



SHALE GAS INTERNATIONAL MAGAZINE

Autumn / Fall 2015
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The magazine about the global
business of shale exploration

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WINNERS
in a downturn

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COVER STORY

**CHINA'S SHALE GAS
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LETTER FROM THE EDITOR



It is with great pride that I present to you the first issue of Shale Gas International Magazine. This publication would not have been possible without our great contributors, our team, and our amazing distribution partners. Thanks to them Shale Gas International Magazine is truly able to combine global coverage with global distribution.

It is my belief that the shale gas industry has reached the point where it is no longer just an American affair. Many countries worldwide have followed the example of the U.S. and have taken interest in exploring their own shale reserves.

Some countries, like Argentina and China, are committed to exploring their huge reserves of shale gas and oil and have found some success in doing so, even if the road to a shale renaissance is not without its challenges.

Other countries, like Poland and Ukraine, got off to a promising start, but a difficult political situation, inhospitable tax regime, or just disappointing results caused by tricky geology caused the dream to sour. Others, like the UK, still hold on to the shale promise while navigating problems with policy and regulation, as well as the difficult task of trying to win the public opinion to the cause of unconventional exploration.

Over the last couple of years the shale industry has become a truly global business - even if the low commodity prices have made things difficult for those E&P companies who overstretched themselves when prices were still high. Foreign utility and chemical companies are still looking to hedge their costs by investing in upstream companies, and technology firms have taken up the challenge of making shale exploration cheaper, safer, and more efficient. Meanwhile, foreign companies and governments are looking to the U.S. to learn from past experiences; transplanting things that work and rejecting things that don't.

This is an exciting time to launch a magazine that aims to follow and report on the business of shale exploration wherever it happens to take place. From China to South America, from the U.S. to the EU, we will keep you updated on all things shale - providing news and analysis on this still thriving - despite the downturn - industry.

Welcome to Shale Gas International Magazine. I hope you enjoy the journey.

MONICA THOMAS

Editor

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Global Overview of Shale Gas Exploration and Production

By Sanjay Samuel

From Poland to Morocco and from Canada to Argentina - Sanjay Samuel takes a look at the current state of the shale industry worldwide.

Highly innovative techniques over the last decade have boosted shale gas from obscurity to being the source of a quarter of all natural-gas production in the US. This proportion is forecasted to approximately double by 2035 by the US Energy Information Administration (EIA), an official government body. The shale-gas story has been overwhelmingly an American one to date, but the huge successes in America are accelerating the exploration and production of shale gas around the world.

The EIA identifies two groups of countries to possess the best prospects for shale gas development. The first comprises countries that are currently “highly dependent on natural gas imports, have some existing gas production infrastructure, and are estimated to have substantial shale gas resources relative to their current natural gas consumption,” such as France, Poland, Turkey, Ukraine, South Africa, Morocco, and Chile, among others. Shale gas

production in these countries could significantly affect their future gas balances, and thus, motivate development. The second group also comprises countries with considerable shale gas resources (more than 200 trillion cubic feet) and extensive infrastructure to facilitate the production of natural gas for domestic consumption, export, or both, such as the United States, Canada, Mexico, China, Australia, Libya, Algeria, Argentina, and Brazil. However, although the existing infrastructure could facilitate timely conversion to shale gas production, it could also lead to competition with other sources of natural gas supply.

Despite the large technically recoverable resources for shale oil and gas worldwide, only four countries have actually produced commercial quantities of shale oil and shale gas formations. There are an estimated 7,299 trillion cubic feet of shale gas resources (global consumption is about 120 trillion cubic feet per year) and 345 billion barrels of shale oil (tight oil)

resources worldwide, but only the United States and Canada have produced commercial quantities of both shale oil and shale gas, while China produced a small amount of shale gas and Argentina produced a smidgen of shale oil in 2014. Out of the four countries, only the United States is a major producer of both shale oil and gas.

Other countries with shale resource exploration efforts underway include Australia, Algeria, Colombia, Mexico, and Russia. However, these countries have not demonstrated the logistics and infrastructure necessary to support commercial exploration and production, and do not have national policies regarding ownership of mineral rights, regulations, and taxes that are conducive for commercial shale resource development.

According to the EIA, recent developments indicate that China is on schedule to produce some 17 million cubic meters per day by the end of this year. By comparison, current U.S. production is roughly

1.3 billion cubic meters per day. Canada, the second-largest shale gas producer, produced roughly 113 million cubic meters per day last year. Mexico has begun to produce a very small amount of the gas, and Poland, Algeria, Australia, Colombia, and Russia are all exploring the potential for developing oil and gas resources from their own shale formations. But according to the EIA, the “logistics and infrastructure” necessary to support production at the level seen in the United States does not yet exist in other countries besides Canada and China.

Russia has the largest technically recoverable resources of shale oil at 75 billion barrels, followed by the United States with 58 billion barrels, China with 32 billion barrels and Argentina with 27 billion barrels. China leads the world in technically recoverable resources of shale gas at 1,115 trillion cubic feet, followed by Argentina with 802 trillion cubic feet, Algeria with 707 trillion cubic feet, the United States with 665 trillion cubic feet, and Canada with 573

trillion cubic feet. Globally, 32 percent of the total estimated natural gas resources are in shale formations, while 10 percent of estimated oil resources are in shale or tight formations.

Because shale oil and gas have proven to be quickly producible in large volumes at relatively low cost in the United States, shale oil and shale gas resources have spurred an oil and natural gas production renaissance in this country. In 2013, shale oil provided 42 percent of total U.S. crude oil production and shale gas provided 47 percent of total U.S. natural gas production.

However, because of the geologic variation of the world’s shale formations and the nationalization of the oil and gas industries, unhelpful regulatory environment, and tax regimes in other countries, the economic recoverability of shale resources is not as advantageous as in the United States and Canada. The production of shale resources is dependent on the production costs, recoverable volumes, wellhead prices and land ownership of the country where it is

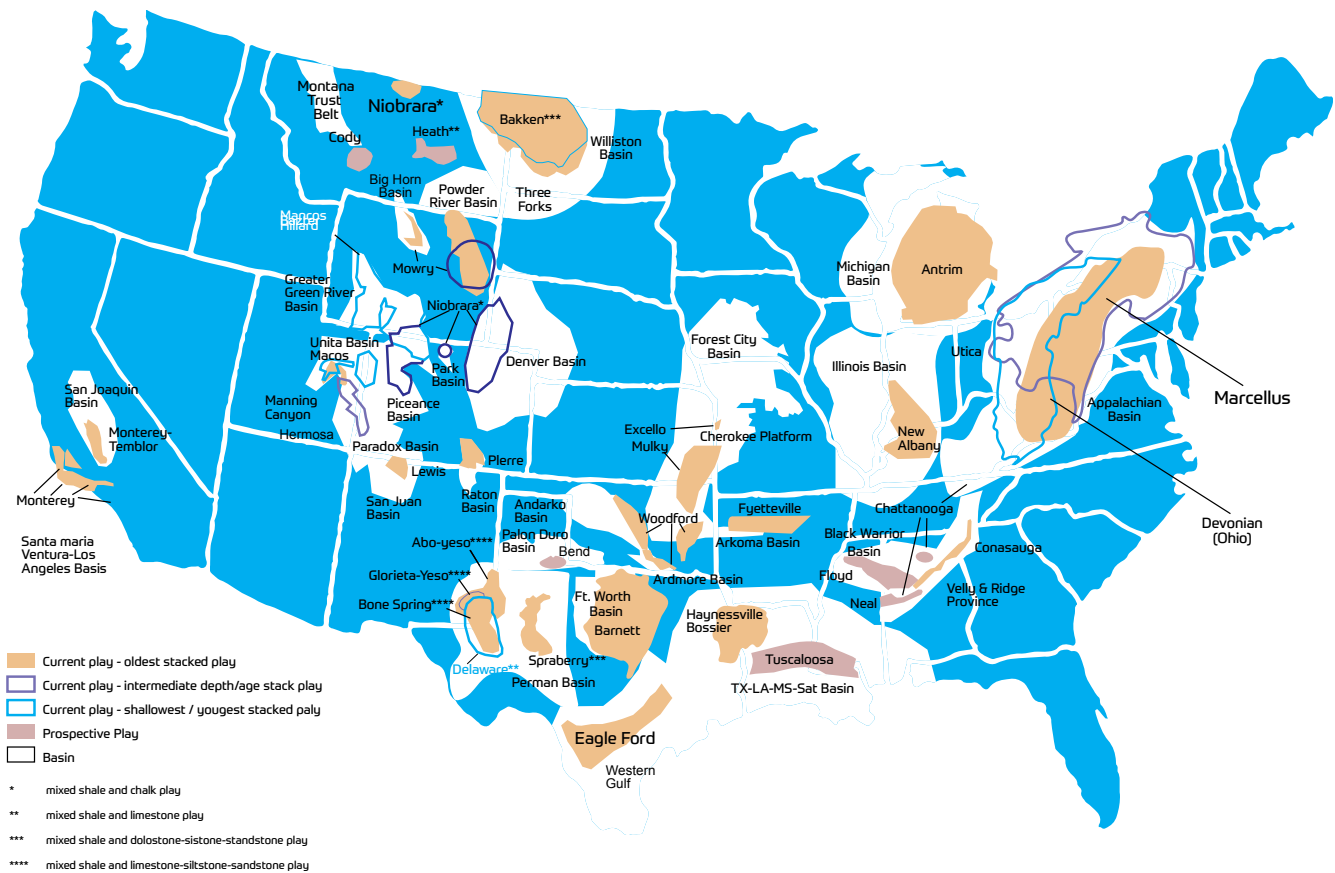
being produced.

In Canada, tight oil production doubled between 2011 and 2014, from 0.2 million barrels per day to 0.4 million barrels per day, coming mainly from Alberta and Saskatchewan. Canadian shale gas production increased from 1.9 billion cubic feet per day in 2011 to 3.9 billion cubic feet per day in May 2014.

In China, Sinopec and PetroChina reported commercial production of shale gas from fields in the Sichuan Basin. Their combined shale gas output totals 0.163 billion cubic feet per day (1.5 percent of total natural gas production). In Argentina, national oil company YPF, partnering with Chevron, is producing about 20,000 barrels of shale oil per day from the Loma Campana area.

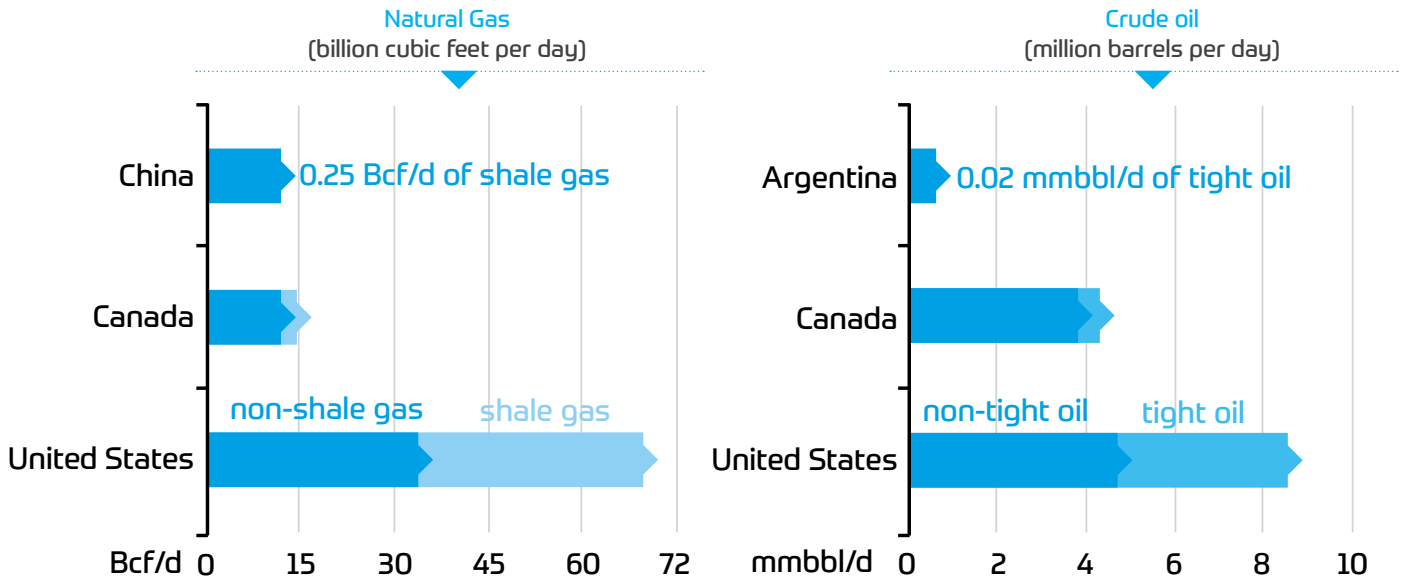
Shale resources remain the dominant source of U.S. natural gas production growth, with a range of longer-term outcomes.

The shale gas technology story is only beginning, with much yet to come.



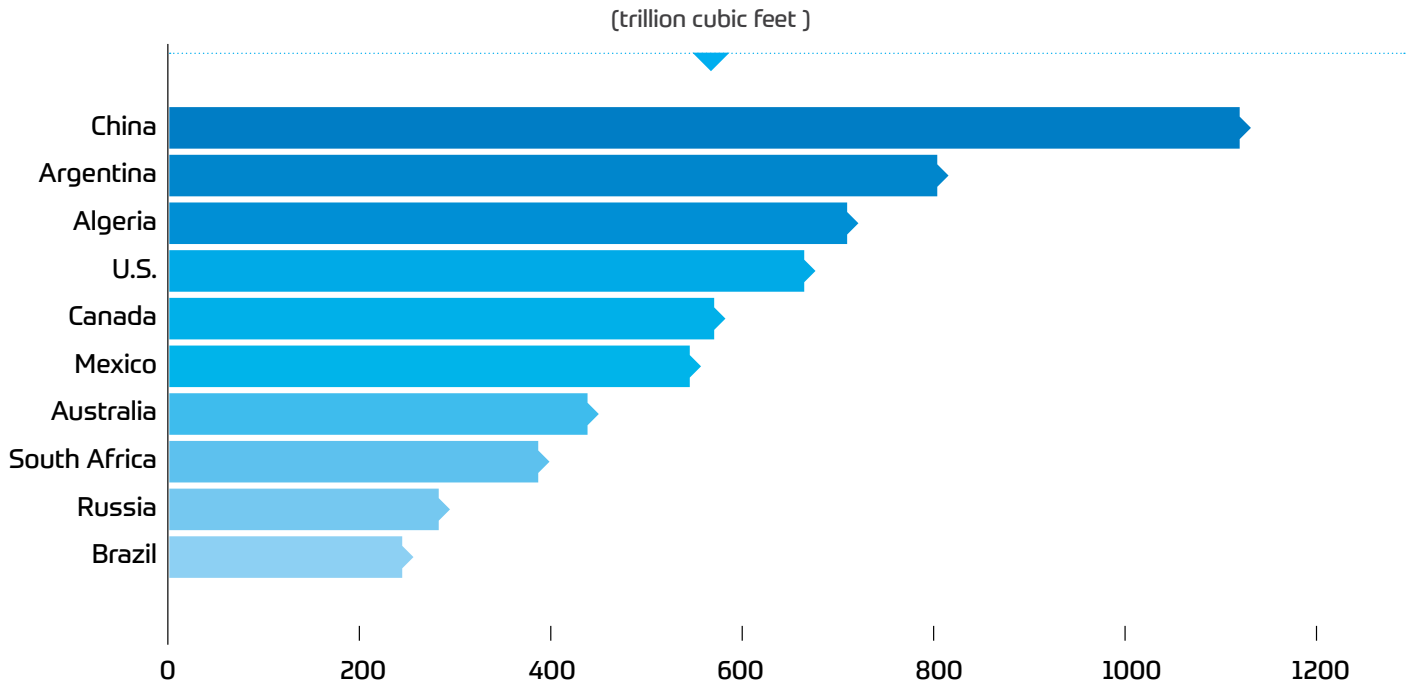
Source: EIA, <http://www.eia.gov/todayinenergy/detail.cfm?id=20852>

TYPE OF ESTIMATED NATURAL GAS AND CRUDE OIL PRODUCTION IN FOUR COUNTRIES, 2014



Source: Energy Information Administration, <http://www.eia.gov/todayinenergy/detail.cfm?id=19991>

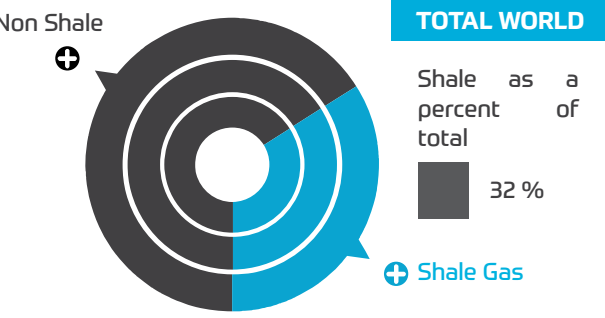
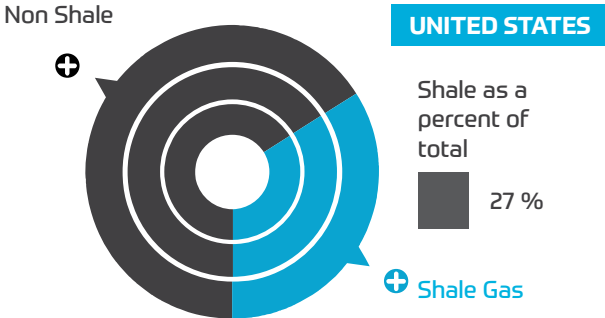
TOP TEN COUNTRIES WITH TECHNICALLY RECOVERABLE SHALE GAS RESOURCES



Source: Energy Information Administration,

TECHNICALLY RECOVERABLE SHALE GAS RESOURCES COMPRISE ABOUT 30% OF TOTAL GLOBAL NATURAL GAS RESOURCES

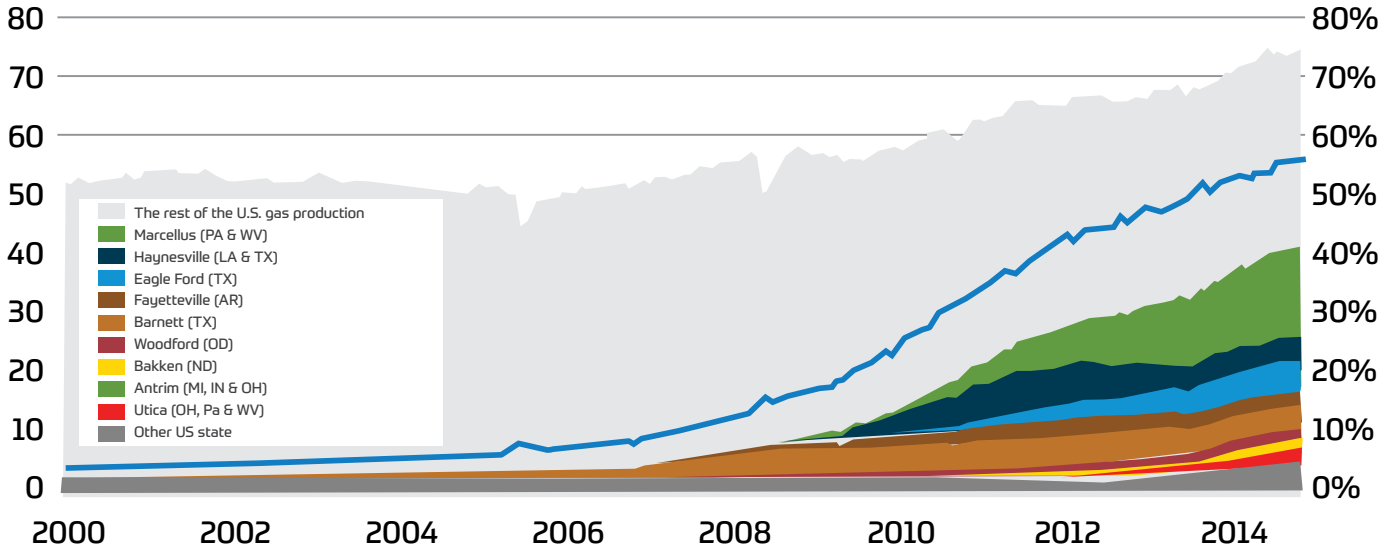
WET NATURAL GAS (TRILLION CUBIC FEET)	
UNITED STATES	
Shale Gas	665
Non Shale	1766
Total	2431
Shale as a percent of total	27%
TOTAL WORLD	
Shale Gas	7299
Non Shale	15583
Total	22882
Shale as a percent of total	32%
Source: EIA	



U.S. SHALE GAS PRODUCTION WAS 5% OF TOTAL U.S. DRY GAS PRODUCTION IN 2004, 10% IN 2007, AND 56% IN 2015

Natural Gas production (dry)
(Billion cubic feet per day)

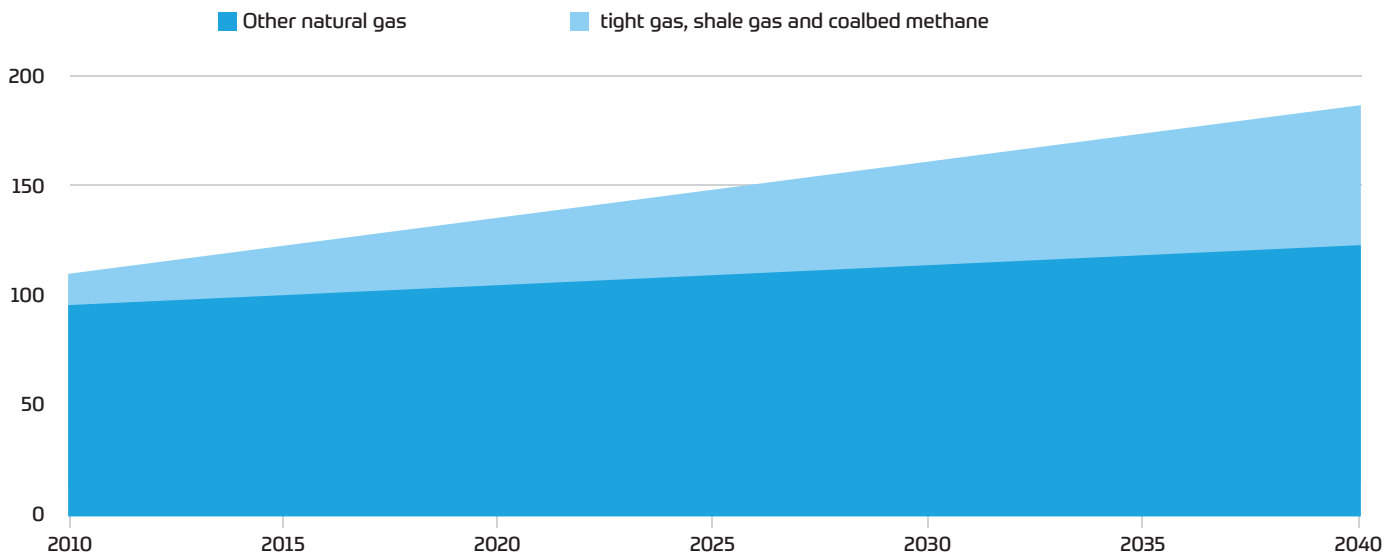
Shale gas production as a percent of total gas production



Source: EIA Natural Gas Monthly data through december, STEO (Trough may 2015 and dilling info)

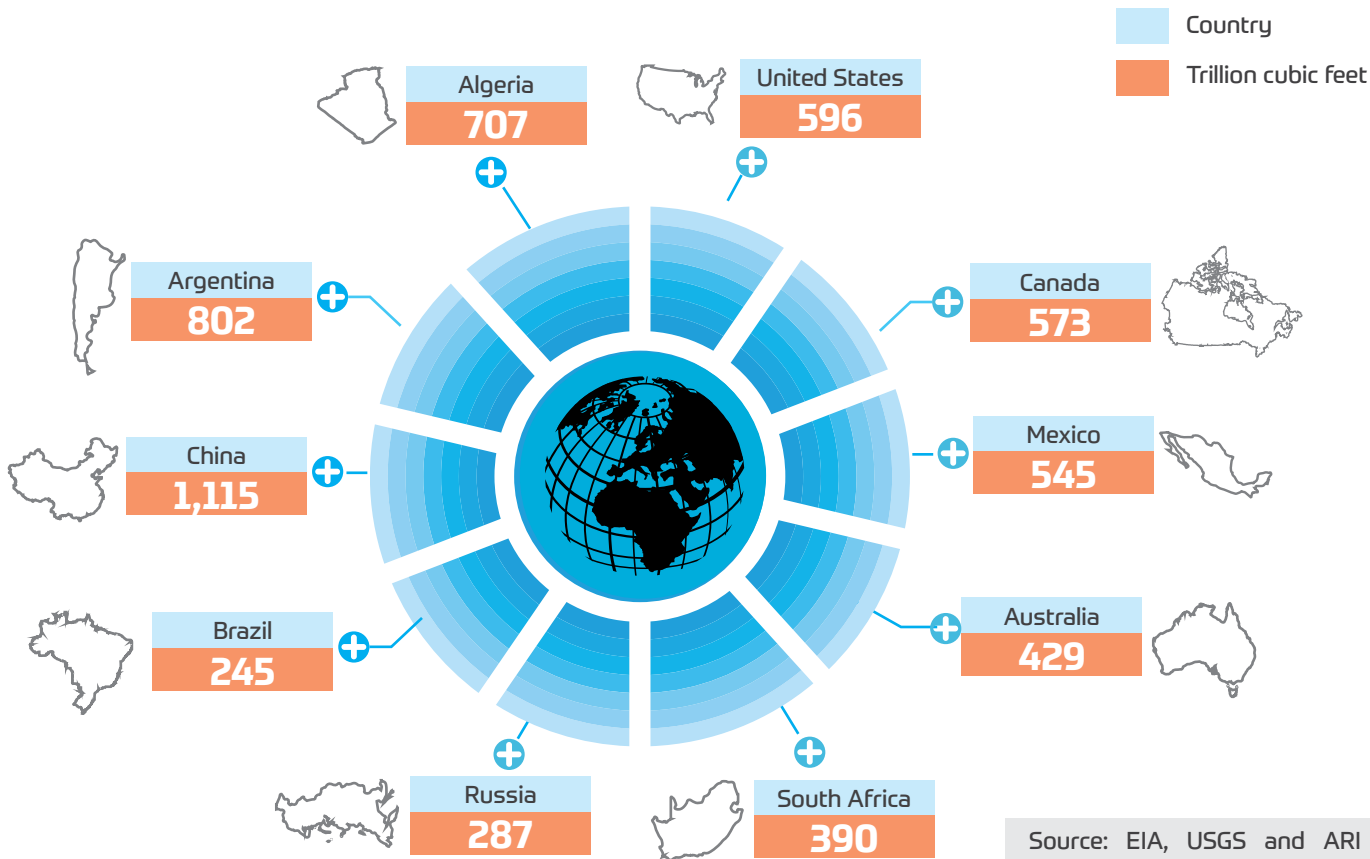
WORLD NATURAL GAS PRODUCTION IS LIKELY TO DIVERSIFY

Natural Gas production
(trillion cubic feet)



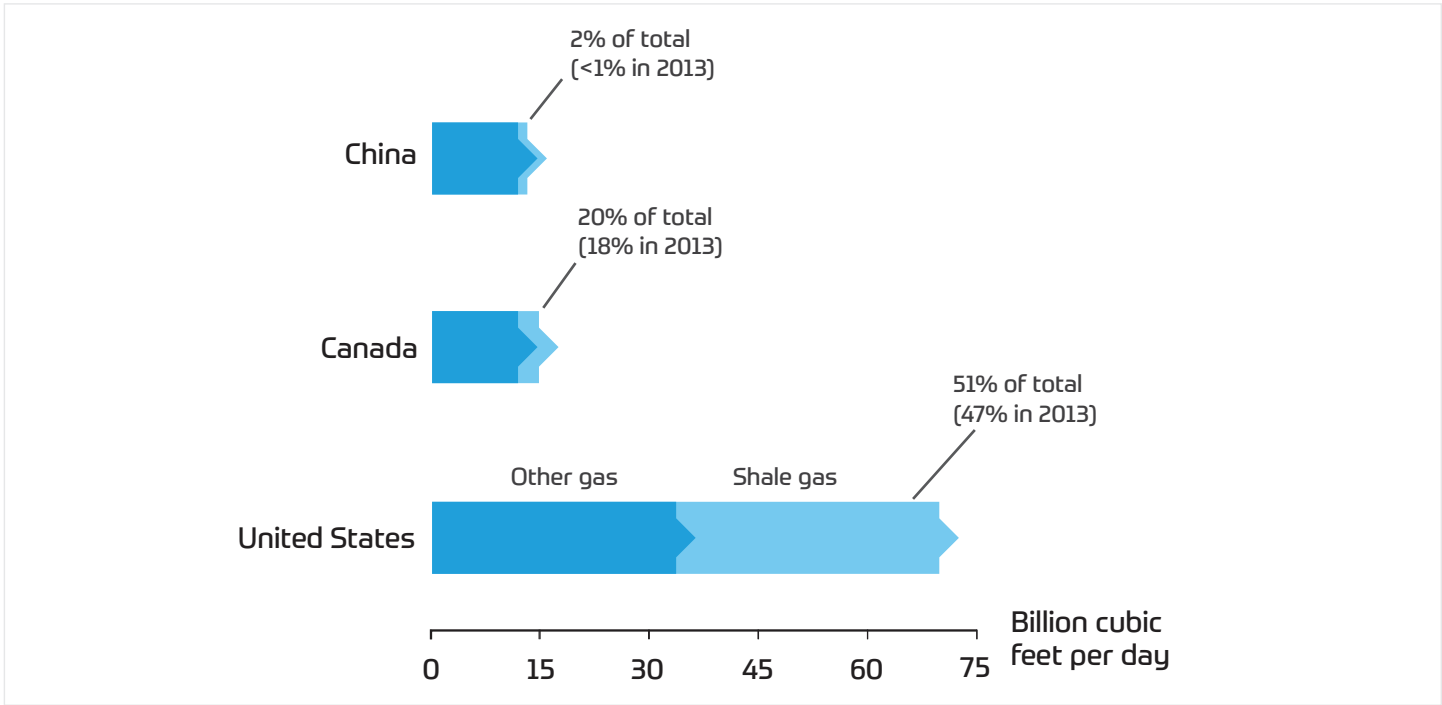
Source: EIA International Energy Outlook 2013, Reference Case

TOP TEN COUNTRIES WITH TECHNICALLY RECOVERABLE SHALE RESOURCES

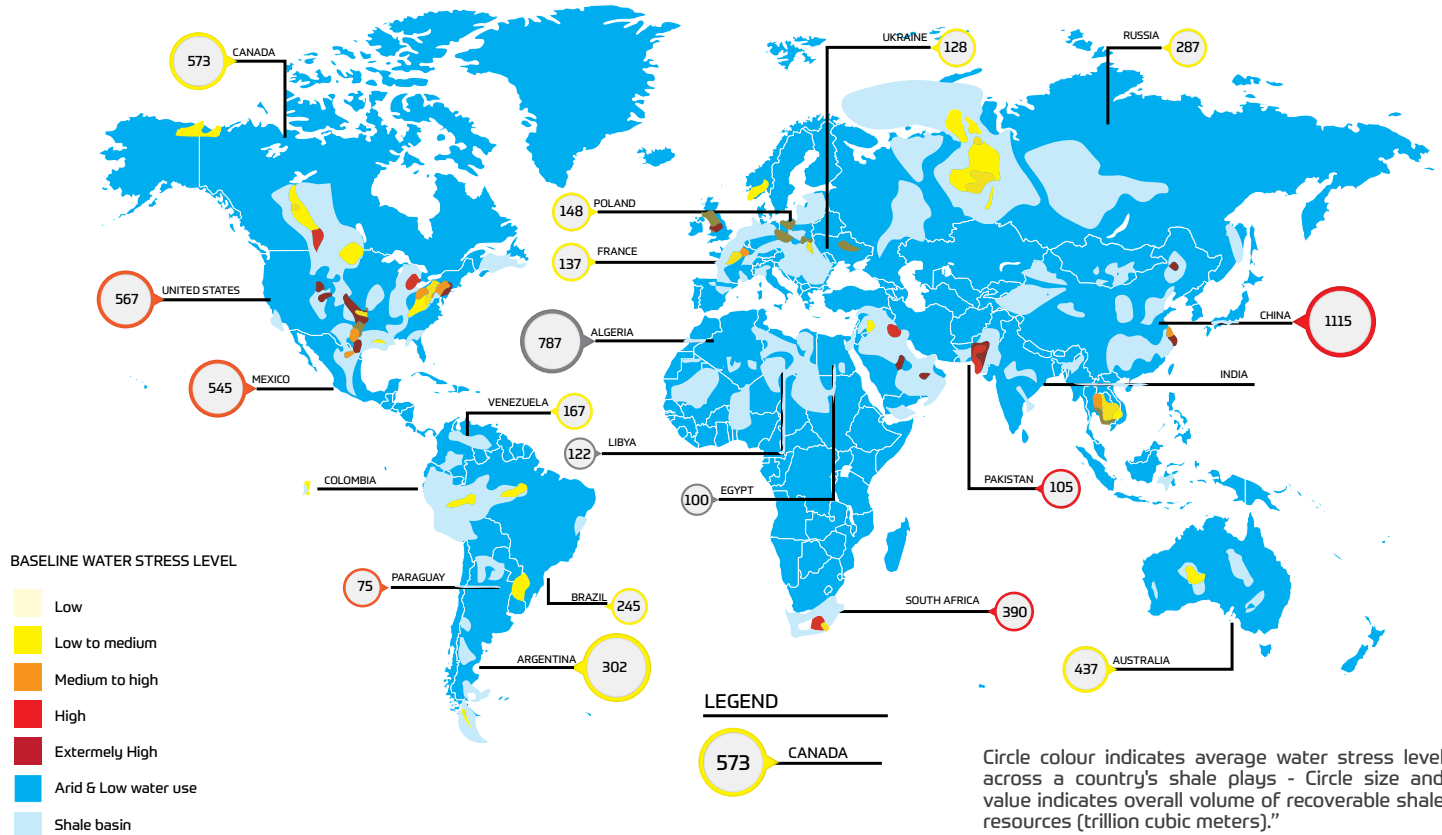


Source: EIA, USGS and ARI 2015 Preliminary Results

COUNTRIES PRODUCING SHALE GAS OIL IN 2014



LOCATION OF WORLD'S SHALE PLAYS, VOLUME OF TECHNICALLY RECOVERABLE SHALE GAS IN THE 20 COUNTRIES WITH THE LARGEST RESOURCES, AND THE LEVEL OF BASELINE WATER STRESS



source - www.wri.org/water-for-shale

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- LNG Projects: Non-Technical Risks, Progress & Delivery

TECHNICAL STREAM

- Application of Innovative Technology
- Shipping
- Gas as a Transport Fuel

SPECIAL FOCUS STREAM

- Health, Safety, Security & Environment
- Emerging Gas Markets: Developments & Investment
- FLNG Innovation, with Containment & Storage

CONTRACTING, PRICING & TRADING

Chairperson's Welcome	<i>Luca Tonello, Head of Oil & Gas - Investment Banking Asia, Sumitomo Mitsui Banking Corporation</i>
JERA's Action for the Change of the Future Asian LNG Markets	<i>Yuji Kakimi, President, JERA Co., Inc.</i>
Flexibility, Liquidity and Price Formation: A Brief History of, and the Outlook for, LNG from a Trade-Structure Perspective	<i>Ann Collins, Vice President, LNG Supply & Optimisation, Global Energy Marketing and Shipping, BG Group</i>
Hybrid LNG Pricing: Confronting the Challenges of Hub-Linked Pricing for U.S. LNG	<i>Jason Bennett, Partner, Deputy Department Chair, Global Projects Group, Baker Botts</i>
Market-based LNG Pricing Using JEPX Indices in the Evolving Japanese Energy Market: Restoring the Competitiveness of LNG	<i>Akira Miyamoto, Executive Researcher, Osaka Gas Co., Ltd</i>
"2015": The Year of Living Dangerously - How are Asian Gas Players Responding to a Low Oil Price Market?	<i>Tony Taylor, Research Director & Advisor, IHS</i>
NORTH AMERICAN FOCUS PANEL: "New Wave North American Supply: What Works Best for Asian Buyers?"	<p>Panelists Include:</p> <p><i>Noel Tomnay, Head Global Gas, Gas and Power Research, Wood Mackenzie</i></p> <p><i>Frederick Jones, Founder and CEO, Delfin LNG</i></p> <p><i>Ma Shenyuan, Vice President, ENN Group</i></p> <p><i>Kunio Nohata, Senior Executive Officer, Tokyo Gas Co., Ltd</i></p> <p><i>Brent Wahl (tbc), Senior Managing Director, Macquarie Bank</i></p> <p><i>Nick Butcher (tbc), Senior Managing Director, Macquarie Capital</i></p> <p><i>Andrew Walker, Vice President of Global LNG, BG Group</i></p>
Changing Dynamics in LNG Contracting Strategy - A Myth or Reality?	<i>Lennart Luten, Manager, Galway Group</i>
An Alternative to Price Reviews?	<i>Gaston Bilder, Senior Legal Counsel, Total</i>
What First-Time LNG Buyers want: The Challenges of Creating a New Regasified LNG Value Chain and their Impact on LNG SPA Negotiations	<i>Daniel Reinbott, Partner, Ashurst LLP</i>
How can LNG Buyers Best Position Themselves Ahead of the Coming Supply Crunch?	<i>Paul Griffin, Partner, Allen & Overy</i> <i>Kristian Bradshaw, Counsel, Allen & Overy</i>
Short-Term Traded LNG - Outlook and Challenges	<i>Alex Orman, Global Pricing & Markets Manager, Shell Eastern Petroleum</i>
Does \$50/bbl Oil Require a New Approach to Delivering Successful Projects?	<i>Philip Loots, Adjunct Professor, Centre for Mining, Energy and Construction Law, The University of Western Australia</i>
Evolution of LNG Trading Activities, LNG Pricing and Project Development in Asia-Pacific	<i>Frederic Barnaud, Executive Director Oil, LNG & Shipping, Gazprom Marketing & Trading</i>
Asia's Future LNG Pricing Challenges	<i>Hiroshi Hashimoto, Senior Analyst, Gas Group, Institute of Energy Economics Japan</i>

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China's shale gas aspirations face a reality check

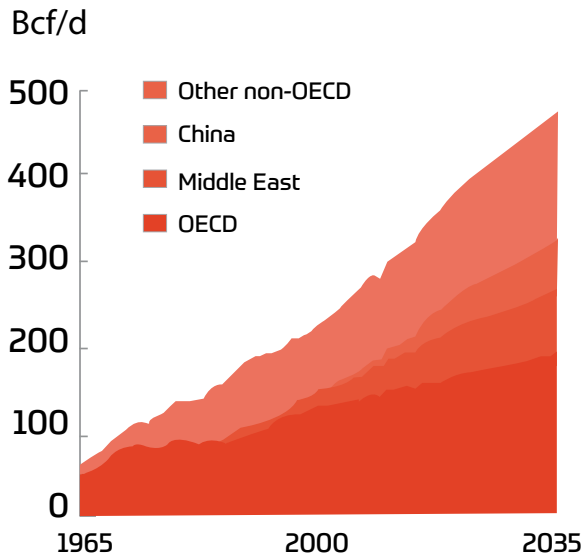
By Ann Chee

Waking up to hard economic facts, China's dreamy ambitions to replicate the US shale gas revolution have been put aside. Faced with a challenging geology and spiralling costs, the Government has scaled back production targets for 2020 to around 30 Bcm – just a third of its original goal, while simultaneously slashing subsidies. Private developers will have to take a greater risk as subsidies will be cut to 0.3 yuan per square meter from 2016 to 2018, and to 0.2 yuan from 2019 to 2020.

Unfazed by pledges from shale gas developers, China's ministry of finance is unwilling to free up any more support, citing changes in industrial development policies and spiralling costs. Senior energy executives including PetroChina's chairman Zhou Jiping have urged the government to extend the current 0.4 yuan per square meter subsidy to 2020 or 2030 to foster a growing use of shale gas.

To attract private funding in tapping promising shale gas plays such as in Sichuan province, the central government in Beijing now needs to open the exploration licensing wider to more private players. Though 18 companies were awarded exploration rights in two auctions in 2011 and 2012, only one of these – state-owned China Petroleum & Chemicals Corp has actually started to commercially produce shale gas. Its bigger rival, PetroChina, is also tapping its own shale gas reserves in southwest China.

NATURAL GAS DEMAND BY REGION



Source:
BP Energy Outlook 2015

MIND SPIRALLING UPSTREAM COSTS

Even if China was able to meet its production targets this year, the actual gas volumes produced would come at more than double the cost of some of the bigger US plays. At the Fuling block of the Sichuan Basin, developed by state-owned Sinopec, analysis from Bloomberg New Energy Finance (BNEF) suggests that China has a good chance of hitting its shale gas production goal of 6.5 billion cubic meters per annum (480 MMcf/d) by 2015. However this current wellhead cost at the Fuling block of \$11.20 per million British thermal units (MMBtu) is far above equivalent costs in the US, where producers can extract dry gas for as low as \$3.40/MMBtu.

Average well costs at Fuling were cut from CNY 100 million (\$16m) in 2012 to currently below CNY 70 million (\$11m). US prices are still up to 75% lower: \$9.3m in the Haynesville, \$6.0m in the Marcellus, \$3.3m in the Barnett and \$2.6m in the Fayetteville plays, according to BNEF figures.

The U.S. experience suggests that shale gas development can be conceptualized into two stages: an initial innovation stage and a secondary scaling-up stage. During the innovation stage, cost-effective extraction technologies are developed through experimentation and innovation.

When technologies are proven to be cost effective, shale gas development enters the second stage, in which producers significantly ramp up their output. Technology improvements continue throughout the second stage, improving profitability and expanding development into new plays. China is still in the first stage and developers have failed to bring down extraction costs in order to make drilling shale wells profitable. By early 2014, China's two national oil companies, (CNPC) and China Petroleum & Chemical Corp. (Sinopec), are understood to have lost over US\$ 1 billion in the course of drilling early shale gas wells.

To make domestic shale gas production attractive – compared to importing pipeline gas from Russia or LNG from Australia or the U.S. – the Chinese government needs to implement reforms along the gas value chain. Liberalization is needed all the way from upstream market entry to third-party access of gas transport infrastructure and the city gate pricing mechanism.

DOUBTS OVER NDRC'S AMBITIOUS TARGETS

Ambitious policy makers in China's powerful National Development and Reform Commission (NDRC) have set a target of 30 Bcm of shale gas output by 2020. Chen Weidong of China National Offshore Oil Corp. explained that this latest target is significantly less than the 60 to 80 Bcm goal set in 2012, when the government first set out to tap China shale gas plays, which are the largest in the world.

Analysts at the Economist Intelligence Unit doubt that they get anywhere near that target as developers are currently barely producing around 1.3 Bcm. The International Energy Agency (IEA), meanwhile, is more optimistic suggesting China might be able to achieve half of its 60 Bcm target for 2020. Even though the actual volume of China's shale gas production is unlikely to be a substantial new source of supply before the end of the decade, its price signal could be significant in the global market as Chinese buyers could use it in negotiations for pipeline and LNG supply.

For the last two years, Chinese developers have drilled more than 200 wells and in the first half of 2015, intensifying efforts to tap the Longmaxi formation in the Sichuan Basin. Though several international companies are active in China, much of the early effort has been led by state-run Sinopec and CNPC PetroChina. According to China's Ministry of Land and Resources, these two companies are on schedule to reach 600 MMcf/d of shale gas production by the end of this year.

State-run oil producers Sinopec and PetroChina recently announced new growth forecasts that would even manage to exceed a government target of 6.5 Bcm of shale gas production by 2015. CNPC has already drilled 125 shale wells, bringing 74 of them into production, and is on schedule to produce 250 MMcf/d of shale gas by the end of this year. Sinopec has a commercial-scale effort underway at the Fuling shale gas field in the Sichuan Basin, currently producing 130 MMcf/d. By the end of 2014, Sinopec completed 75 test wells at the Fuling field, with plans to drill an additional 253 wells. It claims the Fuling field will yield 5 billion cubic meters next year, compared with just 200m cubic meters of shale gas produced nationally in 2013.

ALL EYES ON CHINA'S GAS PRICE REFORM

The final stage of China's gas price reform is due to be completed before the end of this year, notably the increase of 'existing' city gate prices to a higher 'incremental' price. Ostensible links of China's city gas prices to liquefied petroleum gas (LPG) and high sulphur fuel oil (HSFO) would normally make gas prices react directly to the plunge in global oil prices. Given the oil-link of city gate prices, China's domestic gas prices should have dropped substantially in H1'2015, but the NDRC had an interest to block this to keep domestic gas netbacks attractive for the likes of PetroChina and Sinopec.

Opting-out of its own 'city gate pricing policy' during the period of low oil prices would help China's national oil companies (NOCs), suggested Wood Mackenzie Asia analysts lead by Cynthia Lim. Domestic gas netbacks would remain attractive and contracted imports could be delivered significantly below city gate levels.

Should policy makers choose to obstruct

the oil-link of China's city gas prices in order to prevent a reduction in domestic gas prices, this would slow down coal-to-gas switching in the power generation and industrial sector. Gas use for power generation has increased by an average 16% a year in the past decade. In 2014, however, gas demand growth slowed down notably from over 13% in 2013 to around 8% last year.

Slowdown in commodity demand exceeds GDP growth

Weakness in China's industrial sector, albeit short-term, is expected to keep a lid on gas and electricity demand growth, particularly as many power producers are sitting on high inventory levels for coal and other fuels.

In fact, the latest economic rebalancing in China has caused a more drastic drop in demand for electricity, gas, coal and diesel than the GDP moderation: China's GDP growth slipped to 7.4% in 2014; in contrast,

power demand growth has almost halved; gas demand fell by more than 8%, coal demand barely grew; and diesel demand contracted for the first time in more than a decade.

Gauging future demand, Gavin Thompson, WoodMac's principal analyst for APAC Gas & Power research said "While we expect domestic demand growth over the next few years to return to historic levels, a swift return to double-digit growth may not be achievable without lower city gate gas prices."

PetroChina seeks to maximize profitability by accelerating domestic shale gas output and hold imports via the Central Asia pipeline to take-or-pay to mitigate high transportation costs of Turkmen gas. Sinopec, may reduce domestic production from the Ordos Basin in order to find a home for contracted Australian imports from PNG LNG and APLNG into its Qingdao regas terminal, as oil-indexed LNG prices are anticipated to fall throughout 2015.



SHIFT TO GAS POWER TO CURB HAZARDOUS AIR POLLUTION

Tapping its vast domestic shale gas reserves not only helps China to diversify supply sources and put pressure on importers, the government is actively promoting a shift to use more gas in the power sector and chemical industries. Air pollution has reached levels that impact the health of citizens in China's urban centers and often cause serious respiratory illness.

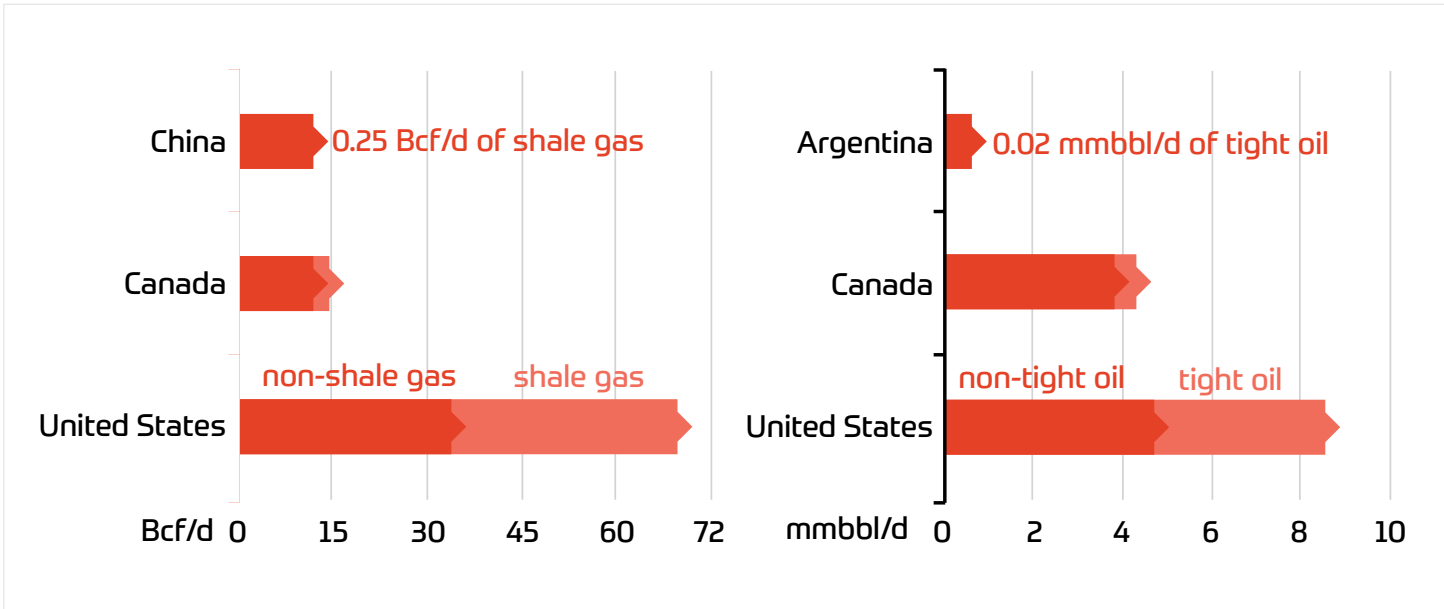
"The government has set a target to cut carbon intensity by 40-45% by 2030 from 2005 levels and last year we've already achieved to reduce emissions by 28.8%, which is equivalent to a reduction of 2.5 billion tons of CO2 emissions, so it is very realistic that we'll meet the overall target," Hongde Jiang, professor of thermal engineering at Tsinghua University in Beijing told a conference held by the European Turbine Network in Brussels.

Shale gas is one solution to achieve China's

low-carbon goals and the government supports power producers to increase the market share of combined-cycle gas turbine units to 5% from currently 3.3%. This means another 100 GW of CCGT capacity will be added in the Chinese power sector over the next 15 years.

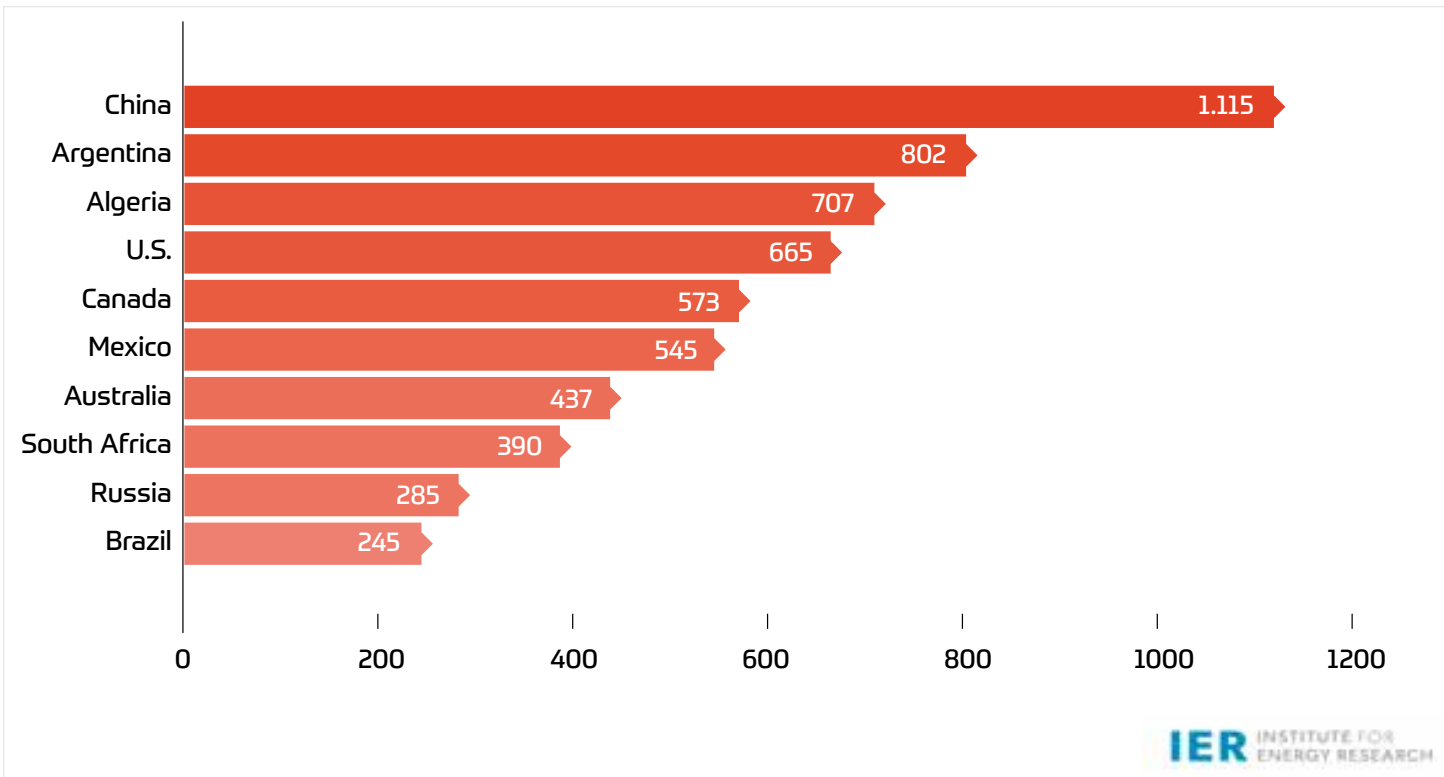
Amid uncertainties about growth rates of domestic shale gas output, the imports of pipeline gas and LNG will have to source enough natural gas to power 100 GW of generating capacity by 2030. Total power generation capacity in China currently stands at 1,246 GW – a staggering 700 times increase from 1949 levels. But this produces only enough electricity to supply 0.9 kilowatt per person. By 2030, the government wants to increase electrification levels and supply 2 kilowatt per person; to this end it pushes for an increase in overall power generation capacity.

ANALYSIS: SHALE GAS IN CHINA - FIGURES



Source: EIA

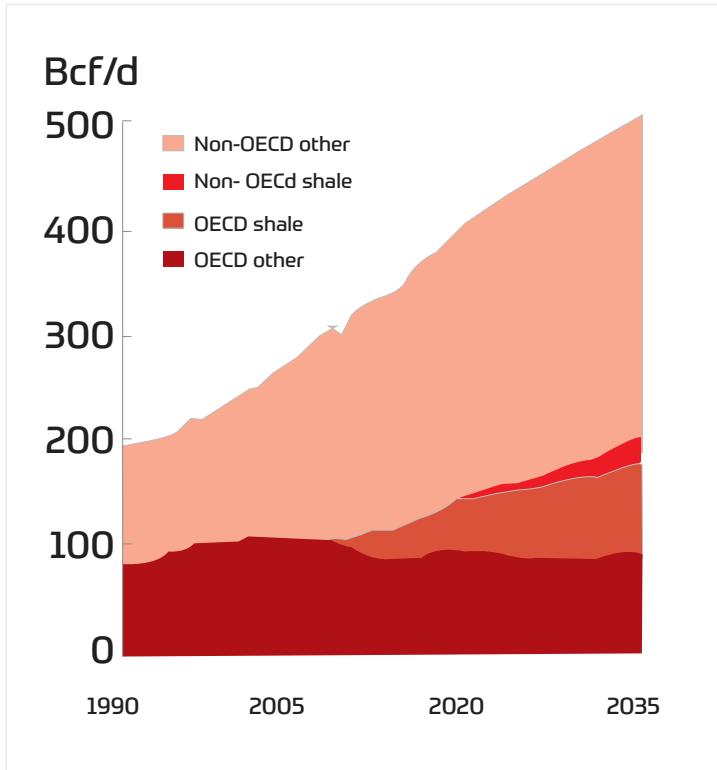
TOP TEN COUNTRIES WITH TECHNICALLY RECOVERABLE SHALE GAS RESOURCES (TRILLION CUBIC FEET)



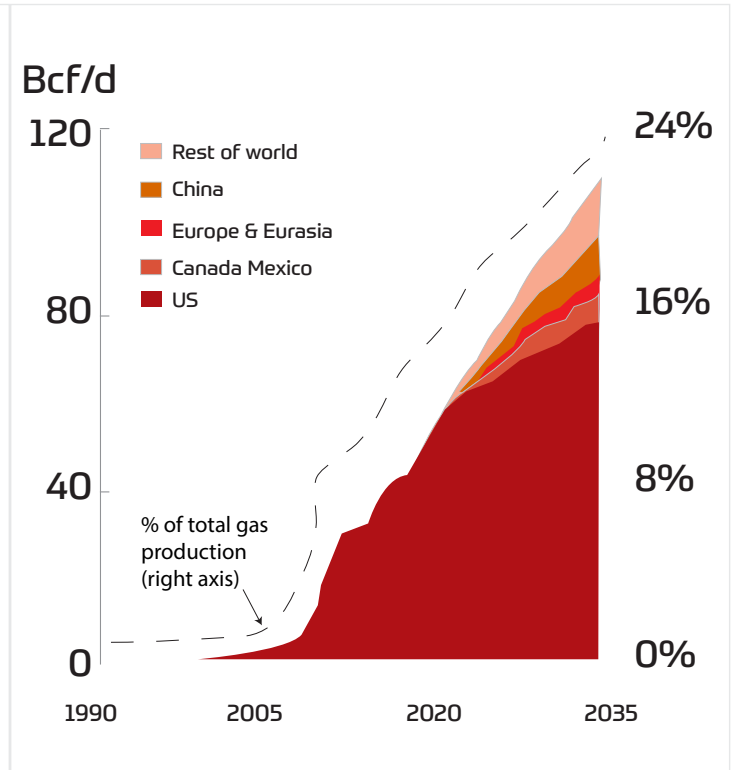
IER INSTITUTE FOR ENERGY RESEARCH

Source: IER

Gas production by type and region

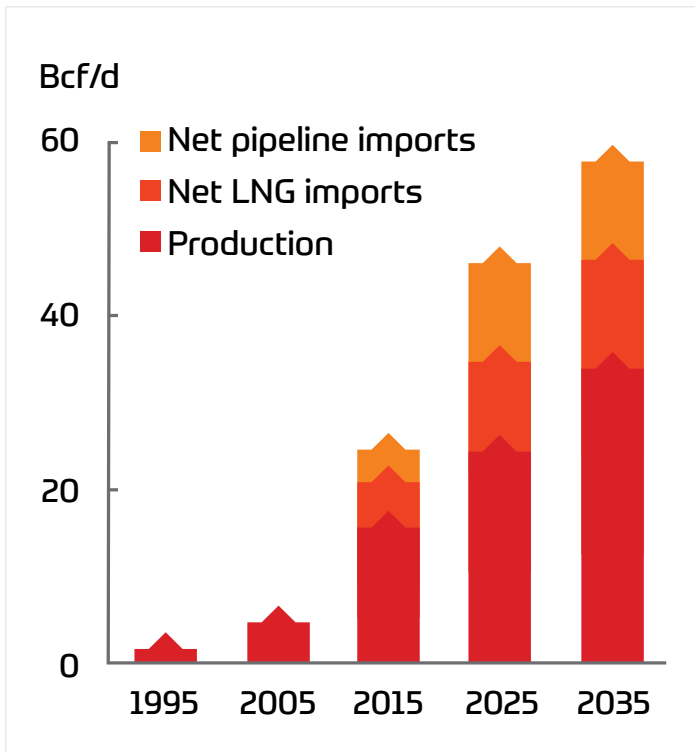


Shale gas production

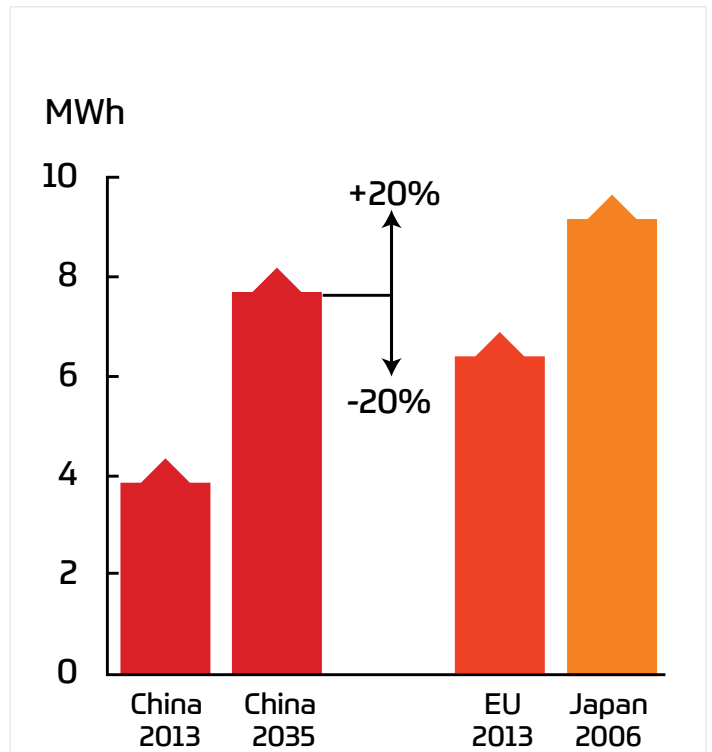


Source: BP Energy Outlook 2015

Sources of gas supply China



Electricity consumption per capita



Source: BP Energy Outlook 2015

Source: BP Energy Outlook 2015



UK shale may be a game-changer but production is still some way off

Interviewing **Chris Hughes**, the Commercial Director at NuTech, is **Monica Thomas**.

In this month's issue we are talking to Chris Hughes, the Commercial Director at NuTech, petrophysical analysis and reservoir intelligence experts, about using legacy data to understand unexplored shale reservoirs and the future of shale exploration in the United Kingdom.

Could you quickly explain to our readers what is it that NuTech does?

NuTech is a consultancy specialising in the technical support of oil companies, contractors and governments around the world, helping them to understand the potential that they have for realising hydrocarbon exploration and production assets. Those could be "conventional" such as the Gulf of Mexico or North Sea type plays; onshore and offshore, or "unconventional"; such as the newly emerging shale plays and tight formation oil and gas reservoirs.

What is the Reservoir Intelligence

process? Is it something that takes place before production commences or is it an ongoing process?

It's a "life-cycle" approach taking place before, during, and after production commences. We term these three life-cycle phases of exploration and production: green field, gold field, and brown field operations.

Green field operations are the new exploration plays, where we help companies understand where to drill and how best to go about that process. We've been responsible for the discovery and enhancement of understanding in all of the main shale plays around the world, particularly in the U.S., ever since attention was turned to it by Mitchell Energy in the late 1990s. We were involved in that process and created studies of all the main shale play areas, either for our clients directly or in a multi-client capacity as screening and guidance for where best to

lease and where best to drill.

We are continuing to do that internationally. We've done studies of this kind in the UK, in The Netherlands, and we're just completing a major project in Pakistan.

Gold field operations represent the way in which those plays get developed - understanding where best to drill and understanding where best to lease, and how best to bring fields into production. Optimising not just the understanding of the petrophysics and the reservoir matrix and the geology, but also the mechanics and the completion methodologies for effective and cost-efficient production techniques to be deployed and maximising the returns on what are expensive investments to develop.

The brown field side of the business is really where the bypassed pay and field-life-extension aspects come into play, in places where the conventional production



is declining and where it is starting to become marginal in terms of cost-effectiveness to continue to operate or produce.

We come in at this point and help our clients look at re-engineering solutions by bringing together a range of different disciplines to really understand the

or do you gather your own data?

When it comes to green field sites, what we do is to look back at the legacy data. We tend to go back down into the archives of previously-drilled wells and use the data associated with those wells, as well as seismic and core, to reassess and reappraise those wells and data sets

from a modern perspective - as if we were looking at the field or the area for the first time.

we had done previously in the U.S. with all of the shale play studies we've done there. We went back into legacy archives of oil companies, and the UK Government in this case, to identify the wells that had data-sets and were drilled to depths that would give us an understanding of the shale-play potential.

Legacy wells in the UK from the very early periods of production, between the thirties and sixties, didn't really have much in the way of logged data that we could use. From the seventies onwards, logging techniques got quite sophisticated, with wells being drilled and logged with full suites of measurements covering electrical and resistivity, radioactivity, and the sonic and density-type measurements for porosity. We were therefore able to use the data-sets from those older vintage wells to reassess them for shale targets. They weren't drilled for shale in those times, but often they were drilled to quite deep depths, into and through some of

“ We help our clients to understand the reservoir and find new places to drill, missed hydrocarbon opportunities, or means of enhancing and extending field-life.”

reservoir and model it more efficiently to find new places to drill, missed hydrocarbon opportunities, or means of enhancing and extending field-life.

Looking in particular at green field opportunities, how is that data gathered? Do you work with the body of geological data that is available for a particular area

We became a data-release agent for the Department of Energy and Climate Change (DECC) in the UK four years ago, when we were at the time putting together the framework and writing our production plans for doing a complete site-assessment and screening study of the UK onshore sector. For the UK project we did exactly as

the targets that we are now looking at for shale play potential.

NuTech has made a very good business in reassessing and understanding the nature of some of these older wells in terms that they are used now as guidance for modern exploration targets such as unconventional shale plays, carbonates and tight sandstones.

So the legacy data allows the industry to get a pretty good idea of what is there in terms of how attractive the reservoir is?

Yes. If one uses the archives efficiently and squeezes every last drop of information out of the previously-collected data-sets - be it the actual wireline logs, seismic surveys or core and cuttings - and use that in a reassessment and reappraisal process, as NuTech is doing, it is considerably cheaper than going out and drilling a brand new well in an area blindly, which could cost as much as 5 to 10 million dollars, at least in the UK.

“ If one uses the archives efficiently and squeezes every last drop of information out of the previously-collected data-sets, it is considerably cheaper than going out and drilling a brand new well in an area blindly. ”

Following on from that, I wanted to come back to the issue of reservoir intelligence. What would you say is critical to reservoir success? If an operator moves into a new area, what are the types of risks they are likely to encounter?

The risks are many and varied. They are mostly commercial, although there are also some environmental risks one has to be mindful of. From a technical and exploration perspective, the key thing that one really has to understand is the nature of the rock and what is in it. This in terms of shale would mean understanding where those source rocks actually are. In simple terms, shale is a combination of clay and silt that was deposited millions of years ago and into which animal and vegetable matter has fallen and decayed, and become trapped and pressure-cooked to form oil and gas.

These sedimentary basins are very wide and very extensive, but they haven't remained completely and utterly uniform over that time. The Bowland shale, for example, now resembles something like uneven crazy-paving. Geological and tectonic processes and continental movement have effectively faulted and broken it up over time, twisted it and bent it out of shape. The understanding of its geological extent and depth and the current faulting of the rock helps us to understand where it is.

We don't always get that information from wells. Sometimes we have to shoot seismic over the top to help us understand that, but wells form a major part of the exploration process. We then gather information from the actual boreholes themselves and recover information out of that well about the rock environment of the shale in question. This helps us map the reservoir properties and petrophysical, geological, and mechanical characteristics of the shale rock, all of which will ultimately assist in siting where to drill new wells.

Two very vital pieces of information are used in that process.

One is core - the plugs or samples of rock taken at the point of drilling. That gives us a real picture and a hands-on ability to examine that rock in detail; to look at what it is made up of, the rock matrix and its constituent parts, the porosity, what's in those pore spaces and what type of hydrocarbon is in the rock itself. It also allows us to assess the permeability of the rock so we can understand how connected the pore spaces are and whether oil, gas or liquids can actually move within the pores and therefore be moved out of the rock to the surface in production terms.

Those are what we would call the key reservoir parameters of the production process, or the exploration process. It's porosity, what's in the pore-space (i.e. water, oil or gas) and how permeable it is, which we need to understand in terms of flow - getting the hydrocarbons out.

We also go into detail about what type of oil or gas it is; whether it is thermogenically produced, i.e. pressure-cooked, or is it biogenically produced, and whether or not it's mature. We have a measurement called TOC (total organic carbon), which helps us to understand the nature of the hydrocarbons, how well-cooked they are, and whether they are mature enough to be turned into oil or gas.

Another aspect that we need to understand is the water content, because within those pore spaces there will also be a certain level of water. The key to understanding the water aspect of the rock matrix, is understanding whether or not it is bound in the formation matrix or whether it is free



to move.

Because water will always move more freely than hydrocarbons, if there's water in the rock matrix, it will move more freely and readily to the surface than the actual hydrocarbon – so what can happen is that we produce water for the most part and a very minor part of the hydrocarbon. We therefore need to understand that water content within the rock matrix as well as the hydrocarbon content and to understand whether it is free to move, or whether it is actually bound in the formation.

In shale formations, for the most part - it being a much tighter rock matrix, with lower porosity and lower permeability than sandstones – water is bound to the actual pores or the grains of rock matrix and therefore the hydrocarbon in that same pore space is free to move without the water moving out with it. That's what we call "bound water". So it's understanding that differential between free and bound water that's a key aspect of the production process.

I would like to move to NuTech's role in the oil discovery in the Weald basin near Gatwick. In April, NuTech announced that the Horse Hill-1 well in the Weald Basin has total oil in place of 158 million barrels per square mile. In July the total Jurassic shale plus tight conventional reservoir section of UKOG's licences were estimated at 9,245 million barrels of oil in place. In your opinion, what does it say about the future of shale exploration in the UK?

There are several caveats to this. The original figures that we put together were based upon the analysis of one particular well and the number that you first gave me is essentially the estimated hydrocarbons in place from all of the different formations we assessed within that well, from top to bottom.

It assumes that there is an acre foot of surface area around the wellbore and that the rock matrix is identical all the way around that position. Measuring that foot-by-foot up the column gives you an assessment of hydrocarbons in place. The key thing to remember is that the calculations are based upon one well and

assume everything in the rock matrix is uniform.

Measurements of hydrocarbons in place do not necessarily equal hydrocarbons that you can produce. This is one of the most important caveats that we put in all of our figures. It is there in the material that we produced for UK Oil & Gas, and it's also what Schlumberger have done in their secondary assessment of the well and site.

Producible hydrocarbons, particularly from shale, always deliver a very much lower number, anywhere between 5% and 25% of that number. It may be that not all of the hydrocarbon-bearing sections that we summed up in the well are actually going to be producible; some may be too thin, too disconnected from the rest of the hydrocarbon column and they may not be economically or commercially viable.

So the figures one takes from that are certainly very encouraging and they are leading us to believe that it's a great-looking play, but when it comes to production we are going to be looking at a far lower volume than the reserves in place.

The other thing to be mindful of is the fact that the bigger figures of the reserve estimates for the licence as a whole, are based on extrapolation from that one well, again assuming the same uniformity is represented throughout the rest of the licences. So we can only estimate what we can see at the moment with the available data.

“ (The Weald basin) figures are leading us to believe that it's a great-looking play, but the production will be much lower than the reserves in place.”

The proving of the play, and the process of getting it into production, will require the drilling of more boreholes, moving further away from where we currently are in the licence to understand if there is any variability to the thickness of the various different target layers and if there is any variation in the rock matrix in that sense. If we moved a mile away from the Horse Hill site and drilled another well, would the rock

would look exactly the same as what we saw in Horse Hill or is it thinner or thicker in terms of the actual target plays? Is it tighter? Is it less hydrocarbon-rich?

These are the secondary phases – we're moving away from that "green field" operation that we've started with, in terms of assessing the parameters of the well itself and such others as we can use around it, and moving more towards the proof of concept phase of our "gold field" operations in the field lifecycle.

The next stage with Horse Hill and other prospective fields in the UK shale play basins will be to move to the gold field operations, which will require the drilling of new wells in order to get maximum information back, as well as trying to site them in areas that we would consider to be the most likely and prospective areas, based on the information that we've assessed so far. From that we will get to the point of understanding exactly how much hydrocarbon there is and exactly what it is going to take in terms of mechanics and operational techniques to get the oil and gas to flow and get it to surface.

Are there any early estimates in terms of when this reservoir is likely to start producing?

In a lot of respects that is going to very much depend upon this very important next phase we're moving into. So drilling new wells and shooting new seismic data in the UK basins is going to depend on how quickly and how efficiently they can get the approvals to perform those activities.

We are sitting on a potential game-changing set of shale plays, but they will only be game-changing if we have the necessary legislative approvals to drill these new wells and get that level of understanding of the nature of these plays up to the levels that they are, for example, in the U.S. We're not going to be drilling perhaps as many wells as they have done in the U.S. in order to actually prove these plays, because technology has moved on now in shale development. Drilling wells is an expensive business, and it's even

more expensive in Europe than it is in the U.S. – sometimes 5 or 10 times more expensive – so anything that can be done to reduce those costs in the form of reservoir intelligence is a real strategic advantage to the oil company.

“ We are sitting on a potential game-changing set of shale plays, but they will only be game-changing if we have the necessary approvals to drill new wells. ”

Equally there are issues in relation to planning law and public acceptance of the whole process of drilling and stimulating production from these wells. So we have to be mindful of that and look at the environmental regulation and mitigation of risk that is required to get both the government, at a central and local level, and the population at a local level, on board with this whole process.

In the UK it is fair to say that the government at the central level is firmly behind this. The Coalition Administration previously and now the Conservative Administration are fully supportive of the development of shale in the UK and see it as a potential game-changer. But a lot of regulations have been set at government level by DECC and the Environmental Agency, and with the assistance of the BGS and other bodies, to understand any environmental risks and make sure that those risks are avoided and that we can successfully develop these shale plays without causing earthquakes, without causing contamination of groundwater, and so forth.

The process is very heavily regulated and the UK is probably one of the most regulated hydrocarbon exploration and productions economies anywhere in the world. It is as safe as it is ever going to be, and every potential risk has been looked at and assessed.

“ The UK is probably one of the most regulated hydrocarbon exploration and productions economies anywhere in the world. ”

That still doesn't necessarily mean that we can go forward with the kinds of drilling programmes that we need to make this economically viable. We've seen in recent weeks and months with the rejection by Lancashire Council of Cuadrilla's application to drill new wells in their county on the basis of some minor planning issues, some better understanding of the processes and procedures is necessary to be communicated at local government and community levels.

We need to be drilling a lot of wells just to gather data and information in order to put these things into production and that's one of the things that one has to be quite mindful of at the moment in terms of the commercialisation of this resource.



Recently the UK government has taken the step to take the decisions about fracking out of the councils' hands if they become too bogged down in their decision process. Do you think this is going to make a big deal of difference? Are you more optimistic about British shale following this decision?

Yes. In my opinion the local levels of planning law are, for the most part, being inappropriately applied to the processes behind the drilling and stimulation (fracking) activities in the UK onshore sector. At the moment, the technical and environmental aspects behind drilling and stimulation are being very well regulated and adhered to by oil companies in their well-plans, which they give to the DECC and the Oil and Gas Authority, who regulate the approvals process for the wells to be drilled. They can turn that around in a matter of weeks – maybe two or three months at most – and give the necessary consent for that to take place. The Environment Agency and the Strategic Environmental Assessments that are required to be produced by the oil companies as a part of their well-plan for a new well are also very streamlined. The monitoring and regulation processes that BGS has put in place in terms of

their baseline study of groundwater and the levels of gas or other naturally occurring radioactive materials (NORMs) in the rock matrix at surface and in the actual groundwater aquifers, are also all in place now. So all of these processes that effectively mitigate the main causes of environmental concern are particularly well-regulated in the UK.

What's not being properly applied are the secondary and approvals processes, which have more to do with local planning applications and the consequent hearings and appeals processes. If you look at some of the recent examples of drilling applications and local authority rejections, they have been on the grounds of noise and traffic on what is effectively only a very temporary inconvenience. My understanding is that such matters would not be permitted as grounds for objection in a planning application for property developments.

Perhaps we are asking our councillors and officers at local level to repeat an approvals process that has already been reviewed by more qualified bodies at a central level, and in so doing, we have allowed the general planning process to be abused in order to impede the development of the shale

business in the UK.

“ Perhaps we are asking our councillors to repeat an approvals process that has already been reviewed by more qualified bodies at a central level. ”

Would you say that shale exploration and production is likely to take place in the UK within the next 5 years?

It is probably going to take that. If you think back to the description I've given of the green field to gold field process – moving from pure exploration at the strategic level to bringing operations into production, three to five years is the time frame that one would reasonably expect to be looking at to get some kind of efficient development from a particular field or block into some sort of production.

But as it stands at the moment, with the levels of work that these companies are having to do and the other inhibiting factors brought about by local level consents, we are probably looking at more like 10 to 15 years.





European shale gas exploration firms work to overcome EU laws

By Finbarr Toesland

Shale gas exploration in Europe has become a hot topic in recent years, with governments across the continent taking very different stances on the issue. The arguments for shale gas exploration have gained momentum after the successful history of shale exploration in North America, which has opened the discussion on the future potential of shale gas in Europe.

Although there is not a single, defined European viewpoint on shale gas exploration, the European Union have spent a great deal of time discussing introducing a new set of laws meant to regulate the exploration of shale gas in member states. However, early last year the European Commission

stopped short of bringing in regulation, which many commentators were expecting, and instead launched so-called 'minimum principles'. These basic standards are simply recommendations, leaving individual countries governments to legislate shale gas exploration on their own terms.

Shale gas exploration has been virtually outlawed in a number of European countries, including Bulgaria, France, Northern Ireland, with a range of other nations imposing restrictive laws intended to limit shale gas exploration. Poland and the United Kingdom are the two countries who most prominently support shale gas development in the EU.



Prime Minister David Cameron has vowed to go “all out for shale”, with his statement being backed up by a recent announcement that Britain will now offer licences for shale gas exploration for the first time in around seven years. None of the new exploration sites will be in Scotland or Wales, as these two regions have imposed a moratorium on all shale gas activities.

Shale gas developers are clearly interested about the opportunities the nascent UK shale gas industry has to offer, as there were 95 applications from 47 companies competing for the 27 available explorations sections. Hutton, Cuadrilla and INEOS are three of the firms that have received authorisation for exploration, as part of this latest round of approvals.

David Cameron is not the only high profile UK politician to

highlight the benefits of shale gas exploration. UK Energy Minister Lord Bourne has stated the important of “pressing on and getting shale moving, while maintaining strong environmental controls. Investment in shale could reach £33 billion and support 64,000 jobs creating financial security for hardworking people and their families, whilst providing a cost-efficient bridge to lower-carbon energy use.”

The Netherlands extended their moratorium on both commercial exploration and extraction of shale gas until least 2020, in July of this year. This was in response to studies the Dutch government had commissioned on the possible social and environmental effects shale gas development could have.

Denmark has an estimated 2.5tn cubic feet of onshore gas resources in the Alum Shale, according to a US Geological Survey. A government issued moratorium was placed on fracking in 2012, notwithstanding the fact that Total was still able to explore Jutland and Zealand for shale gas. Depending on the results from Total’s test drilling, the Danish government may reconsider the moratorium to allow further shale gas extraction.

Both France and Germany have outlawed hydraulic fracking for shale gas since 2011, alongside the former revoking a number of previously issued exploration licenses. However, France has the largest amount of prospective shale in Western Europe and Germany languishes well behind with a far lower estimated recoverable shale resources.

Countries that have major public opposition towards shale gas development are finding it difficult to pass legislation allowing such activities. However, environmental concerns may soon be overtaken by political realities, especially when large percentages of energy are imported. The recent oil price slump has made the cost of shale exploration activities comparatively expensive, although the need for energy independence is driving exploration in the UK.



Poland has the largest perspective shale gas supply in Europe, alongside a supportive government, leading many to hope that the country would see positive results in their exploration attempts. Unfortunately, Exxon Mobil, France’s Total SA and Marathon Oil have all announced their exit from shale activities in Poland.

The Polish government introduced several cumbersome and inflexible regulations that have cooled the appetite of shale gas explorers. Legislation was brought into law in 2011 in the country that was supposed to bring regulation up-to-date and increase the percentage of shale gas income for the government. However, the implementation of this scheme proved to be one step too far and discouraged energy firms investment in the burgeoning shale gas industry.

In response to the backlash against this legislation the law was modified to reflect concerns around an exodus of energy firms, which was simply too little too late as ConocoPhillips’ Polish company has also stopped all exploration activities.

Romanian Prime Minister Victor Ponta said in May of last year that "For the time being and in the next five years, not a single cubic metre of shale gas will be exploited in Romania", dashing hopes of a shale gas boom originating from Eastern Europe. US oil firm Chevron confirmed at this year that they would be relinquishing all their interests in Romanian shale gas concessions, following a similar announcement last year that saw the company stop shale exploration activities in both Ukraine and Lithuania.

Even countries that have an otherwise supportive legislative approach can face opposition from outspoken ministers, with a prime example of this happening in Lithuania. "As the situation goes forward, I become more skeptical about the need to carry out exploration here in Lithuania" Lithuanian Minister of Environment Kestutis Treciokas said to reporters in Vilnius. The Lithuanian government continues to be receptive towards investment in shale gas exploration, although these firms have pulled out due to falling oil prices.

Lithuanian's 2012 tender for shale gas exploration and production saw Chevron be the only firm taking part. Later research showed that the actual reserves of shale gas were lower than originally thought, with the regulations leading Chevron to opt out of the 2013 tender. Tendering for shale gas in Lithuania has been put on hold until suitable energy companies can be found to invest in the developing industry.

Ukraine's shale gas resources were once seen as a key target by many exploration firms, but the political instability facing the country decimated the interest in this country. Both the east and west regions of Ukraine had strong shale gas prospects before the damaging disruption severely affected exploration.

It is very unlikely that there will be a blanket ban on shale gas exploration and production in the EU, especially in the context of dependence on Russian gas by many European countries. Developing innovative energy sources is becoming increasingly important to member states, even though the current political climate in many countries is hampering this goal.

SHALE GAS EXPLORATION MOVING FORWARD



The newly established European Science and Technology Network on Unconventional Hydrocarbon Extraction is the pre-eminent EU body that aims to provide detailed analysis and research to key players throughout the European shale gas industry, by putting together

the expertise of academics, shale experts as well as the wider civil society. The launch of this network by the EU Commission places renewed importance on the scientific community's research into improving shale gas technologies and ensuring the safe and profitable extraction of this innovative energy supply.

According to the EU Commission the network "will collect, analyse and review results from exploration projects and assess the development of technologies used to extract unconventional gas and oil." Perhaps more importantly the body will "structure the dialogue among the stakeholders, fostering open information and knowledge sharing." If there is to be positive shale gas exploration laws across the European Union the general public will have to be back these activities on a broad scale, as significant public concerns have repeatedly derailed favourable regulatory environments.

Environmentalist pressure groups continue to pose a major threat to the development of shale gas exploration laws, with their lobbying often swaying public officials and opinion against this alternative source of energy. The future of exploration laws in the EU will be governed by how effective the dissemination of scientific research on this topic is and the assurance of quality safeguards around extraction.

The legal framework around shale gas exploration in Europe is constantly developing, as public opinion changes and concerns grow around the availability and cost of more traditional energy supplies. In the short term the legal situation is unlikely to drastically change on a continental level, due to the divergence of opinions that nation states hold.

EU directives and initiatives impacting shale gas prospects

The European Union have launched a range of plans and strategies aimed at addressing the central issues around energy provision throughout the union. Although other countries with large amounts of shale gas reserves, such as the United States, have exploited the so-called 'shale revolution', EU member states still heavily rely on gas imports.

Political tensions in Ukraine brought the issue of energy security to the forefront of policy discussions in 2014, with the EU Commission introducing the European Energy Security Strategy, in an attempt to create a more diversified energy supply.

EUROPEAN ENERGY SECURITY STRATEGY

The strategy itself conveys the importance of including shale gas in the EU energy mix, as "producing oil and gas from unconventional sources in Europe, and especially shale gas, could partially compensate for declining conventional gas production provided issues of public acceptance and environmental impact are adequately addressed," according to the European Energy Security Strategy.

There are a number of key points in the Strategy, with the most relevant being the need to increase energy production in the European Union. On an EU level a more detailed and accurate assessment of shale gas reserves is vital to ascertain if extraction can be undertaken on a commercial scale.

When a greater number of member states have new and precise shale gas reserve figures, commercial entities will be more likely to begin exploration and extraction across the continent. The argument for shale gas is getting stronger as other more traditional forms of energy are either increasing in price or becoming harder to obtain.





RECOMMENDATION ON MINIMUM PRINCIPLES

Early last year the European Commission released a recommendation on minimum principles for the exploration and production of hydrocarbons, outlining a set of non-binding guidelines for member states. Although this recommendation does not place any legal obligations on member states, as opposed to regulations or directives, the effectiveness of the recommendation will be reviewed 18 months after its release. Therefore, at the time of review the Commission may decide to introduce legislative proposals to be discussed.

As part of the minimum principles, shale gas in the EU should work towards reducing the greenhouse gas emission levels in the short to medium term. An effort should be made to make the EU more energy independent, by limiting the need for imports. The Commission also recommends that exploiting shale gas should, either directly or indirectly, offer benefits to not only the EU as a whole but also in the areas shale gas operations take place. Strong levels of public acceptance and an environmentally friendly approach should be achieved, if the minimum principles are to be reached.

EUROPEAN SCIENCE AND TECHNOLOGY NETWORK

The European Science and Technology Network on Unconventional Hydrocarbon Extraction has played an important role in the EU shale gas policy environment since its launch in July last year. The commission hopes that the network will "bring together practitioners from industry, research, academia as well as civil society. The Network will collect, analyse and review results from exploration projects as well as assess the development of technologies used in unconventional gas and oil projects".

As part of the stated aim of the Network to improve their knowledge around shale gas, two working groups have been set up; simply named WG1 and WG2. WG1, chaired by Professor Grzegorz Pieńkowski of the Polish Geological Institute, has been tasked with collecting environmental data

on a range of exploration projects and WG2, chaired by Dr Francois Kalaydjian, IFP Energies Nouvelles, is assessing the development of technologies used in unconventional oil and gas projects. Both groups met in February and June this year, with a further meeting expected in September and an annual conference in February 2016.

The network is made up of 74 members, with 14 of these individuals working for the European Commission. It is hoped that the network will give environmental and industry groups the opportunity to share their thoughts and opinions on important shale gas issues. The research produced by the network will also be utilised by the commission, as a source of independent data knowledge.

HORIZON 2020

The EU's research programme called Horizon 2020 has allocated €12 million in funding for shale gas research, with University College London (UCL) and Edinburgh University being selected to undertake two research projects. These studies will investigate what impact, if any, shale gas exploration and extraction has had on the environment. A further two projects around shale gas research will also be paid for out of this allowance.

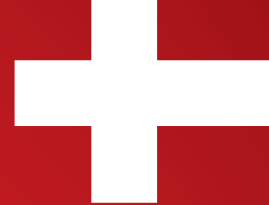
"For the very first time, we have launched a dedicated action which will support researchers and scientists in their quest to understand, prevent and mitigate the potential environmental impacts and risks of shale gas exploration and exploitation," said Robert-Jan Smits, director-general for the European Commission's Research and Innovation directorate. Member States must be in a position to make informed and responsible choices. It is here that science and innovation play a crucial role."

The Edinburgh University study, coordinated by Christopher McDermot, will focus on an above ground environmental assessment, with Uppsala University and Pennsylvania State University assisting in the three-year study.

Alberto Striolo, professor of molecular thermodynamics at UCL, will be the project coordinator for the second study that looks at the below ground environmental aspects of shale gas extraction. Manchester University, Alicante University and Halliburton will work with UCL in this study, however no EU funding will go to Halliburton.

It is increasingly clear from the EU commission's initiatives and directives that they understand the importance of the use of shale gas as part of the continent's overall energy consumption. However, they also reiterate the need for the potential implementation of shale gas to address energy security problems, assist in reducing greenhouse gases and boost economic growth.

Member states still have total control over their policies towards the shale gas industry, although they of course take into consideration the recommendations and other non-binding guidelines set by the commission. It is of the utmost importance to the commission to ensure the risks of shale gas are kept to a minimum and environmental safeguards are implemented.



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- **Azizollah Ramazani**, Chairman, **National Iranian Gas Export Company (NIGEC)**

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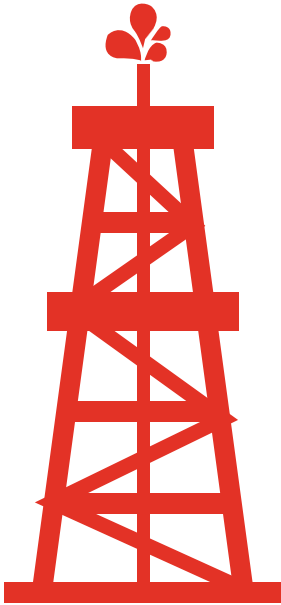


Boom or bust - The Argentinian Question

By Mark Storry

INTRO

Vaca Muerta is one of the true big beasts of the shale gas world. It is a development that could convert Argentina from a nation which needs the international credit markets to pay for its energy imports, to one on its way to achieving energy independence. The strength of investment in Vaca Muerta suggests that, even with the depressed energy prices of 2015, Vaca Muerta will continue to be developed. However if one were to look back to 2012 Repsol executives would have been bullish about their prospects in Vaca Muerta. Those feelings have since been quashed.



Overview of Vaca Muerta

Argentina was one of the quickest up-takers of horizontal drilling and hydraulic fracturing drilling. More than 300 wells have been drilled between 2013 and 2015 in Argentina. Indeed, for unconventional shale reserves, it was one of only four countries which actually produced shale gas in 2014. The other three were the USA, Canada and China (as reported by the EIA).

There are considered to be four main basins in Argentina: Neuquen, Golfo San Jorge, Austral and Paraná. The Neuquen is considered to be the most advanced, within it, the late Jurassic to early cretaceous shale form Vaca Muerta (see Figure 1 for more information).

Vaca Muerta is a geographical feature that covers more than 30,000 Km² and contains oil and gas at a depth of more than 2,500m. According to the EIA, the Vaca Muerta formation has technical recoverable gas reserves of 308 Tcf of shale gas together with 16 billion barrels

of oil, with the nearby Los Molles having reserves of 275 Tcf of shale gas and 3.7 billion barrels of oil. Its thickness is roughly three times that of the average in the US. Thus these formations are considered to be some of the most promising unconventional resources in the world.

Vaca Muerta is also assisted by its proximity to existing gas pipelines thus requiring less investment to bring the gas to market (conventional gas is being produced at the nearby Mulichinco formation). Production currently is limited to a few sites, although this is expected to increase. YPF, the 51% Argentinian government owned oil company, reported production in April 2015 of 22,900 barrels per day (b/d) of oil and 67 million cubic feet per day (MMcf/d) of natural gas. Indeed, the Loma Campana field, which is in partnership with Chevron, is the second largest operating non-conventional field outside the USA.



Regulatory Framework - Unstable Ground

For Argentina the discovery of a world class shale gas reserve presents it with a unique opportunity to achieve energy independence. Christina Kirshner's leftist government has focused on energy independence as a way of reducing its dependence on foreign energy sources and the need to have foreign exchange in order to pay for energy imports (Largely natural gas from Bolivia and LNG imported via the Escobar and Bahia Blanca terminals). Thus the administration's policies may seem erratic if viewed from a free market prism, however its actions must be looked at from the perspective of resource nationalism.

Until 2012, Argentina was considered to have one of the most open oil and gas sectors, in which the private sector played the dominant part and market forces ruled. This followed a period of privatization and economic liberalism during the 1980's. However under the successive Kirshner administrations, Argentinian energy

policy became more inward looking and nationalistic. Thus in 2012 Christina Kirshner re-nationalised YPF which previously was majority owned by Repsol. There were two principal rationales given by the Argentinian government for this : firstly that as the ownership of YPF became more fragmented and foreign owned there was insufficient focus on developing Argentinian resources, in essence the Argentinian operations were being treated as a cash-cow and had seen a reduction in production while increased dividends to the Spanish parent company. Secondly it came as part of a wider process of nationalization of assets which included various pension funds and Aerolineas Argentinas. The initial re-nationalization did not come with compensation, and a lengthy legal battle followed between Repsol and the Argentinian government as to the correct value. It is surprising that Vaca Muerta has received the level

of international investment that it has when investors must be aware that there is a substantive risk to doing business in Argentina.

Figure 11 shows Argentinian inward investment, it appears that investment remained high even throughout the nationalization process in 2012 and 2013. Indeed, inward investment drops just as global energy prices dropped towards the end of 2014. Despite this drop; Chevron & Petronas among others have announced substantial investments into Vaca Muerta.

Thus the driving force behind the Vaca Muerta development became a 51% Argentinian government owned company, YDF. YDF control around 12,000 of the 30,000 Km² that make up Vaca Muerta. While it was a division of a successful privately ran company (Repsol) for more than 20 years, it is vulnerable to political interference.

TECHNOLOGICAL CHALLENGES – Continued search for excellence

The existence of the Vaca Muerta formation has been known for some time. Essentially the key change has been the technologies practiced and mastered on various formations in North America, in a safe regulatory environment, can now be used in a more politically risky environment. “What I saw here was frankly an impressive display of technology,” Daniel Poneman, the U.S. Deputy Energy Secretary stated in 2014. One particular method used, according to a technical expert Pedro Lezama, is based on the openhole, multistage fracturing systems currently used across North America, which allows

for a constant pumping action and the associated efficiencies in performance.

The technology required to operate in Vaca Muerta does to a large degree exist, however as development on the formation is new, there is a learning curve and there is a large capital requirement. YPF’s partnering strategy suggests that they value companies that bring access to cheap capital above companies with a particular expertise in shale gas (although there is of course overlap between the two).

CONCLUSION

The EIA has ranked Vaca Muerta as having the second largest resource of shale gas and the fourth largest resource of shale oil in the world. Investment in the area appears to have continued despite the spectre of resource nationalism looming over the development. The future of Vaca Muerta is very much alive, the Argentinian government appear to have created a more stable regime which

will encourage inward investment, indeed none of the candidates in the October 2015 elections are expected to take such an active role in the economy as the current Kirshner administration. The high reward of Vaca Muerta appears to match the high level of risk. If the Argentinian government could reduce that risk, Vaca Muerta could exceed even current expectations.

REGULATORY REGIME

On the back of declining investment in the oil and gas sector, Argentina introduced a new law amending its hydrocarbon regulatory framework (the “New Hydrocarbon Law”). This new law particularly focuses on encouraging unconventional oil and gas development. Its key features include

- » A change from a regional bidding process to a national bidding process
- » A change in the length of the exploration permits to 11 years for conventional and 13 years for unconventional
- » An increase in the exploration period to 35 years in the case of unconventional resources

» Increased concessions for investments of more than \$250m and of 3 years - Concessionaires will be able to sell up to 20% of their product free of export taxes in the case of unconventional resources

» Royalties unified at a rate of 12%, this can be increased by up to 3% at the end of each concession up to a maximum of 18%

However, since 2014 the Argentinian government has U-turned on various incentives that were aimed at encouraging investment in its shale oil developments. Interestingly these incentives came in the form of USD denominated government bonds, similar to those it defaulted on in 2002.

COMPANY TRACKER

(COMPANY & ACTIVITIES)

YPF
YPF control 12,000 KM2 of the Vaca Muera formation. YPF have announced two shale gas discoveries in 2015; in La Ribera. CEO Miguel Galuccio recently stated that costs have declined from the predicted \$7.5m per well to \$7m

WINTERSHALL
German giant Wintershall is already the fourth largest gas producer in Argentina. Wintershall America has interests in the San Roque, Aguada Pichana, Bandurria and Aguada Federal blocks in the Neuquen Basin

PETRONAS
Petronas plans to invest \$475m in the Vaca Muerta over the next 3 years in conjunction with YPF

DOW CHEMICAL
Dow Chemical have a joint venture with YDF in the El Orejano field

GAS Y PETRÓLEO DEL NEUQUÉN
A regional company formed in 2008 that has strong positions in Vaca Muerta often in partnership with international Majors that bring access to the capital markets

CHEVRON

Chevron have interests in three principal areas; El Trapial, Loma Campana and Narambuena. These interests are held by Chevron Argentina

EXXONMOBIL

ExxonMobil have interests in approximately 900,000 net acres in Vaca Muerta. This consists of an 85% working interest in the La Invernada and Bajo del Choique. Gas y Petroleo del Neuquén holds a 15% interest in both areas. ExxonMobile, together with their partner Gas y Petroleo del Neuquen SA, announced production of 448 barrels of oil (b/d) and 1 million cubic feet of gas per day (MMcf/d) at their Invernada X-3 well

TOTAL

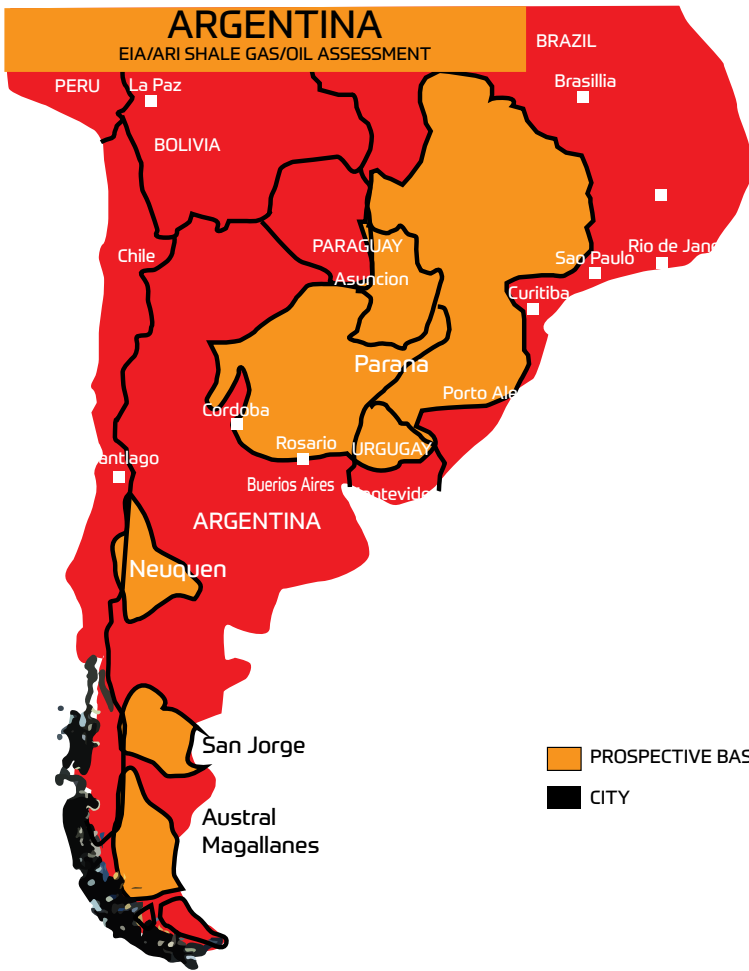
Production began at Totals Aguada Pichana pilot project in June of this year

SHELL

Shell Argentina will invest more than \$250m in the Cruz de Lorena & Sierras Blancas sites

MADALENA ENERGY

Magdalena is a Canadian junior with more than 950,000 Acres of holdings

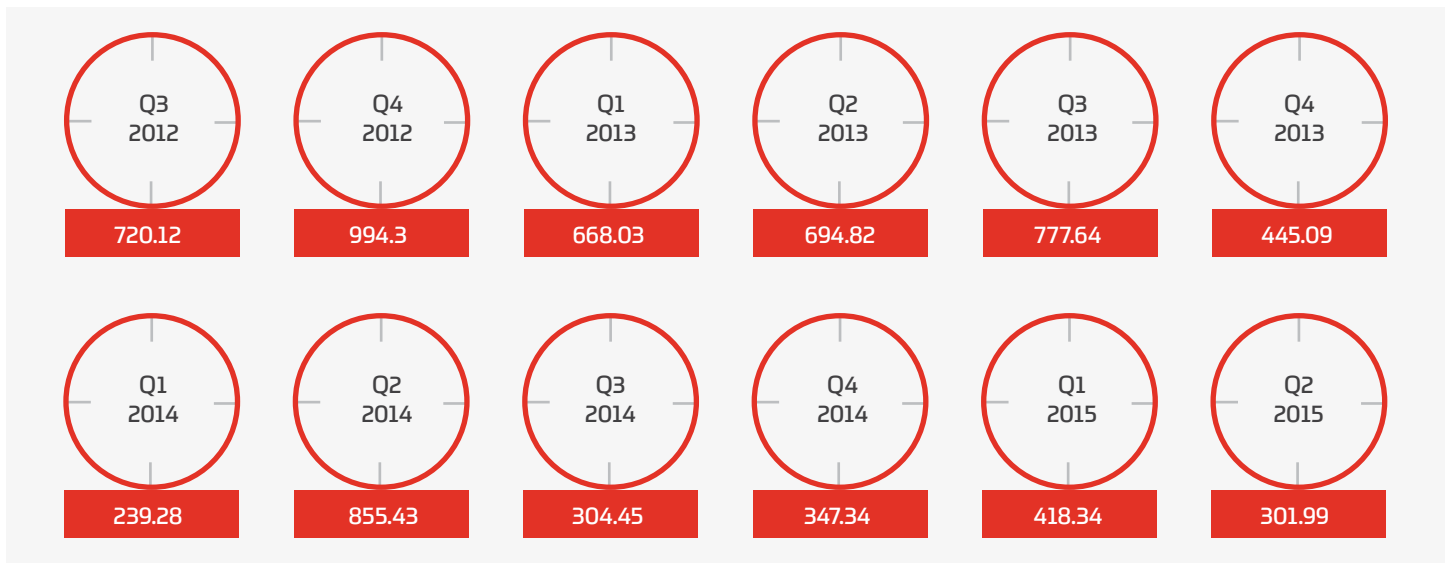


SHALE GAS LOCATIONS

Figure I

Argentinian Inward Investment Figure II

Time | Inward Investment (USD, Mil)



Source: Central Bank of Argentina



Interview with MATIAS BORDERES, Senior Attorney, EBV

"Matias Borderes is a senior associate of Estudio Beccar Varela. His professional practices include corporate law, oil & gas, transactional, M&A and construction law.

He received his law degree from the Universidad Católica Argentina in 2004, completed a masters course in business law at the Austral University in 2008, and obtained an oil & gas law specialization degree from the University of Buenos Aires in 2013."

SHALE GAS INTERNATIONAL: Given the substantial fluctuations in the Argentinian tax regime do you consider the Vaca Muerta field to be a "safe" investment for international gas community?

MATIAS BORDERES: An investment in Argentina can be considered "safe" or "unsafe" (from a legal/political standpoint) depending with what you compare it to. It could be deemed to be less safe than an oil & gas investment in Canada, the US, or Scotland, though it might be safer than an investment in the Middle East (at least certain parts), Africa or southern Asia. Argentina has stability that other places do not have (no wars, no coups, etc.) though at times the Government (both Federal and Provincial) has adopted unanticipated measures that have not always been business friendly.

Notwithstanding the above, it is important to point out that the Federal Government has strived during the last three years to boost private investment in oil & gas exploration and production, especially of the non-conventional (shale, tight, etc) nature. In this regard, Federal Law No. 26,741 (enacted in May 2012) has declared hydrocarbon self-sufficiency to be of "national public interest". In addition, through Federal Law No. 27,007 (enacted in October 2014) the Federal Hydrocarbons Law No. 17,319 (enacted in June 1967) was substantially amended, in order to provide specific regulation regarding non-conventional exploration and production (which provide better conditions to the permission or concession holders, like greater time extensions on their

exploration and production rights), and an "investment promotion regime", originally granted through an Presidential Executive Order (No. 929/2013) was broadened and given a stronger legal status.

Provincial Governments (which grant exploration permits and production concessions located in their territories) have also strived to make private oil & gas investments safer or friendlier. For example, certain provinces (for example Neuquén and Santa Cruz) have included in the agreements entered into with concession holders for the purposes of extending the duration of those concessions (in exchange for investments commitments) tax stability clauses, by which the Provinces agree not to create or amend Provincial taxes applicable to exploration and production activities.

The above measures evidence the intention of the Government (both Federal and Provincial) to attract private investments in oil & gas activities. These measures should limit unexpected fluctuations in the Argentine tax regime and hopefully make Argentina an interest market in which to make investments."

SHALE GAS INTERNATIONAL: What reforms could the government undertake that you believe would encourage investment in Vaca Muerta?

MATIAS BORDERES: The Federal Government will have to make a number of changes to encourage investment in Vaca Muerta (and in Argentina in general). One of the current deterrents are the existing exchange control limitations, which limit the transfer of money to, and especially

from, Argentina. These limitations should be relaxed or eliminated, given that foreign investors will not be keen to make an investment if they are not sure that they will be able to timely recoup it and take it back to their own country.

Another (related) problem is the current exchange rate of the Argentine Peso with foreign currencies. The Argentine Peso is being kept artificially expensive, thus making US Dollar investments in Argentina costly. The exchange rate should be permitted to float, thus making US Dollar investments more attractive.

Inflation is also a problem that the Federal Government needs to undertake. Currently at around 30/40% a year, it makes it difficult to do business. And if we take into account that the exchange rate has remained almost unchanged for more than a year, it means that such inflation has also been in US Dollars (or any other foreign currency).

From a legal standpoint, Federal and Provincial Governments should be more open to accepting international arbitration as the jurisdiction that would rule in case of conflict. Currently most Provinces will not accept another jurisdiction other than Provincial courts (which can sometimes tend to be friendly to the position of the Government).

It is expected that the new Federal Government will necessarily address the economic issues detailed above, though this might not all be done in the short run. Presidential elections will take place in October of this year, and the new President will take office in December."

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U.S. SHALE - 10 winners in a downturn

By Mark Tygart

The dramatic downturn in the price of oil, natural gas and other commodities over the past year or so has taken its toll on a whole host of companies in the natural resources sector. Shale gas and oil drillers have not been spared hardship as the plummeting price of their products has led to drastic cutbacks and even bankruptcy for some firms in the sector. However, even in the midst of the turmoil engendered by the difficult operating conditions the industry faces, some firms have managed to prosper.

This is not to say that the 10 firms identified below are making money hand over fist. In a downturn like this winning can consist of simply managing to remain profitable or cutting costs to stay afloat while improving future prospects. The companies selected for this list have used a variety of tactics to improve their strategic position during the crisis, including:

COST CUTTING: Almost without exception, the companies on the list below have found ways to dramatically reduce their cost structures. The main methods for doing so have been to use innovative drilling techniques, elicit cost reductions from suppliers and cut overhead costs as much as possible.

PRODUCTION CUTS: Shutting in non-profitable production is a step a number of shale producers have taken to conserve capital and preserve their assets until a more favorable pricing environment presents itself.

HEDGING: Companies that have hedged production through the downturn have been able to insulate themselves, at least to some degree, from the worst effects of the crisis. Profits on the downside protection the hedges provide has helped to offset declines in revenue realized from production due to falling energy prices.

CAPITAL CONSERVATION: With capital hard to come by throughout the industry, the firms on the list are taking steps to husband their capital carefully. This can include avoiding taking on new debt, paying down existing debt and deferring the launch of new projects requiring large capital expenditures.

Another factor that plays a part in differentiating a number of companies selected for inclusion on the list from their competitors is location. Firms operating in low-cost production areas have a marked advantage in today's pricing environment. Vincent Piazza, writing for Bloomberg Intelligence, identified four companies which also appear on this list that have performed better than expected during the downturn, partly due to location. All four firms, Range Resources, Cabot Oil & Gas, EQT, and Southwestern Energy, operate in the Marcellus/Utica shale formations. The low cost natural gas they extract from their acreage in these plays, combined with hedging, have helped the firms weather the current industry crisis.

Below is a list of 10 U.S. shale companies doing well during the downturn, followed by an analysis of the action each firm is taking to turn the hard times to their advantage:

- ANTERO RESOURCES
- CABOT OIL AND GAS
- CIMAREX ENERGY
- EOG RESOURCES
- EQT
- NEWFIELD EXPLORATION COMPANY
- PIONEER NATURAL RESOURCES
- RANGE RESOURCES
- SM ENERGY
- SOUTHWESTERN ENERGY

● **ANTERO RESOURCES:** Antero has utilized a strong hedge position to improve its ability to deal with the current challenging circumstances in the industry. The firm's ability to improve both its gross margin and cash flow over the past year, downturn notwithstanding, is evidence of this. Due to its hedges Antero averaged \$4.37 per million cubic feet equivalent for its natural gas during the first quarter of 2015, more than \$1.00 above the average NYMEX price over the period.

With production of almost 2.5 trillion cubic feet equivalent hedged from April of 2015 through the end of 2021, Antero has placed itself in position to weather a lengthy downturn in the price of natural gas if necessary. The company is also reducing operating and servicing costs to improve its position further. Negotiations with service companies have helped bring about significant reductions in cost per well in both the Marcellus and Utica plays.

By reducing costs over \$1,000,000 a well the company is able to book total savings of close to \$2 billion on its over 5,300 wells.

With capital expenditure outlays reduced by almost 50% in fiscal 2015 versus 2014, the company appears well positioned to prosper in good or bad times.

● **CABOT OIL & GAS:** While Cabot reported a loss of \$.07 per share for the second quarter of 2015, after adjusting for items such as a \$36.5 million non-cash charge to mark certain derivatives to market the company realized adjusted earning of \$.03 per share. Operating cash flow amounted to \$171 million, which was less than the year earlier figure due to a 38% and 43% decline in prices realized for natural gas and oil respectively.

In reaction to price weakness, the company discontinued drilling at a significant number of wells in the Marcellus in the second quarter, and plans to continue this strategy in the third quarter of 2015. Even with reductions the company estimates at approximately 500 million cubic feet equivalents per day in the quarter, Cabot's equivalent production nonetheless increased 25% over the first half of 2015 when compared to the year earlier period.

The company is focused on reducing costs via more efficient operations and reduction in costs. Cabot reported that its spud to spud cycle time decreased to 15 days in the second quarter compared to approximately 19 days in 2014. The company also reported working with its service providers to reduce costs further. These efforts allowed Cabot to report completed well cost results at the low end of the \$6.0 to \$6.5 million range. The company expects to realize between \$.30 to \$.35 per Mcf of uplift to its prices from hedges.

In the company's second quarter results conference call, Dan Dinges, Cabot CEO, stated that the company is focusing on "improving margins and returns" to maximize value over the long-term. He cited the company's ability to "continue to efficiently grow our production and reserves in this low-price environment without straining our balance sheet or issuing equity" as evidence of this.

● **CIMAREX ENERGY COMPANY:** Cimarex beat production expectations in the second quarter of 2015, helped by better than expected performance of its horizontal wells in the Delaware Basin Wolfcamp play. The company reported record production of 1.26 Bcf (billion cubic feet) a day, surpassing the 1-Bcf-a day level for the first time ever. Second quarter production was up 22% from 839 million a day in the year earlier quarter.

The majority of the company's production came from the Permian Basin, with gas production in the region rising 26% from the first quarter, while NGL (natural gas liquid) production rose 46% and oil production rose 12% over the same time frame. The company projected 2015 production to be in the range of 960 to 980 million cubic feet a day, up from previous projections of 920 to 950 million a day.

In its conference call discussing these results, the company emphasized that its focus on science and innovation has helped it improve its results via enhanced well and completion design, among other innovations. The Woodford shale and Meramec play were cited as particular sources of success and innovative drilling techniques for the company. With \$730 million in additional capital as a result of an equity issuance in May of 2015, the company's balance sheet is well positioned to support its drilling programs.

The company's CEO Tom Jordan expressed considerable enthusiasm for Cimarex's 2016 drilling plans in the Delaware and Anadarko basins. He cited "multi-zone spec potential capital efficiency by exploiting multiple zones within a single development project."

Given the "volatile environment," Jordan stated that the company planned to operate with its current capital without incurring further debt in 2015 or 2016. Cimarex also continued to experience service costs decline in the second quarter, falling as much as 20-30% from peak levels in 2014. Jordan said the company has made "significant progress in lowering lease operating expense," mainly as a result of reduced costs for saltwater disposal. He added that with commodity prices depressed, Cimarex has directed its efforts at finding ways to "survive and thrive" in the current challenging environment.

● **EOG RESOURCES:** Houston-based EOG Resources has aggressively cut costs and divested non-strategic units in response to the current downturn in the price of oil and natural gas. As a result, its most recent quarterly results showed operating cash flow of \$7.34 billion, substantially in excess of the company's \$4.4 billion in debt.

The company has also decided to focus on quality over quantity when it comes to production. The producer of natural gas and oil saw second quarter production levels fall 5.2% year over year to 560,500 barrels of oil equivalents. Despite this decline the company remained profitable, turning in an operating profit of \$40 million in the second quarter. This stemmed from reducing the firm's cost structure and the divestment of its Canadian operations.

The company has also kept its dividend lower than that of its peers, helping conserve cash and position its operations for growth over the long term. Also, by diversifying its production profile to include oil as well as natural gas, the firm has access to greater opportunities for growth.

● **EQT:** While depressed commodity prices significantly impacted EQT during the second quarter of 2015, the company still reported positive earnings, albeit just \$.01 per share as compared to \$.61 in the second quarter of 2014. The company's adjusted cash flow dropped substantially as well, but was still a positive \$80.7 million. EQT's production division turned in an operating income loss in the production that was offset by gains at the company's EQT Midstream Partners and EQT GP Holdings division.

Despite the loss at its production division in the second quarter, the division booked production sales volume 34% above the year ago quarter. With approximately \$2 billion in cash on its balance sheet at the end of the second quarter, the company has stated that its liquidity condition remains sufficient to achieve its goals. One opportunity the company has expressed interest in pursuing is M&A in the upstream sector. EQT sees potential value creation opportunities from the consolidation of assets in the Marcellus shale into larger, contiguous blocks allowing for greater efficiencies.

During the company's second quarter conference call EQT announced that it has successfully fracked a dry gas well in the Utica formation using ceramic proppant. The company reported that a test of the well revealed an average flow of 72.9 million cubic feet per day. The company believes this well has exhibited the highest IP of any well drilled in the Utica, with a per-foot rate greater than twice the previous high. With its control of midstream assets in the area, the company was able to send the output from the well directly to the pipeline system without having to shut in production from other wells it owns.

With the success of the Utica well, the company plans to spud a further deep Utica test well, with plans to evaluate drilling more wells at lower drilling and completion costs going forward. The company's midstream assets have provided significant capital to enable development of its drilling assets in the Marcellus and Utica plays. With growth in these plays the company sees opportunity for organic investments in its Midstream division as well as growth in its production unit.

● **NEWFIELD EXPLORATION CO.:** Newfield was highly profitable in the second quarter of 2015, earning \$.46 per share, a number that convincingly beat analyst expectations. Even more impressive was the near 7% increase in the quarter's earnings over the previous year's quarter, given the difficult operating conditions the industry is experiencing currently.

Similar to competitor EOG Resources, the company's ability to control costs allowed it to do well even as its overall revenue was shrinking. Revenue for the second quarter of 2015 declined over 23% from the year ago quarter to \$469 million as compared to \$612 million.

Newfield is a highly diversified oil and gas producer, with 49% of its revenue coming from natural gas and natural gas liquids and 51% derived from oil. Given its strong operating performance it is no surprise that the company is not backing down from its production guidance even in the face of the slump. The company expects to increase its output in 2015 and plans to boost capital expenditures during the year as well – increasing their amount by \$200 million from the previous year.

● **PIONEER NATURAL RESOURCES:**

Pioneer's adjusted second quarter earnings of \$.10 per share beat analysts' expectations of approximately \$.03 per share due to robust production growth. While the company managed to stay profitable during extremely challenging operating conditions, its earnings fell substantially from the year earlier period, dragged down by falling energy prices.

Total production increased 12% year over year as measured by barrels of oil equivalent per day. The increase stemmed primarily from growth in the company's assets in the Spraberry field and Wolfcamp Shale. The company continues to expect production growth over the balance of 2015, projecting 10% year over year growth in the metric.

Cost control played a big part in the company's ability to turn in solid profits in the second quarter. In the second quarter results conference call CEO Scott Sheffield stated that the company has been able to reduce capital expenditures by 20-25% compared to the previous year, with expectations that they will fall further going into 2016.

With its costs under control, Pioneer is ramping up activity to target production growth in 2016 and thereafter. Sheffield mentioned during the conference call that increasing rig activity "is expected to bring horizontal activity back to the level it was at prior to the oil price collapse in late 2014."

● **RANGE RESOURCES:**

At first glance, Range Resources appears to be struggling after reporting a loss of \$119 million for the second quarter of 2015. Low gas prices resulted in the company realizing revenue of \$247.50 million, representing a 15% decline compared to year earlier results. However, non-GAAP earnings for the company showed a small \$2.3 profit. In addition, Range experienced solid production growth of 24% during the quarter with natural gas accounting for 70% of production, beating expectations and turning in solid cost reductions resulting in 11% lower unit costs. The company also generated positive cash flow of \$161 million in the second quarter. Range reported expense reduction in direct operations, production, taxes,

exploration, and G&A in the quarter.

The second quarter saw cash unit costs fall by \$.25 per Mcfe, with total unit costs coming in down \$.36 per Mcfe from the previous year. The company believes further unit cost reductions can occur as it improves efficiency in operating and capital expenditures. It also has low-cost transportation contracts inked beginning in 2016 that should help its cost cutting efforts.

During Range's second quarter results conference call Roger Manny, the company's CFO, stated that Range is well positioned to handle adverse conditions such as the current commodities price downturn. He cited the firm's "low-cost structure, high-return projects, long life assets, strong balance sheet, plentiful liquidity, and consistent performance history" as reasons Range is able to perform well during challenging times in the industry.

During the same call Range Resources' CEO Jeff Ventura cited a study by energy consultancy Wood Mackenzie according to which Range possesses the largest resource base in the Marcellus shale formation, as well as the lowest breakeven cost. In addition, the company has as much as "400,000 net acres of dry Utica gas" beneath its Marcellus assets. Ventura believes the company's resource base and disciplined spending and access to a variety of marketing arrangements positions the company well going forward.

● **SM ENERGY:**

In the midst of the downturn SM Energy's second quarter 2015 results showed remarkable resiliency. The company reported that production of oil, natural gas and natural gas liquids (NGL) was ahead of budgeted numbers, mainly due to excellent well performance in the Eagle Ford and Williston Basin shale formations.

The company combined cost cutting (reducing its operating rig count from 17 at the beginning of the year to 9 by the end of the second quarter) with the sale of assets during the quarter to maintain its strong balance sheet. At the same time, SM Energy reported total capital approximately \$50 million above the amount budgeted originally.

The company announced an increase in the mid-point of its 2015 production guidance as well as lowering its lease operating expense expectations for the balance of the year. SM Energy plans to prove-up further leases in the Eagle Ford and Williston plays while refraining from adding additional debt for the balance of 2015. In 2016, the company believes that its existing portfolio of leases can provide year over year production growth without undue investment costs.

● **SOUTH WESTERN ENERGY:**

Southwestern Energy's fiscal second quarter results seem less than stellar at first glance. The company reported a loss of \$2.13 per share and revenue of \$764 million, a decline of 26% from the \$1.035 billion reported in the previous year's second quarter. Southwestern also reported a \$1.5 billion pretax impairment charge in the quarter.

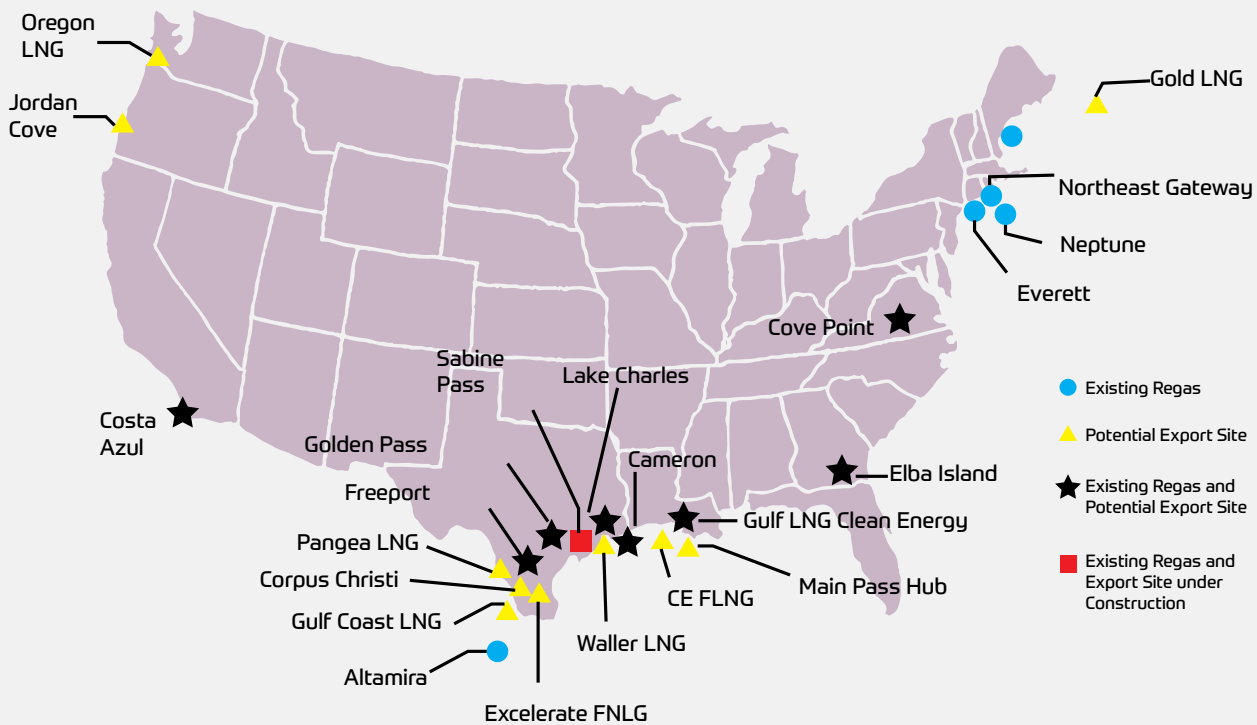
However, poor financial results notwithstanding, the company increased its production guidance for 2015, lifting it from 973 Bcfe (billions of cubic feet equivalent) to 982 Bcfe. In addition, Southwestern anticipates significant reduction in capital spending in 2015, reducing guidance for this metric from the \$2.015 billion it had established in February of this year to \$1.875 billion. CEO Steve Mueller cited the company's ability to operate with a low cost structure and its "unique portfolio" as factors allowing the company to "thrive in an environment where many in the industry are focusing on how to survive."

Mueller spoke highly of the company's recent acquisition of acreage in the Southwest Appalachians. He said production in the region was proceeding nicely with well costs and days to drill already matching where the company "hoped to be in 2017 in the Marcellus," with well productivity coming in better than expected. In reference to Southwestern's diversified acreage portfolio, with significant assets in the Marcellus, Utica and Fayetteville shale formations, he stressed the company's "uniqueness as a focused gas producer with three high quality assets" as setting it apart from its competitors in the industry.



New LNG Terminals – Will They Save American Shale?

By Mark Tygart



Over the next five years several new American LNG terminals permitted for export to non-FTA (Free Trade Agreement) countries are slated to debut. This can only be welcome news for U.S.-based shale gas drillers: the current downturn in the price of oil has coincided with substantial declines across the board in the commodity complex, and natural gas has not been an exception. While this sell-off may bring into question groundbreaking on new LNG facilities, the present price declines are not expected to halt construction on any terminals being

built currently as most of their planned capacity has already been pre-sold to overseas buyers.

While any added demand for their product LNG exports cause is likely to be welcome to American shale operators, exactly how much of an effect these exports will have on the price of natural gas in the U.S. is an open question. On one hand, the U.S. Energy Information Administration (EIA) has released a study claiming that LNG exports will be mostly beneficial for the country, with a modest impact on

natural gas prices as increased demand from LNG exports is offset by increased domestic production. On the other hand, a report by Charles River Associates for Dow Chemical claims just the opposite – that this increase in demand due to LNG will cause natural gas prices to rise substantially over time in the U.S., hurting domestic manufacturers who currently benefit from the low cost of this crucial energy source.

Before diving deeper into the details of the prospects for American LNG exports

APPROVED LNG TERMINALS



and how they seem likely to affect shale drilling in the U.S., an examination of the latest data in regards to projected operating timetables for approved LNG export terminals is in order. The U.S. DOE (Department of Energy) website shows that as of July of this year, 13 applications for export of domestically generated natural gas to non-FTA (Free Trade Agreement) countries for firms in the continental U.S. had been approved, either fully or conditionally, while 32 were under review and pending approval.

Of the 13 approvals, some represent repeat approvals for terminals planning to operate multiple LNG trains, some of which require separate approvals. The 13 approvals cover a total of seven different terminal complexes. Of these seven, four are under construction currently with one, Cheniere Energy's Sabine Pass terminal in Louisiana, expected to begin initial operations in the fourth quarter of 2015. The other three projects are still years away from operation, with Sempra Energy's Cameron

LNG terminal in Hackberry, LA scheduled to be completed in 2018, Freeport LNG in Freeport, Texas aiming for 2017 operations, and Dominion Resources' Cove Point, Maryland terminal expected to be operational in late 2017.

The other three projects include Oregon LNG's Jordan Cove, Oregon terminal, which has been granted conditional approval by the DOE and expects to complete construction in 2020; Cheniere's Corpus Christi project, which is projected by energy consultancy Wood Mackenzie to begin construction sometime in 2015; and Magnolia LNG, a subsidiary of Australia's Liquefied Natural Gas Limited (LNG), which has received conditional approval for its terminal in Lake Charles, Louisiana, and hopes to be operational by the end of 2018. Another potential source of future LNG exports is Kinder Morgan's Southern LNG terminal on Elba Island near Savannah, Georgia, which Wood Mackenzie expects to break ground in 2015 along with the Corpus Christi project.

A QUESTION OF CAPACITY

While the DOE's web page shows that all approved and pending applications for LNG exports to non-FTA countries equates to 45.10 bcf/d (billion cubic feet per day), with only four terminals under construction currently and the majority of applications still under review by the DOE, the actual amount of LNG capacity coming online in the next few years is highly likely to be well below that number. Energy market analytics firm BENTEK Energy's conservative forecast is that six of these terminal complexes are up and running in the next five years, with average exports from the U.S. of 7.3 bcf/d by 2020.

Will this amount have more than the modest impact on natural gas prices in the U.S. projected by the EIA's study? The main point at issue between this report and the CRA report seems to be the elasticity of natural gas supplies in the U.S. If the

EIA is correct, increased demand for LNG exports will be met by increased supply from U.S. drillers, helping to keep prices in check. If this view is accurate, rising LNG exports are unlikely to be a panacea for American shale drillers – instead they will mainly benefit low cost producers who can profitably meet the increased demand. If the CRA report is correct, shale drillers as a whole should benefit as prices rise in a market where supply is not as elastic as some project.

Another possibility is that the impact of LNG exports falls somewhere between the results envisioned by the dueling reports. In this case, a number of other factors such as global supply, economic conditions and the rate of adoption of horizontal drilling and hydraulic fracturing in other countries seem likely to tip the scales one way or the other.



GLOBAL ECONOMIC CONDITIONS



If the current downturn in commodity prices is linked to a slowdown in growth worldwide, as some contend, it could serve to delay the build out of U.S. LNG export capacity. While the construction of terminals already underway is unlikely to be halted, as mentioned earlier, the same is not necessarily true of terminals still in the planning stage. Given the billions of dollars in costs associated with construction of LNG liquefaction and storage trains,

funds may not be forthcoming for new construction projects of this type in the event of a downturn in the global economy. Even if a slowdown does occur, much depends on the price of natural gas in international markets: if the substantial difference in price between natural gas in U.S. and European and Asian markets persists, the case for constructing more LNG terminals remains a strong one.

OVERSEAS PRICE DIFFERENTIALS AND COMPETITION

With prices for LNG imports in Japan, the largest importer of LNG worldwide, running as high as \$16 or \$17 per million BTU (mBtu) in 2105, and European markets paying nearly \$12.00 mBtu at times this year, the attraction for American suppliers of the large price differential prevailing between U.S. and foreign natural gas is clear. Even at the current depressed prices of approximately \$7.50 at the main Asian natural gas benchmark and \$6.74 at the UK National Balancing Point, there is a substantial difference between those prices and the current Henry Hub price level for American natural gas of around \$2.75. While costs for shipping and converting natural gas to LNG add to the overall cost of the gas, if these extreme price differentials persist exporting LNG is likely to be a profitable endeavor even after taking such costs into account.

However, there are other suppliers of LNG interested in taking advantage of the opportunity such differentials present as well. Qatar and other Middle Eastern suppliers of LNG are likely to attempt

to increase exports to maintain market share as U.S. LNG export terminals come on line. Australia, a relative newcomer to the market, has undertaken an ambitious program of LNG terminal construction to take advantage of LNG demand in Asian markets. Worldwide, there are 63 LNG terminals either planned or under construction. The window of opportunity for U.S. producers to capture a large market share in the sector may be a short one if the majority of these projects reach fruition.

One wild card to consider in terms of LNG demand is the prospect of increased usage of nuclear power in Japan. The country has already given the go-ahead to restart two of its idled reactors – if this trend continues it could cut into demand for LNG coming from Japan. Additionally, if India and China, two large LNG importers, were to liberalize their gas markets this would tend to encourage more local production, decreasing the attractiveness of LNG imports somewhat, at least in the short run.



FRACKING PROSPECTS WORLDWIDE

Another variable when it comes to the attractiveness of U.S. LNG exports is the attitude of other countries towards hydraulic fracturing (fracking). The technique, so successful in generating increased production of natural gas in the U.S., has run into significant difficulties outside of North America. Concerns about fracking's environmental impact has thwarted the use of the technique in some European countries even though indications exist of substantial shale gas formations in the region.

For instance, in Great Britain, after a ban on fracking was lifted in 2012, not a single well has been fracked, largely due to environmental opposition to the technique coupled with delays in the approval process at the local level. To attempt to speed things up, the British government has recently stated that it may intercede in cases where local councils have on multiple occasions failed to come to a decision on fracking applications within a reasonable amount of time. The move to spur fracking



applications in Britain comes on the heels of the British Geological Survey's estimate a few years back that the Bowland Basin in northern England holds sufficient gas to supply English demand for nearly five decades.

Fracking hasn't taken off in any great extent in other European countries, by and large. However, if it were to do so at some

point it could call into question the need for extensive LNG imports.

Another factor to take into account is that in some countries outside North America the technological knowledge necessary for wide-scale exploitation of shale assets needs to be acquired to profitably extract the available resources. In these situations, if the political will to develop shale deposits

exists, the expertise can always be acquired via partnership agreements with firms possessing the necessary know-how. Even in these cases, in some countries with large shale reserves, China, for example, the infrastructure to deliver gas liberated from shale formations is lacking, raising an impediment to the near term exploitation of these formations.



SHORT AND LONG TERM PROSPECTS

What conclusions can be drawn from all this as to LNG's ability to support U.S. shale gas drilling? In the short and medium term, over the next 1-5 years, the impact of LNG exports is likely to be moderately supportive of natural gas prices, primarily benefiting low cost shale producers. Over the longer term the situation appears to be more feast or famine – if the large price differential between the price of natural gas in U.S. and overseas markets persists, the potential of a significant increase in demand for American natural gas bodes well for shale gas producers in the country as a whole. However, if various factors combine to thwart the development of significant LNG exports, the hoped-for demand boost

may prove to be a flash in the pan.

This article has identified several factors that could stand in the way of a happy ending for American shale producers. These include: a halt or slowdown in new LNG facility construction due to a weak global economy; significant competition from new LNG terminals outside the country; reduced demand due to actions taken by individual countries to spur their own natural gas supplies, including the widespread adoption of fracking and horizontal drilling. All these factors make it difficult to answer the question posed by the title of this article with anything other than a resounding... “maybe.”

Projected LNG Terminal Opening Dates

(Y) = yes

(N) = no

OPERATOR	LOCATION	UNDER CONSTRUCTION?	PROJECTED INITIAL OPERATION
Cheniere Energy	Sabine Pass, Louisiana	Y	4th Quarter 2015
Sempra Energy	Hackberry, Louisiana	Y	2018
Dominion Resources Cove Point, Maryland	Y	Late 2017	
Magnolia LNG	Lake Charles, Louisiana	N	Late 2018
Cheniere Energy	Corpus Christi, Texas	Y	2018
Southern LNG	Elba Island, Georgia	N	Late 2017
Oregon LNG	Jordan Cove, Oregon	N	2020

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Environment



Ear to the ground

By Sanjay Samuel

In this new column we present an overview of recent reports and news about the environmental impacts of shale exploration.



EPA: No Widespread Damage from Hydraulic Fracturing

The U.S. Environmental Protection Agency (EPA) released a draft assessment of the potential impacts to drinking water resources from hydraulic fracturing for public comment and peer review in June 2015. The report synthesized available scientific literature and data to assess the potential for hydraulic fracturing for oil and gas to degrade the quality or quantity of drinking water resources, and identify factors affecting the frequency or severity of any potential changes. The report identifies mechanisms, such as water withdrawals in times of, or in areas with, low water availability, spills of hydraulic fracturing fluids and produced water, fracturing directly into underground drinking water resources, below ground migration of liquids and gases, and inadequate treatment and discharge of wastewater, that could degrade water quality. Although the report did find specific instances where one or more mechanisms led to impacts on drinking water resources, including contamination of drinking water wells, the number of identified cases was small compared to the number of hydraulically fractured wells, and no evidence was found for these mechanisms leading to widespread, systemic impacts on drinking water resources in the United States.

Scientist Convinced Earthquakes in Kansas Fracking-induced

Kansas Geological Survey (KGS) scientist Tандis Bidgoli speaking at a conference in August 2015 said that he believes the increase in earthquakes in two southern Kansas counties and hydraulic fracturing are “definitely linked,” according to The Topeka Capital-Journal. More than 200 earthquakes have been recorded in Kansas since Jan. 1, 2013 in contrast to only five that have been detected in the previous 10 years. Bidgoli says KGS wants more study of the relationship between the increased underground pressure and the quakes to know how much the pressure might need to be “dialed back” to reduce seismic activity.

Fracking Could be Related to Adverse Health Effects

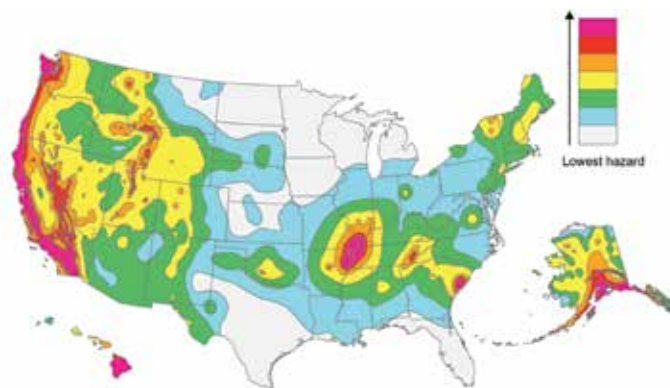
People who live near natural gas wells drilled with hydraulic fracturing may experience adverse health effects, two



Fracking possibly behind Earthquakes in British Columbia and Oklahoma

A recent earthquake near Wonowon is thought to be linked to hydraulic fracturing and is the largest of over 500 seismic events in northeastern British Columbia believed to be caused by hydraulic fracturing. The quake's epicentre was just 3 kilometres from Progress Energy's fracking site and the company immediately shut down operations and notified the province's oil and gas commission. Although the matter is still under investigation, Alan Clay, the commission's communications manager says “it was likely induced by hydraulic fracturing.”

In addition, about half a dozen noticeable quakes hit the town of Crescent, Oklahoma on July 27. They were all centered within about a mile of Cripple Creek Stoneyard, about 30 miles north of Oklahoma City, in an area where three wastewater injection wells were operating. After the Crescent quakes, new limits on injection wells were announced for a broad swath north of Oklahoma City, forcing operations in that “area of interest” to reduce their volumes by nearly 40 percent, and three wells near the epicenters of those quakes have been shut down. Industry officials have also said previously that there's a history of natural seismic activity in the region, injection wells have been operating safely since the 1930s, and that injection volumes were higher in the 1980s than today. Although still under investigation, Alan Clay, OCC's communications manager believes “it was likely induced by hydraulic fracturing.”



recent studies (published in June, 2015) have concluded. Researchers from the University of Pennsylvania and Columbia University found higher rates of hospitalization for heart conditions, neurological illness, and other conditions among people who live near fracking. And researchers at the University of Pittsburgh found that pregnant women living near clusters of fracked wells were more likely to have babies with lower birth weights. However, the first study noted that

conclusively demonstrating that fracking causes health problems is impossible “because it would require exposing people to what is believed to be a known risk and comparing them to an unexposed group, which would be unethical.” And although the joint study by researchers from University of Pennsylvania and Columbia University also stopped short of blaming fracking for adverse health incidents, they said it should be considered further.

NO IMPACT TO WATER QUALITY FROM SHALE DRILLING – SRBC



The Susquehanna River Basin Commission (SRBC) says in a report published in July 2015 that it did not find any impacts from Marcellus Shale gas drilling on the quality of water in streams it has been monitoring, including several in Bradford County. Data was collected at water quality monitoring stations over a three-year period in streams in some of the watersheds of the Marcellus

Shale region of the Susquehanna River Basin. SRBC says that "with a few exceptions, the water chemistry at the monitoring stations indicates good water quality," and that "the results of aquatic insect monitoring were not affected by the density of upstream natural gas wells or pads."

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Smartphone Apps For Oil & Gas Professionals

By Finbarr Toesland

Smartphone owners have access to literally millions of apps on their devices, with Android users being able to choose between 1.6 million apps on Google Play and iPhone users having the choice to download any of the 1.5 million apps in Apple's App Store. Oil and gas professionals can use these apps to stay on top of industry developments and make their jobs easier, with the most useful software discussed below.

SCHLUMBERGER OILFIELD GLOSSARY



Particularly suited to those who are new to the industry, the Schlumberger Oilfield Glossary is a reference guide with over 4,600 definitions, all easily searchable on your iPhone. Thanks to the comprehensive glossary, which requires an active Internet connection, both the expert and the generalist will find definitions to meet their needs.

One of this app's best features is the highly detailed illustrations and photographs that help to clarify many terms, with some definitions also including an explanatory video. All of the entries have been thoroughly fact checked by oil and gas experts, to ensure accuracy.

Apple App Store

OIL AND GAS – NEWS



Although Oil and Gas – News was created by the Louisiana Oil & Gas Association, and therefore contains a great deal of information that is relevant to the oil and gas industry in Louisiana, the app also curates the latest news from a national perspective. Once the app is downloaded users can navigate between the daily top stories, Haynesville Shale, Presidents Articles and LOGA news.

Interesting stories can easily be saved for reading at a later date and a range of events are listed in the calendar section, focusing on shale in the United States.

Apple App Store

OIL AND GAS JOBS AT YOUR FINGERTIPS



Leading specialist provider of technical personnel in the oil, gas and energy industries, Kin-Tec Global Recruitment, released Oil and Gas Jobs at Your Fingertips to offer job opportunities to both those starting out and experienced professionals looking to move up the career ladder.

As the app was specifically created for oil and gas professionals only the most relevant jobs will be shown, as users can filter their searches based on expertise, application and discipline.

Google Play Store & Apple App Store

OILFIELD ESSENTIALS



An app that can be used day in day out by oil and gas explorers and drillers is Oilfield Essentials. This no-frills app contains 23 pages of regularly used calculations, including rig, reservoir evaluation, oil and gas zone analysis calculations and many more.

As data is automatically saved there's no chance of losing important calculations if you accidentally leave the app. If you need to show the results of the calculations, they can be easily emailed in PDF format to your colleagues.

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PennWell's Oil & Gas Journal, which was first published in 1902, offers a companion app that provides insightful news and analysis on the most important issues facing the oil and gas industry today. The content is packaged in a simple and easy-to-use format, with the only three sections used to navigate the app being latest news, most viewed and saved articles. A useful search function is available to quickly track down articles on a particular topic.

PennWell also offer the Oil & Gas Financial Journal, for professionals to keep up-to-date on significant financial developments in the oil and gas industry.

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OIL HANDBOOK



A useful calculator app that assists with conversions between different types of oil is the Oil Handbook. The handy app gives users oil engineering design tools and tables, as well as economic analysis functions, including IRR, NPV and Payback.

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