, $MM

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>‘11 - ‘12 % change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil &amp; gas revenue (a)</td>
<td>$211,357</td>
<td>$149,757</td>
<td>$190,391</td>
<td>$204,388</td>
<td>$202,787</td>
<td>-1%</td>
</tr>
<tr>
<td>Lifting costs</td>
<td>$51,007</td>
<td>$41,924</td>
<td>$55,716</td>
<td>$56,298</td>
<td>$62,145</td>
<td>10%</td>
</tr>
<tr>
<td>Exploration expenses</td>
<td>$6,023</td>
<td>$5,836</td>
<td>$5,423</td>
<td>$6,130</td>
<td>$7,610</td>
<td>24%</td>
</tr>
<tr>
<td>DD&amp;A (Incl. write-downs/impairment)</td>
<td>$89,854</td>
<td>$88,952</td>
<td>$58,797</td>
<td>$60,523</td>
<td>$95,997</td>
<td>59%</td>
</tr>
<tr>
<td>(Write-downs/impairment) incl. above</td>
<td>$45,673</td>
<td>$40,568</td>
<td>$6,357</td>
<td>$7,326</td>
<td>$28,918</td>
<td>295%</td>
</tr>
<tr>
<td>Other expenses/(income)</td>
<td>$4,704</td>
<td>$3,685</td>
<td>$3,251</td>
<td>$4,163</td>
<td>$326</td>
<td>-92%</td>
</tr>
<tr>
<td>Pre-tax profit</td>
<td>$59,770</td>
<td>$9,360</td>
<td>$67,203</td>
<td>$77,273</td>
<td>$36,710</td>
<td>-52%</td>
</tr>
<tr>
<td>Income tax/(benefit)</td>
<td>$23,301</td>
<td>$2,659</td>
<td>$22,598</td>
<td>$28,861</td>
<td>$13,062</td>
<td>-55%</td>
</tr>
<tr>
<td>Net income (b)</td>
<td>$36,469</td>
<td>$6,701</td>
<td>$44,605</td>
<td>$48,412</td>
<td>$23,648</td>
<td>-51%</td>
</tr>
<tr>
<td>Cash flow</td>
<td>$134,533</td>
<td>$102,319</td>
<td>$109,599</td>
<td>$116,124</td>
<td>$128,046</td>
<td>10%</td>
</tr>
<tr>
<td>Free cash flow</td>
<td>($4,653)</td>
<td>$21,125</td>
<td>($45,074)</td>
<td>($41,814)</td>
<td>($60,575)</td>
<td>46%</td>
</tr>
</tbody>
</table>

Source: IHS Herold, Global Upstream Performance Review, United States Results, 2013.
But there is another side to the story – the land grab is ending

The land grab significantly skewed results on two levels; the land grab phase is in many cases being replaced by more efficient operations

- Until 2012, much of capex was on acreage acquisition
- Much of funding via JVs (often with foreign companies) or VPPS, or sale of non-core acreage
- In addition to high and rising per acre acquisition costs, work requirements were fulfilled at minimum levels as the land grab continued and as minimum spending was need to hold acreage and meet minimal obligations; this process masked underlying efficiency gains, and understated the pace of technological growth
- Lower-than-expected natural gas prices reduced cash flow against expectations and often firms turned to oil directional from natural gas directional drillings
- Only now as a more mature phase of development is entered should cash flows in some plays start to exceed capex
- Companies with extensive resource bases should start seeing solid cash flow growth, with output increases potentially accelerating

Reserves surged, while write downs have become problematic

Land grab took place in high nat gas price environment; reserve bookings overly optimistic; eventually write downs and exiting from various plays – but that too is over

Reserve changes - oil/liquids (MMbbl) and gas (Bcf) reserve changes

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil</th>
<th>Gas</th>
<th>Oil</th>
<th>Gas</th>
<th>Oil</th>
<th>Gas</th>
<th>Oil</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>19,106</td>
<td>157,960</td>
<td>17,485</td>
<td>168,929</td>
<td>18,464</td>
<td>172,760</td>
<td>20,490</td>
<td>192,878</td>
</tr>
<tr>
<td>2009</td>
<td>(1,602)</td>
<td>(7,926)</td>
<td>1,214</td>
<td>(12,471)</td>
<td>974</td>
<td>319</td>
<td>769</td>
<td>(5,188)</td>
</tr>
<tr>
<td>2010</td>
<td>892</td>
<td>21,668</td>
<td>1,073</td>
<td>31,077</td>
<td>1,909</td>
<td>32,242</td>
<td>2,862</td>
<td>29,770</td>
</tr>
<tr>
<td>2011</td>
<td>403</td>
<td>1,726</td>
<td>175</td>
<td>725</td>
<td>402</td>
<td>1,339</td>
<td>328</td>
<td>846</td>
</tr>
<tr>
<td>2012</td>
<td>514</td>
<td>1,027</td>
<td>259</td>
<td>630</td>
<td>974</td>
<td>319</td>
<td>769</td>
<td>(5,188)</td>
</tr>
</tbody>
</table>

Natural gas writedowns crush reserve replacement metrics

Rising proved acquisition spending pushes prices higher

Source: IHS Herold, Citi Research
Shale output sustainable once euphoric expectations are tempered

As source rocks of conventional hydrocarbons, the technically recoverable shale gas resources are large, though some question their sustainability....

...Some claim that production declines faster than expected, but the hyperbolic decline, with a very flat tail, remains in place if proper physical parameters are used...

...In fact, production per rig has surged, partly on raising the recovery rates from the shale layer, but technological improvement should help...

...Leading to more sustainable production levels in the future, with some wells being refrac’ed at low costs but with high production again
Lower prices can stem the growth but not damp it

North American shale oil and gas seeing numerous, localized cost curve changes, down through productivity gains, up through infrastructure constraints; lower prices can reduce output, but higher prices will increase it

Source: Company reports, Citi Research
Recapping: Growing evidence of profitability, sustainability

Multiple matrices are pointing to future profitability, sustainable at significantly higher production levels than today’s

- Undoubtedly the oil and gas industry is under great pressure to improve capital efficiency, which means avoiding high-cost plays in favor of lower-cost areas.

- Intensive drilling to hold leases is being replaced by greater diligence on project execution.

- The drive for efficiencies is resulting in shorter drilling times, higher productivity from more selective drilling and greater efficiencies.

- So far the efficiencies are being led by faster drilling, more sophisticated geological understanding, 24/7 operations, multi-well pads.

- Services costs are becoming more competitive over time.

- Cost curves are likely to continue to see downward pressure.

- High and sustainable oil and natural gas production at plateau levels significantly above today’s are in the cards.
Appendix A-1

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