

Shale: Transforming US Energy

Over the past few years, there has been a transformation in the North American energy industry, thanks to the production of shale oil and gas. New technology has not only made extracting resources out of shale rock possible, but significantly improved productivity of wells, resulting in attractive cost economics. The industry hopes to push this further by advancing technology and increasing recovery rates of wells. There is widespread opportunity across North America, as shale formations stretch across a large part of the United States. Shale oil and gas domestic production can help pave the road for US energy independence, which has positive implications for US foreign policy and also expansion of US GDP.

Heavy capital expenditures in both the exploration & production (upstream) and transportation, storage, gathering & processing (midstream) segments of the sector have created a need for third party capital and provide an important opportunity for investment.

Advances in technology spurred significant shale production

Across North America, there are enormous deposits of oil and natural gas trapped inside shale rock formations. For decades, there was no known way to economically extract from shale rock, leaving oil and gas producers to focus upon conventional reservoirs. It was not until the mid-1990s that the industry discovered how to access resources directly and economically from shale. The key was combining two technologies—hydraulic fracturing¹ (known as “fracking”) and horizontal drilling. Using these two techniques, the production of shale gas took off starting in the mid-2000s and has since rapidly expanded. In 2007, shale gas accounted for 5% of total US gas production; in 2012, it was estimated to account for 36%. Output grew at annualized growth rate of 51%, soaring from 3 billion cubic feet per day in 2007 to 24 billion cubic feet per day in 2012.¹ Chart 1 on the next page shows the evolution in production from the largest North American shale formations over the last few years. This growth is projected to continue- the U.S. Energy Information Administration (EIA) believes that shale gas will become the single most important source of natural gas in the future (by 2040, it will comprise over 50% of natural gas production), as demonstrated by Chart 2 (next page).

The Thinking Man’s Approach



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The boom in production of shale oil and gas has changed the dynamic of energy production in North America. Advances in technology have made wells more productive, translating into better economics and significantly improved profitability. Oil and gas producers are deploying meaningful capital to capture this opportunity- to explore new shale formations; drill new wells in proven fields and also revisit old wells to maximize extraction using new technologies. These heavy capital expenditures have created an entry for investors to provide third party capital to these energy producers, through private equity managers. .

For more on how we are positioning our portfolios, please contact your investment advisor or email:

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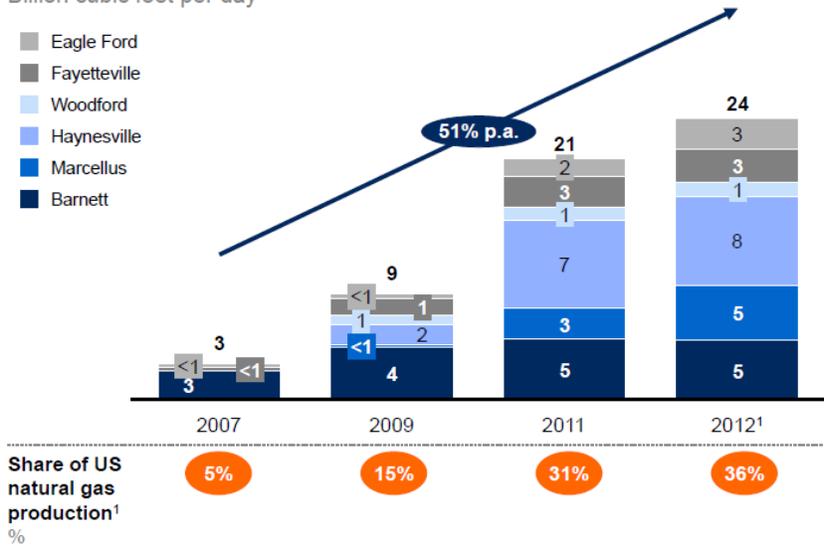


The industry is focused on developing new “super fracking” technologies to boost productivity of shale formations. Some industry experts believe this could improve recovery rates by up to 70%, further increasing the importance of shale in US domestic energy production¹

Chart 1: North American Shale Gas Production Growth

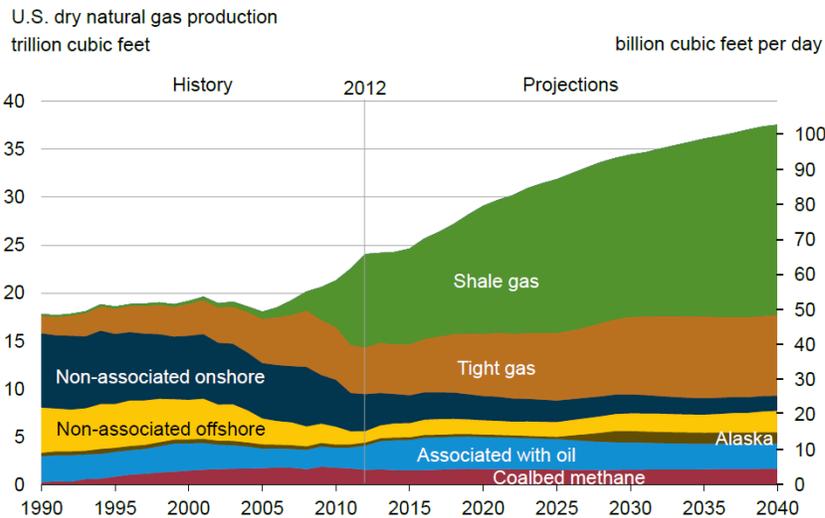
North American shale gas production has grown by 51 percent annually since 2007

North America gas production from shale
Billion cubic feet per day



Source: McKinsey Global Institute, “Game changers: Five opportunities for US growth and renewal,” July 2013

Chart 2: Shale gas leads growth in total gas production through 2040



Source: EIA, Annual Energy Outlook 2014 Early Release, January 4, 2014

¹ T. Inglesby, R. Jenks, S. Nyquist and D. Pinner, “Shale gas and tight oil: Framing the opportunities and risks,” Summer 2012



Better economics makes shale an attractive play

The attraction to shale plays is due to the superior economics resulting from both higher recoverable reserves and production volumes. Although drilling and completion (D&C) costs have generally increased, finding and development (F&D) costs have decreased due to better well performance. The result has been in higher profitability of these wells, as demonstrated by the Chart 3.

The below example is of a well in the Permian basin, and shows a comparison of using vertical and horizontal drilling. The productivity of the well has exponentially increased by the use of new horizontal technology- as demonstrated by estimated recovery of Mboe (million barrels of oil equivalent). Even though the cost of the well has grown, the increase in productivity is such that the the overall return on the well investment has been significantly increased.

Chart 3: Higher profitability of horizontal drilling

Permian Basin Well Comparison	Wolfcamp Vertical	Wolfcamp Horizontal
Vintage Year	2012	2012
Avg. Well Cost (\$MM)	\$1.0	\$5.1
# of Fracs	3	23
Estimated Ultimate Recovery (Mboe)	42	323
IRR	17%	60%
ROI	1.19	1.99
Finding & Development Costs (\$/Bbl)	\$29.76	\$19.74

Source: EnCap Portfolio Company
Note: Returns listed at \$90 / Bbl and \$3.00 / Mcf

Wide spread opportunity throughout North America

Shale gas formations stretch across large parts of the United States and also parts of Canada and Mexico. The Marcellus and Haynesville shale formations are among the world's largest gas fields. New production is ramping up in Pennsylvania, Texas and North Dakota.¹ The below map shows the currently known shale opportunities in North America. The light pink indicates an oil & gas basin, areas where hydrocarbons exist- these areas are being surveyed for their potential to be productive sources. The yellow indicates a prospective shale play, an area targeted for exploration due to indications that there is an economic quantity of oil or gas to be found. The red indicates a current shale play, a producing oil and or gas formation or multiple formation.

¹ McKinsey Global Institute, "Game changers: Five opportunities for US growth and renewal," July 2013



Chart 4: North American Shale Plays



Source: Energy Information Administration

Important implications and support from government

The shale play has widespread implications for the US. In 2005, natural-gas prices were above \$13 per million British thermal unit (MMBtu). Thanks to the oversupply of domestic production, prices are around \$4 per million British thermal unit (MMBtu).¹ Lower energy costs bring lower energy bills for consumers and businesses. Increased domestic energy production could lead to higher economic output and employment.² By 2010, shale activity was reportedly supporting more than one million jobs in the US, and is projected to support almost 1.5 million jobs by 2015.³ A study by McKinsey Global Institute projects that by 2020, the US will see an increase of \$115 billion to \$225 billion in annual GDP in the oil and gas production sector.⁴ Increased domestic energy production also brings the US closer to energy independence. Limiting the significant costs of importing energy

¹ Inglesby *et al.*, "Shale gas and tight oil: Framing the opportunities and risks," Summer 2012

² Inglesby *et al.*, "Shale gas and tight oil: Framing the opportunities and risks," Summer 2012

³ IHS, "Shale, Other Unconventional Natural Gas Supports More than 1 Million US Jobs Today; Nearly 1.5 Million By 2015." Jun 13, 2012

⁴ McKinsey Global Institute, "Game changers: Five opportunities for US growth and renewal," July 2013

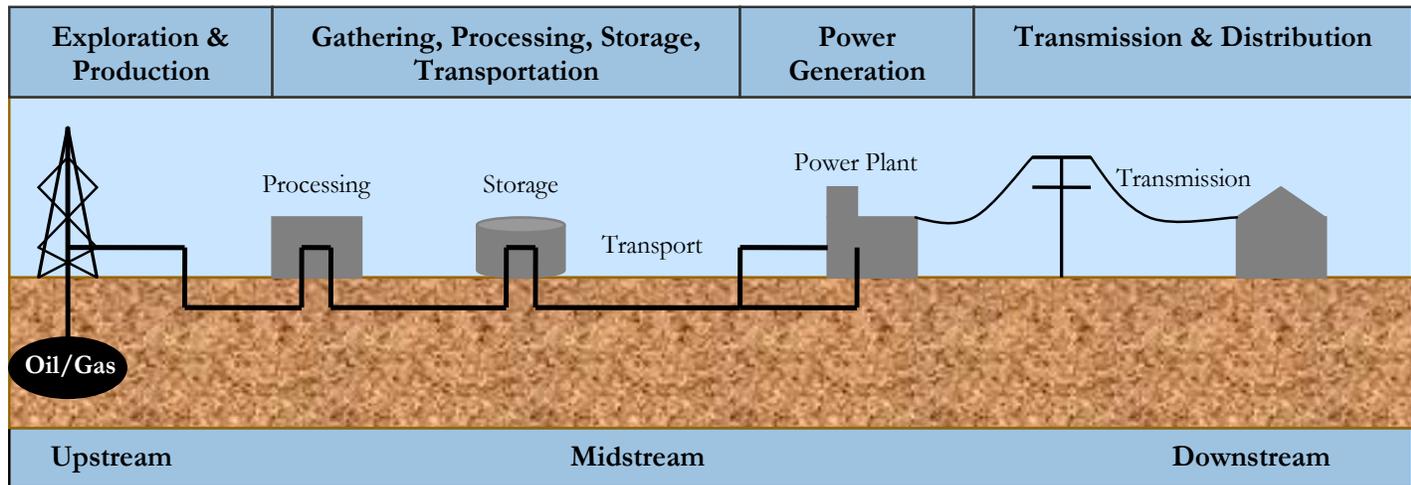


would bring a boost to the US economy. This also has important geopolitical implications- energy has been an important factor to US foreign policy and has tied US interests to highly unstable regions of the world, namely the Middle East. Energy independence would translate into freedom from these ties and improved national security for the US. Given the potential impact to the economy and foreign policy, the US government has been highly supportive of the shale revolution. The Department of Energy (DOE) has paired with various industry players to help create and improve shale technology. In 1991, the government helped cost share on demonstration projects with Mitchell Energy, the company who pioneered shale gas in Texas. The DOE continues to support industry players with resources (including geological mapping) and various tax credits.¹

Opportunities for Investment: High Capex Spending in Upstream; Midstream Sectors

There are three main sectors of the oil and gas industry: upstream; midstream; and downstream. The upstream stage of the production involves searching for and extracting raw materials. It is commonly referred to as exploration and production (E&P). The midstream stage of production includes the transportation; storage; gathering & processing of oil and gas. The downstream stage of production involves the refining of oil; purifying of natural gas; marketing and distributing. This is the sector which touches consumers. Each of these sectors are shown across the energy value chain in Chart 5 below.

Chart 5: Energy Industry Value Chain



Source: Cambridge Associates

The introduction of shale oil and gas has massively transformed the industry in North America. There is a large opportunity for exploration and production (upstream) sector: exploring new shale formations; drilling new wells in proven fields and also revisiting old wells and maximizing extraction using new technologies. These opportunities require significant capital investment, and there have been important increases in the capital expenditure budgets of E&P companies. Barclay's estimates that US spending in E&P will be up 9.3% from 2013, and total North American E&P spending up 8.3%

¹ Canary LLC, "The US Shale Revolution: Who Really Deserves the Credit?," June 24, 2014



since 2013.¹ Chart 6 below demonstrates the increase in spending in E&P over the last decade. They expect this trend to continue, with E&P spending growth in North America “to remain in the mid to high single digits through at least 2017.”²

Chart 6: North American E&P Spending



Source: Barclays Research, “Barclay’s Global 2014 E&P Spending Update”

There are also opportunities in the midstream sector: new infrastructure is needed to handle the significant amount of new supply created by shale oil and gas. The new influx of shale plays will require gathering, processing, storage and transportation. In the last 5 years, over \$300 billion has been spent in the sector for organic growth projects and acquisitions. One specialist firm projects that for every \$1.00 of capital expenditure on the upstream side, \$0.15 to \$0.35 will be necessary to provide the midstream infrastructure required to deliver product across the value chain. This equates to \$30 to \$70 billion per year of capex dedicated to midstream development.³

Opportunities for Investment: Private Equity

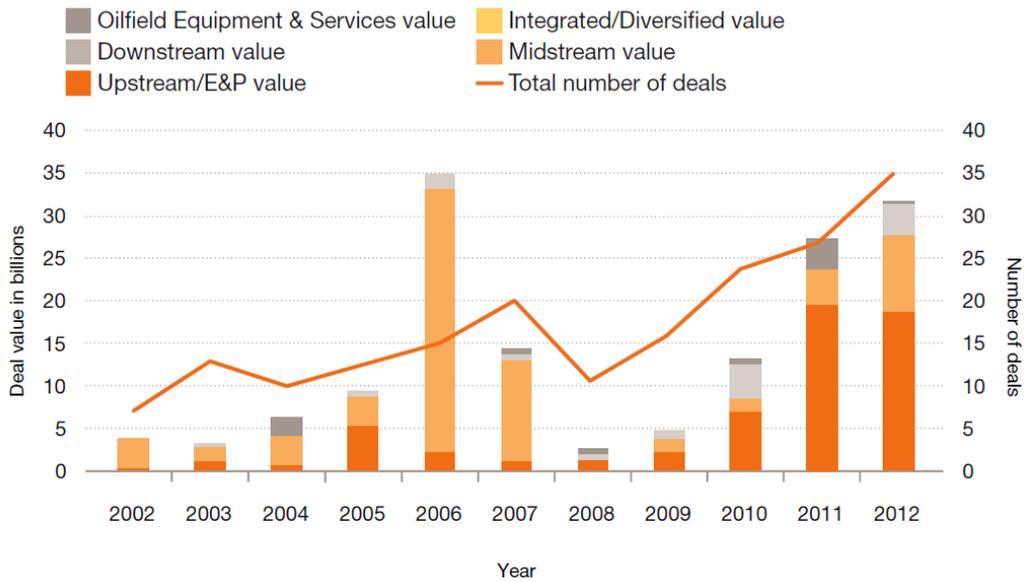
The heavy capex requirements have left industry players looking for external third party capital to fund their new projects- and private equity has been moving in to capitalize on this demand for capital. Over the last decade, as the capital requirements of the industry increased, so did the number and volume of deals (illustrated by Chart 7 on the next page). Deal activity has been focused on the exploration & production (upstream) segment of the sector.

Chart 7: Total private equity deal activity

¹ Barclays Research, “Barclays Global 2014 E&P Spending Update”, June 18 2014

² Barclays Research, “Barclays Global 2014 E&P Spending Update”, Dec 9, 2013

³ EnCap Investments L.P, “The Midstream Opportunity,” <http://www.efmidstream.com/about/midstream-opportunity>



Source: PWC, "The US Energy Revolution: The role of private equity in oil and gas," IHS Herold, February 2013

Traditionally, a few long-standing energy funds (i.e. over 20 years) have focused on E&P, either buying properties or backing experienced management teams to build companies (by leveraging their relationships and geologic expertise). However, recently large private equity players have entered the market mostly via corporate deals, changing the landscape of E&P deals for private equity.

We are currently undergoing due diligence of a few potential investments. Our focus is on those few long-standing energy funds. We believe that seasoned professionals with experience in the space over different cycles have a distinct advantage. An important part of this business is putting together the right teams of people for projects. Long standing funds have deep relationships and understanding of the best players in the industry. As the opportunity set is largest in the E&P and midstream sector, we would like our investments to be focused on this part of the value chain. For more information on which funds and teams we like, please contact us.



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