accenture

Strategy | Digital | Technology | Operations

Integrating Unconventionals

International Development of Unconventional Resources: If, where and how fast?

High performance. Delivered.

Contents

Executive summary

Unconventional resources—specifically shale gas, tight gas, shale oil and tight oil—have revolutionized the energy landscape in the US, using new technologies such as horizontal drilling and hydraulic fracturing to access previously unavailable reserves. America's success with unconventional resources has prompted many to consider whether other countries that show similar promise will also be successful in developing their unconventional resources—and if so, where and how fast.

There are many locations around the world that have both a wealth of unconventional resources and regimes that support investment. However, actual unconventional activity varies widely, regardless of fiscal openness and the presence of resources. There are additional factors affecting the likelihood, timeliness and pace of development in various locations outside the US and Canada.

In addition to the estimated size of the technically recoverable reserves and the fiscal regime, there are other critical factors that are important in determining the viability of unconventional resources in countries that have yet to explore their potential in the area:

- A region's geology—the quality of the rock, the presence of data about the resources it contains and the complexity of local characteristics
- Land access and operability—the road and rail infrastructure that exists, water availability, views of Non-Government Organizations (NGOs) and the local community, population density and other non-technical factors that impact how easy it is to access and set-up operations to develop the resources
- An existing unconventional services sector that can support high-volume drilling and fracturing operations
- Established oil and gas distribution networks that can distribute unconventional resources to consuming markets
- The presence or absence of competition from conventional or other resources development, which can present a major barrier to investment
- A strong oil and gas workforce with personnel whose skills can be adapted to serve the unconventional resources sector.

It is important to consider each of these factors in addition to fiscal support and the estimated size of the resource base when assessing the viability of unconventional development. Sites that are promising in one category may pose obstacles to investment in others.

For example, China is estimated to have a greater wealth of technically recoverable shale gas than the US but its geography is very different—which poses extraction and operability challenges—and much of the acreage is controlled by Chinese national oil companies (NOCs). Similarly, the development of Poland's Baltic Basin was slowed by fiscal proposals that included high taxes and the creation of a state regulator that would act as partner in any development, although this has recently been abandoned.

The more factors that are favorably met in each prospective location, the sooner that location is likely to present as a viable unconventional resources investment. But a single factor can slow down or speed up the development of the basin. In this study, we have tried to identify the factor that we believe is determining the pace of development today. We consider the viability of unconventional resources developments in nine basins around the world according to all of the eight factors discussed above, to assess which basins are the most immediately promising prospects for investment.

Introduction: The eight factors of unconventional resource viability

As illustrated in the US Energy Information Administration (EIA) chart below, there are many countries with potential shale gas[1] and shale oil[2] resources similar in magnitude to those in the US. For example, Argentina and China are estimated to have larger technically recoverable shale gas reserves than the US, and Russia is estimated to have larger technically recoverable shale oil resources than the US.

A number of recent developments in the industry suggest an increase in unconventional resource activity in some geographic locations. These include:

- YPF's and Total's successful results in Argentina's Vaca Muerta formation[3]
- Sinopec's recent find in China's Sichuan Basin[4]
- San Leon's successful test in Poland's Baltic Basin[5]
- Santos' successful production in Australia's Cooper Basin.[6]

However, the nine basins that we reviewed for this paper suggest greater variation in activity, size of potential resources and supportive fiscal regimes, as illustrated in Figures 2 and 3.

Despite the size of potential resources and supportive fiscal regimes in many locations, we expect significant variability in the pace and development of unconventional resources worldwide. In addition to the fiscal regime, this variability is also influenced by six additional factors that are equally important in determining if, where and how fast shale oil and shale gas resources will be developed.

These are:

Geology

- The availability of data
- The quality of the rock
- Access to the skills necessary to adapt existing technologies to local rock characteristics.

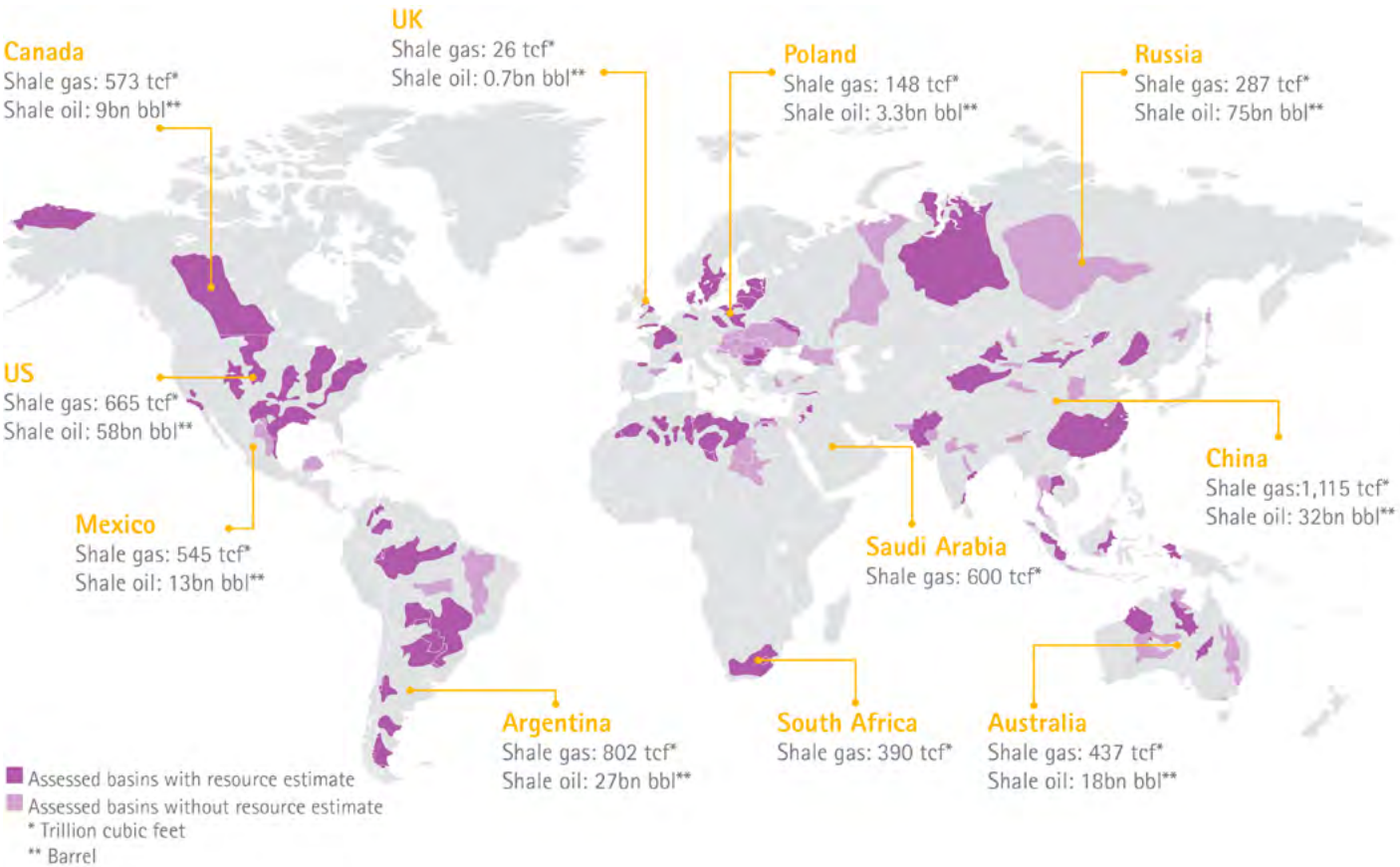
Land access and operability

- The road and rail infrastructure that exists
- Water availability
- Views of NGOs and local community
- Population density
- Other non-technical factors that impact how easy it is to set up operations to develop the resources.

An existing unconventional services sector

- The technology skills to support horizontal drilling, hydraulic fracturing and completions.

Figure 1: Estimated technically recoverable shale oil and shale gas resources[7]



Existing oil and gas distribution networks

- The ease in which organizations can commercialize and market the oil or gas.

Competition

- From conventional or other resources development—including whether financial and human resources are tied up in competing unconventional developments (e.g., coalbed methane (CBM) in Australia) or whether there are more attractive conventional opportunities (e.g., shallow/offshore development in Mexico) available.

A skilled oil and gas workforce

- A workforce that can support the future development of the industry.

Figure 2: Activity in shale gas and oil basins reviewed in this paper

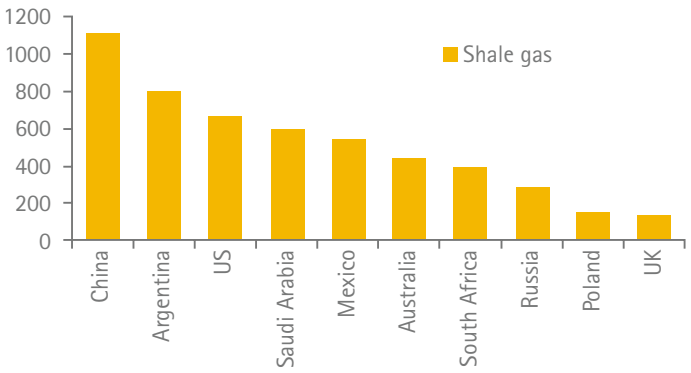
Country	Basin	Unconventional wells per country
Argentina	Neuquén	>200
China	Sichuan	>200
Australia	Cooper	~40
Poland	Baltic	>60
Russia	West Siberian	<10
UK	Bowland	<10
Mexico	Burgos	<20
South Africa	Karoo	0
Saudi Arabia	South Ghawar	>80

Source: Accenture research

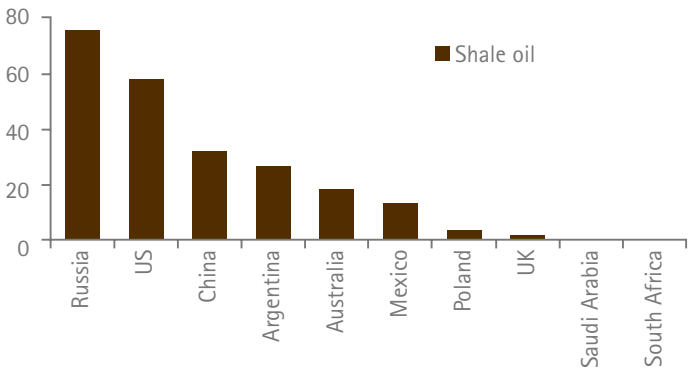
Figure 3: Size of potential resources and support of local fiscal regimes[8]

Size of potential resources

Technically recoverable shale gas reserves (tcf)



Technically recoverable shale oil reserves (billion bbl)



Enabling fiscal regime

	Argentina	Australia	China	Mexico	Poland	Russia	Saudi Arabia	South Africa	UK
International access to resources	•	•	•	•	•	•		•	•
Production sharing agreement	•	•	•	•	•	•		•	•
Fiscal support above conventionals	•		•			•			•
Direct subsidy			•						
Capital allowance									•
Tax break/exemption	•					•			•

Source: EIA, Accenture research

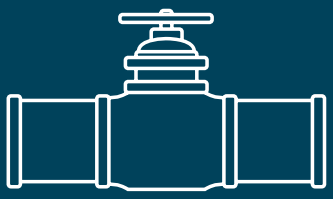
In this section, we compare the potential of nine basins around the world using eight critical factors

The eight critical factors for unconventional resource development:

Size of potential resources

Unconventional services sector

Enabling fiscal regime



Oil and gas distribution network

Geology

Conventional and other competition

Land access and operability

Skilled workforce

The following factors in each chart have been coded as follows:

GREEN Line of sight on how this factor will be overcome but continued investment required.

AMBER Factor widely acknowledged as an issue and a variety of actions being taken to address. However, unclear if the actions are enough and how long it will take for this factor to be overcome.

RED Still a lot of uncertainty whether this factor can be overcome at all.

Argentina:
The Neuquén Basin

The Neuquén basin promises the greatest unconventional resources potential outside the US and Canada

The geology of the Neuquén Basin is promising for unconventional resource development. Favorable test results have led Chevron, Shell, Total and YPF among others to announce aggressive development plans in the region.[9]

Although Argentina is a challenging environment for foreign investment, its government has begun to offer attractive investment incentives. For example, Argentina has instigated a new oil and gas promotion regime that includes exemptions from export tax for up to 20 percent of production after five years from the start of each project with a total five-year investment over one billion US dollars. With production falling significantly and imports increasing over the last decade, the government is committed to developing its unconventional resources.

Neuquén is an established basin with significant conventional oil and gas production and existing infrastructure, including roads, pipelines and rail. There is also an existing oil and gas workforce but investors will need to develop skills in the unconventional services sector. In addition, the prevalence and power of unions across all aspects of the operation—from transport to fracturing services—are likely to contribute to the cost and complexity of developments. For example, the work day is limited to 12 hours, which means that 24-hour operation, prevalent in the US, is not possible in Argentina (so rigs and equipment do not have the same utilization).

Figure 4: Factors affecting the viability of the Neuquén Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources 	• Neuquén Basin is a key focal point for unconventionals by major exploration and production companies and national oil companies • 583 tcf shale gas and 20bn bbl of shale oil	
Enabling fiscal regime 	• Investment promotion regime • Exemptions from export tax for up to 20 percent of production after five years from the project start	●
Ease of Implementation		
Geology 	• Depth 2,000-2,500m and thickness 150–250m • Good rocks and high total organic content (TOC), data available • >200 wells drilled	●
Land access and operability 	• Existing oil and gas production basin • Good road infrastructure	●
Unconventional services sector 	• More than 50 operators and service suppliers • Immature unconventional supply chain (e.g., logistical challenges for sand and water, need to import fracturing chemicals)	●
Oil and gas distribution network 	• Complete regional connectivity: open access pipelines and well-connected electricity network • One of the most extensive pipeline system in Latin America	●
Conventional and other competition 	• Declining production from conventional resources • Almost 70 percent of YPF's[10] oil and gas project portfolio are unconventional resources (shale and tight gas and oil)	●
Skilled workforce 	• Insufficient skilled labor for the oil and gas sector to address the upcoming boom	●

Source: Accenture research

China:
The Sichuan Basin

The Sichuan Basin poses geological and operability challenges, arising partly from factors such as high population density and water stress

China's geology is very different to that of the US. This means that organizations hoping to invest in unconventional resources in China will need to adapt existing fracturing technology to the local geology to make any investment viable. In addition, there is a lack of available data required for potential investors and developers to assess the attractiveness of investment—and obtaining this data would involve a significant initial cost. Although the government has awarded licenses to a number of organizations, approximately 80 percent of the best acreage already belongs to four NOCs: Sinopec, China National Petroleum Corporation (CNPC), China National Offshore Oil Corporation (CNOOC) and Yan Chang Petroleum. NOCs also control the distribution infrastructure. We believe Sinopec's and CNPC's exploration success will drive the pace of the market, as these companies control access, the services sector and infrastructure.

However, the country's above-ground, non-technical factors pose the biggest challenges for investors. Sichuan is a mountainous, densely populated area with poor surface conditions and water stress in some areas, which makes it difficult to move rigs and trucks. Moreover, large-scale development of shale gas requires full support from both central and provincial government, as well as the local community. A sustainable ecosystem and a collaboration mechanism among government, shale developers and local communities need to be further established.

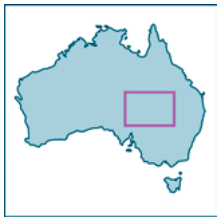
Even so, China is progressing and has already drilled more than 200 wells[11] and Sinopec has begun commercial production in Chongqing, in the eastern part of Sichuan Basin.[12] The government has also shown great commitment to the region by creating an attractive fiscal regime and opening the market to foreign investment. In addition, the various agencies that manage the land, infrastructure, environment, fiscal regime and taxation system are openly working together.

Figure 5: Factors affecting the viability of the Sichuan Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources	• Sichuan Basin is the largest shale gas basin in China with 287 tcf of gas reserves (technically recoverable reserves)	
Enabling fiscal regime	• There is a subsidy of RMB 0.4 per cubic meter of gas sold to the grid • The National Energy Administration is working on a tax break proposal • China allows tax-free import of equipment and prioritizes land approvals	●
Ease of Implementation		
Geology	• Depth 3,000-4,000m and thickness 75–125m • Rock quality is different from the US shales and it is expensive to adapt the fracturing technology	●
Land access and operability	• High population density; mountain area, poor surface condition; difficult to move rigs and trucks • Water scarcity; lack of water disposal options	●
Unconventional services sector	• Existing service sector for conventional oil and gas • Lack of local technical capability; need to import technologies and equipment for developing unconventional resources	●
Oil and gas distribution network	• CNPC/Sinopec/CNOOC jointly own 95 percent of pipeline • Limited gas storage facility (1.8 percent of total consumption vs. 12 percent world average)	●
Conventional and other competition	• CNPC and CNOOC both have large amount of conventional acreage • Sinopec's domestic conventional acreage is limited	●
Skilled workforce	• Large oil and gas workforce but limited experience	●

Source: Accenture research

Australia:
The Cooper Basin



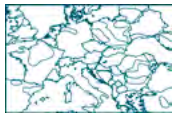
Australia's unconventional resources potential is constrained by competition for resources from coalbed methane and conventional development

The Cooper Basin lies in the largest onshore hydrocarbon production area in Australia, in which Santos is the largest producer. Unconventional resources tests in the basin have been promising. The basin has existing road and gas processing infrastructure and access to a pipeline distribution network. Extensive coalbed methane (CBM) development in Australia (approximately 2,000 wells) means there is an existing unconventional services sector.

The big challenge in developing shale resources in Australia, even in the Cooper Basin, is competition from CBM and conventional resources—for investment dollars and skilled workers. Much of Australia's investment is already tied up in existing plays and there is a shortage of appropriate labor. This labor shortage has resulted in some of the highest labor costs in the world, significantly higher than the US. As a result, the cost of drilling and completion of a shale gas well in Australia is approximately between two and three times what it would cost in the US. Despite the positive results from exploration and appraisal programs, geology remains a challenge and developers have yet to prove the commercial viability of large-scale shale development. Lack of incentives is another factor. For shale gas developers, the current fiscal regime is far from attractive. Similarly landowners do not own the mineral rights, which could pose some challenges in land accessibility although this may prove less of a challenge in the remote Cooper Basin.

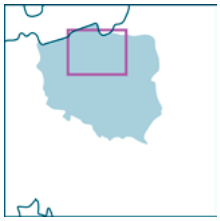
However, Australia does have a structural undersupply of gas, and there is also the possibility that the productivity and longevity of the CBM wells will be less than initially estimated. For both of these reasons, the outlook for shale resource development in Australia could change quickly.

Figure 6: Factors affecting the viability of the Cooper Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources 	• Cooper Basin, the largest onshore hydrocarbon production area, has 93 tcf shale gas technically recoverable reserves (TRR)	
Enabling fiscal regime 	• Currently there are no tax incentives for shale gas • Capital expenditure allowances for exploration and research and development are required to offset exploration costs	●
Ease of Implementation		
Geology 	• Depth 1,800-3,000m and thickness ~100m • Wells drilled and good gas flow from five wells • Commercial production from two wells (Santos)[13]	●
Land access and operability 	• Existing road and airstrip infrastructure • Remote location, therefore low population density • Lack of incentives for landowners	●
Unconventional services sector 	• Strong conventional and CBM service sectors • Shortage of specialized rigs, experienced operators and technicians	●
Oil and gas distribution network 	• Existing Moomba facility in the Cooper Basin accepts production from 115 gas fields and 28 oil fields and sends processed gas to east, southeast coast via pipeline	●
Conventional and other competition 	• Structural undersupply in both West/East coast • Natural gas is largely produced from offshore fields • Potential competition from CBM but most of the CBM gas is committed to Liquefied Natural Gas (LNG) projects	●
Skilled workforce 	• Australia is already suffering skilled labor shortages due to the boom in CBM and conventional resources	●

Source: Accenture research

Poland:
The Baltic Basin



The promise of Poland's Baltic Basin is undermined by a pending fiscal regime and the need to adapt or develop fracturing technologies to the local geology

The Baltic Basin is Poland's most promising unconventional resources area. The basin benefits from low population density, has good surface conditions and favorable infrastructure, and is connected to an existing natural gas transmission pipeline. The basin also has access to Europe's oil and gas workforce, although Europe has yet to develop an unconventional services sector. Poland's unique geology would also require the creation of new fracturing techniques to make unconventional resource developments viable.

Poland has ongoing unconventional resource developments, which started after an initial burst of enthusiasm for shale development in the country in 2007. At the end of last year, Lane Energy (a consortium owned by ConocoPhillips and 3Legs Resources) renewed its commitment to the Baltic Basin after encouraging test results.[14] This year, San Leon also published promising results[15] from its well tests, after successfully adapting its unconventional resources recovery technology to suit the basin's properties.

An unattractive draft bill released in February 2013, including proposals to change Poland's hydrocarbon taxation and regulations, has since dramatically reduced optimism for the success of Poland's nascent shale industry. The regime entails high taxes, uncertainty around development and production licenses, and the creation of a state regulator that would also act as a production partner. However, the forthcoming new bill, which is pending final approval at the Polish Parliament, marks a significant departure from the government's earlier proposals, abandoning plans to create a new national regulator, proposing a more attractive tax regime and seeking to streamline licensing procedures The key question is whether the early enthusiasm for Poland will return.

Figure 7: Factors affecting the viability of the Baltic Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources	• The Baltic Basin is the most prospective region in Poland with an estimated reserve (TRR) of 105 tcf shale gas and 1.2bn bbl of shale oil	
Enabling fiscal regime	• Uncertainties include the tax regime (taxing approximately 40 percent of gross profit), the National Operator of Energy Minerals, licensing of exploration and output, and position within the European Union • New bill, pending for final approval by the parliament, is a departure from the current situation, abandoning plans to create a new national regulator, proposing a more attractive tax regime and seeking to streamline licensing procedures	●
Ease of Implementation		
Geology	• Depth 2,400-3,800m, thickness ~130m • Many exploration wells drilled and good data availability • Modest/good results from test wells in the Baltic Basin (e.g., 3Legs/Conoco and San Leon wells)	●
Land access and operability	• Low population density (vs. other European states) • Good surface condition and favorable infrastructure	●
Unconventional services sector	• European services sector is easily accessible • Further infrastructure development required (including water treatment/disposal)	●
Oil and gas distribution network	• The Baltic Basin is connected by the existing natural gas transmission pipeline	●
Conventional and other competition	• Limited oil and gas production from conventional sources • Heavy reliance on gas imports from Russia	●
Skilled workforce	• Easy access to the oil and gas workforce in other European countries	●

Source: Accenture research

Russia:
The West Siberian Basin

The West Siberian Basin has immediate potential for tight oil development, but shale development will require infrastructure investment and access to US technology and skills

The West Siberian Basin is the largest petroleum basin in the world by the geographical area it covers, and it accounts for 60 percent of Russia's oil production.[16] Oil production in Russia has been flat in recent years and conventional drilling is moving towards the high-cost Arctic region. This has created an opportunity for tight oil development in Russia. The Energy Minister has stated that tight oil production could comprise 11 percent of Russia's oil production by 2020 and announced attractive fiscal incentives specifically for shale/tight oil development. However, these enabling fiscal regimes become less attractive due to recent political tension between Russia and the US.

The Bazhenov shale formation in West Siberia is often compared to the Bakken formation in Williston Basin, North Dakota, but is actually estimated to be much larger. In September 2013, the Russian government announced specific fiscal incentives, including reducing the mineral extraction tax (MET) rate to zero for the Bazhenov formation and other three tight oil deposits. The industry has mixed views towards the new regime. There are also concerns among large international developers about the stability of government policy in Russia.

Furthermore, there is good infrastructure and access to the basin, as well as connections to existing oil and gas distribution and export pipelines. However, the characteristics of the shale will still require developers to invest in infrastructure, which will require fiscal support. Given the probable locations, operators in Russia are unlikely to face environmental concerns that others are currently facing in densely populated countries. Water supply in winter might pose some challenges due to sub-zero temperatures for a significant part of the year.

Probably the biggest uncertainty is foreign investment. In order to develop the Bazhenov shale, Russia will need access to US technology and skills. BP/Rosneft,[17] Rosneft/ExxonMobil,[18] Rosneft/Statoil[19] and Gazprom/Shell[20] have announced development plans in the region. However, foreign companies have taken different actions towards their investment activities in Russia. For example, Shell announced it would put new investments in Russia on hold[21] and Statoil made a similar move earlier to postpone its partnership with Rosneft[22] until next year, while BP recently announced its shale development plans with Rosneft and LukOil, and Total announced[23] a large joint investment in unconventionals.

Figure 8: Factors affecting the viability of the West Siberian Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources	• Reserve estimates (technically recoverable) for the Bazhenov shale formation in the West Siberian Basin is 75bn bbl oil and 285 tcf of gas	
Enabling fiscal regime	• Tax break for shale and offshore oil from January 2014 • 50–100 percent discount on MET, zero MET for oil from the Bazhenov play • Uncertainties in foreign investment and US entry will be slow due to the current political environment • Financial incentives need to support infrastructure development	●
Ease of Implementation		
Geology	• Depth 2,500-4,100m, thickness ~85m • Limited unconventional activities so far but often compared to Bakken • Shell/Gazprom plan to drill five wells in 2014/2015 • International Oil Companies (IOCs) formed joint ventures with Russian oil companies to explore shale resources	●
Land access and operability	• Away from population centers and easy to access • Long history of conventional oil and gas production, therefore good infrastructure	●
Unconventional services sector	• Strong local oil and gas service sector – domestic drilling providers such as Eurasia Drilling, CAT Oil • Large presence of major oil field service companies (e.g., Schlumberger, Baker Hughes)	●
Oil and gas distribution network	• The West Siberian Basin is well connected with existing oil and gas distribution and export pipeline • The oil pipeline is owned and run by Transneft	●
Conventional and other competition	• Oil production in Russia has been flat in recent years and conventional drilling is moving toward the high-cost Arctic region • Tight oil will be the focus, not shale gas	●
Skilled workforce	• Large oil and gas workforce but low development efficiency and productivity	●

Source: Accenture research

The UK:
The Bowland Basin

Shale gas presents an opportunity for the UK to mitigate the effect of declining North Sea gas production

UK net gas imports are forecast to grow from 45 percent of demand in 2011 to 76 percent by 2030.[24] As North Sea gas production continues to decline, shale gas development of the promising Bowland Basin is becoming increasingly important to the UK.

Accordingly, the government plans to put in place one of the most favorable and comprehensive regimes in the world to support shale gas development. The proposals include a "pad allowance" to reduce the effective tax rate from 62 percent to 30 percent for a portion of the production income, while local authorities will keep all income from business rates paid.[25] Regulators will be able to submit proposals on how to streamline permits and access. Moreover, the industry announced that local communities will also receive £100,000 per test well fractured and one percent of the production if shale gas is discovered.[26]

The UK has experience in onshore development, with more than 2,000 conventional onshore wells drilled during the last few decades, 10 percent of which have involved fracturing.[27] The UK is also home to Western Europe's largest conventional onshore field in Dorset. Even with such a long history of oil and gas industry, opinion polls saw an increasing number of people against shale gas development in the UK since late 2013.

Non-government organizations (NGOs) pose the biggest challenge to shale gas development in the UK. These entities are making access and operations challenging, and continue to fight against shale gas development. There is similar significant opposition to shale resource development, and particularly hydraulic fracturing, in Western Europe.

Figure 9: Factors affecting the viability of the Bowland Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources	• The Bowland Basin is estimated to have 26-130 tcf (TRR) of shale gas (British geological survey suggests 1,300 tcf reserve and 10 percent recoverable)	
Enabling fiscal regime	• Government proposed to introduce a "pad allowance" to reduce the effective tax rate from 62 percent to 30 percent for a portion of production income • Community incentive plan	●
Ease of Implementation		
Geology	• Depth ~2,500m and thickness ~120m • Good TOC and good data • Few wells drilled	●
Land access and operability	• Good road and air infrastructure in the Lancashire • Population density in England is higher than the US, and land owners do not own the mineral rights • NGO opposition	●
Unconventional services sector	• Limited number of onshore rigs, limited onshore services industry • Well developed conventional industry with experience in well design, integrity, fracturing	●
Oil and gas distribution network	• Already has an extensive gas transmission and distribution systems with spare capacity • Grid connection can take 3.5 years	●
Conventional and other competition	• Production in the North Sea is declining • The UK is increasingly reliant on gas imports • Limited competition from conventional onshore operation	●
Skilled workforce	• Large oil and gas workforce from the North Sea operation	●

Source: Accenture research

Mexico:
The Burgos Basin

Changes in the fiscal regime could unlock the potential for Mexican shale

The Eagle Ford shale formation underlies much of South Texas and extends into Mexico's Burgos Basin. The basin already represents 20 percent of Mexico's hydrocarbon output, and there are existing roads to wells and pipeline access. It is also in close proximity to the US services sector and workforces that have skills relevant to unconventional resources. In addition, the reforms to Mexican energy legislation announced in December 2013 ended 75 years of a state-run monopoly. This allows Petróleos Mexicanos (PEMEX) to enter profit share contracts and form partnerships with foreign investors, enabling it to explore and develop the Burgos Basin's shale resources. Before the reform can take effect, Mexico needs to finalize the secondary laws detailing the fiscal regime.

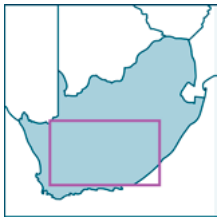
These factors make the Burgos Basin an attractive proposition. The key challenge in developing unconventional resources in the basin is competition from other resources; specifically, the increasing amount of gas imported from the US and foreign investment and interest in conventional development. For example, investments in shallow water or deep water offer higher rates of return than unconventional resources. As a result, PEMEX has allocated a small share of its budget to shale gas development and planned to drill only 10 test wells in 2014.[28] The sector is unlikely to grow fast without improvements in PEMEX's financial situation or large foreign investment, not to mention the efforts required to supply water and escort crews to/from the drilling sites in the relatively insecure border region.

Figure 10: Factors affecting the viability of the Burgos Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources	• The Burgos Basin has the most potential of any basin reviewed in Mexico • Eagle Ford shale: 343 tcf of gas and 6.3bn bbl of oil; Tithonian shale: 50 tcf of gas	
Enabling fiscal regime	• Energy reform in December 2013 allows PEMEX to have profit share contracts and to form partnerships with foreign developers	●
Ease of Implementation		
Geology	• Depth 2,000-3,500m and thickness ~65m • Direct extension of the Texas Eagle Ford Basin • Limited well data and modest results	●
Land access and operability	• The Burgos Basin represents 20 percent of Mexico's hydrocarbon outputs with existing roads to wells • Security issue around the border	●
Unconventional services sector	• Easy access to the unconventional services sector in the US	●
Oil and gas distribution network	• Open access the pipeline network currently operated by PEMEX	●
Conventional and other competition	• Increasing amount of gas imported from the US • Independents and large oil field services companies have showed interest in Mexico shale gas • Shallow-water plays and deep-water offshore plays have higher investment return, drawing PEMEX's capital investment	●
Skilled workforce	• Skilled workforce for conventional and offshore operations	●

Source: Accenture research

South Africa:
The Karoo Basin

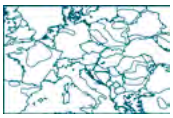


The Karoo Basin has been slow to develop due to concerns about hydraulic fracturing, water use and lack of infrastructure

The name Karoo is derived from a Khoikhoi word meaning "thirsty land" and, of the nine basins reviewed here, it presents the most challenges to development. Water sourcing in the semi-acrid Karoo Basin is a problem for potential operators. There is significant local public concern about the potential environmental impact of unconventional development in the basin. Between 2011 and 2012, the South Africa government imposed an 18-month moratorium that put all shale gas exploration activities on hold. There is also poor road infrastructure, no distribution network, and a limited oil and gas workforce.

Karoo is still in early dialogue between regulators, industry and the public. However, the government is supportive of shale resource development, as the country has no significant conventional resources. Regulation is moving slowly, but the government has already published a draft technical regulation for petroleum exploration activities, including hydraulic fracturing, based on the American Petroleum Institute standards. The industry is currently waiting for the publication of final regulations and awarding of exploration licenses to progress the agenda. It is likely that there will be requirements for local content in procurement, manufacturing and shareholding. The government has also published for comment an Infrastructure Development Bill that is designed to speed strategic infrastructure delivery by shortening approval times for projects, and extending state powers for the expropriation of land.

Figure 11: Factors affecting the viability of the Karoo Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources 	• Estimated recoverable shale resources in the Karoo Basin is 390 tcf gas	
Enabling fiscal regime 	• Infrastructure Development Bill covers expropriation • No formal view on tax incentives or subsidies • Draft legislation on ministerial discretion of who is awarded mineral rights may limit investment	●
Ease of Implementation		
Geology 	• Karoo Basin is considered a good prospect due to the presence of mature black shales, no wells drilled • Depth ~2,500m and thickness ~120m	●
Land access and operability 	• Poor road infrastructure and lack of water • Introduced the Infrastructure Development Bill • Significant local public concerns regarding potential environmental impact	●
Unconventional services sector 	• Limited existing service sector for conventional oil and gas	●
Oil and gas distribution network 	• Sasol and Transnet own all significant pipeline infrastructure • No coverage in the Karoo Basin	●
Conventional and other competition 	• No significant conventional resources available to compete • Interests in offshore exploration following the success in Mozambique	●
Skilled workforce 	• Limited access to oil and gas technical skills • Some presence of maintenance and oil field services skills • No exposure to unconventional gas	●

Source: Accenture research

Saudi Arabia:
The South Ghawar Basin

The South Ghawar Basin presents an opportunity to meet domestic gas needs and increase oil exports

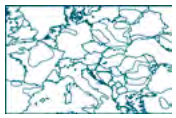
Energy demand in Saudi Arabia is growing rapidly and the country is burning oil that could be exported. However, the government could use the development of shale gas to meet domestic generation needs, and, in turn, increase the amount of oil the country has available for export.

The South Ghawar Basin is the world's largest conventional oil field by reserves and is connected to the state's Master Gas System to transport associated gas. A long history of oil and gas industry operations in the country and the location of shale deposits being far from population centers are both enablers for large-scale development. Saudi Arabia also has a strong oil and gas services sector and a conventional skilled workforce. In addition, local companies have made significant progress recruiting foreigners with unconventional skills to support development.

Although the local gas price is heavily subsidized at US$0.75 per million British thermal units (compared to US$3.50-4.00 in the US and much higher in Europe and Asia),[29] Saudi Aramco can still show a positive return by substituting the oil provided to the national electricity company for power generation with the unconventional gas and by exporting the crude to international markets at market prices.

Water sourcing during exploration is not currently an issue for the South Ghawar Basin due to an underlying aquifer; however, water availability during large-scale development will be an issue. Exploration and appraisal drilling started last year, but lack of knowledge of the formation and lack of infrastructure in some frontier locations are so far among the biggest challenges for developing unconventional resources in Saudi Arabia.

Figure 12: Factors affecting the viability of the South Ghawar Basin as a location for unconventional resources investment

Market Attractiveness		
Size of potential resources 	• Saudi Oil Minister Ali al-Naimi has given a reserve estimate of over 600 tcf of unconventional gas	
Enabling fiscal regime 	• Strategic target rates have been set for 2020 • The incentive for gas is to continue replacing oil as a fuel gas for domestic electricity production • Saudi Arabia has subsidized gas price as a macro economic growth lever for the country	●
Ease of Implementation		
Geology 	• Exploration and appraisal drilling has started in the northwest, South Ghawar and the Rub' al-Khali	●
Land access and operability 	• Some deposits are in remote areas far from the population centers; takes time to mobilize manpower and equipment • Water availability will be an issue during large-scale development	●
Unconventional services sector 	• Very strong conventional services sector • Oil field services for unconventional gas currently being developed and optimized	●
Oil and gas distribution network 	• A Master Gas system is in place—an infrastructure to transport conventional gas; unconventional business will be able to take advantage of this	●
Conventional and other competition 	• Saudi Arabia has a strategic focus of increasing its gas supply for domestic power production, including conventional and unconventional gas	●
Skilled workforce 	• There is demand in the oil and gas sector, which has so far been met mainly by recruiting foreigners; there is a skills shortage for shale gas	●

Source: Accenture research

Conclusion

The factors that have the greatest influence on if, where and how fast each basin will develop differ across locations and will change over time. Figure 13 shows an overview of the current status of the basins reviewed in this paper. The chart also highlights the factor that we believe, at time of writing, will have the greatest influence on the pace of each basin's development.

Understanding the factors that will pace the market is much more important than counting the greens vs. ambers. A single factor can prevent a market from developing while overcoming a single factor could create the momentum for others to be resolved.

In Argentina, the fiscal regime is the most important factor driving pace of development. Similarly, Poland could increase its activity to the Baltic Basin with the help of pending changes to its fiscal regime. US sentiment towards Russia could change, accelerating investment into Russia.

China's biggest challenge is land access and operability given its terrain, population density and water scarcity.

China has a history of rapid infrastructure development, and a major find from Sinopec and/or CNPC could result in innovation being applied much more aggressively to solve the access and operability issues. In Saudi Arabia, lack of knowledge on its shale formation and lack of infrastructure and water to support large-scale development in some frontier locations are among the biggest challenges for local shale development.

In Australia and Mexico, the level of competition for investment and human resources from conventionals or other resources such as CBM in Australia and shallow water/offshore investment in Mexico will have the greatest effect on the pace of developing unconventional resources operations.

In the UK, NGO opposition to unconventionals is the key factor affecting the pace of development.

South Africa is still in the very early stages of development, making it difficult to single out a lone factor affecting the pace of development there.

The key factors detailed here present only a snapshot of the current potential in each of these locations. We expect that as one factor is overcome, another will become the factor most likely to drive the pace of development.

In terms of the overall outlook for international shale resource development, we anticipate that:

- Shale gas and tight oil resources outside of the US and Canada will take between five and 10 years to develop, given the eight factors examined
- All eight factors need to be amendable to successful development, and issues in any single factor can delay or even prevent development
- Regulators need to support the progression of all eight factors, not just the local fiscal regimes
- Markets with tight oil (like Argentina) have a higher likelihood of developing unconventional resources operations in the current environment
- In many markets, such as China and Poland, the effort to adapt technologies to local characteristics can be significant
- Although Argentina is the most promising market today, this may change depending on how other markets address the eight factors; for example, Australia, the UK and Saudi Arabia could all advance quickly.

Figure 13: Factors that will influence if, where and how fast shale resources are developed
The number of unconventional wells apply to the country, not the specific basin.

	Argentina (Neuquen Basin) > 200 wells	China (Sichuan Basin) > 200 wells	Australia (Cooper Basin) ~40 wells	Poland (Baltic Basin) >60 wells	Russia (W.Siberian Basin) <10 wells	UK (Bowland Basin) <10 wells	Mexico (Burgos Basin) <20 wells	Sth. Africa (Karoo Basin) No wells	S. Arabia (S. Ghawar Basin) >80 wells
Size of potential resources	583 tcf 20bn bbl	287 tcf	93 tcf	105 tcf 1.2bn bbl	285 tcf 75bn bbl	26-130 tcf	393 tcf 6.3bn bbl	390 tcf	600 tcf
Enabling fiscal regime									
Geology									
Land access/ operability									
Unconventional services sector									
Oil and gas distribution network									
Conventional and other competition									
Skilled workforce									

Pacer today (will change) for speed of market development

Source: Accenture research

Accenture services to help the international development of unconventional resources

Accenture supports the international development of unconventional resources, focusing on:

Integrated planning

Implementing operating models, processes and applications to support three levels of planning: field level, well scheduling/facilities construction and supply chain integration.

Logistics

Network design and implementation; logistics operating models; processes and systems for water, proppant and well pad equipment.

Materials management

Implementing leading practices around standardization, demand and supply planning, analytics, integration vendor supply chains, material visibility and surplus management. We also offer materials management as an outsourced managed service.

Services management

Leading practice management for a large number of service contractors, from basic financial services and health, safety and environment (HSE) controls—such as buying on contract, managing change requests and overseeing payment processes—to collaboration tools to support onboarding, tracking and knowledge sharing.

Water management

Including end-to-end support in developing water management strategies (treatment technologies and movements) and implementing water management information technologies to manage flows and quality.

Drilling analytics

Working with Accenture Digital and the Massachusetts Institute of Technology (MIT)/Accenture alliance to create analytics solutions that incorporate large amounts of data from service providers, equipment vendors and operators.

Unconventional finance

Developing finance solutions for unconventionals, including a finance framework for investment decision making, accounting and policy development, cost control and cost structure setup, supporting systems, planning, budget and forecasting.

Unconventional IT

Development of unconventional IT strategies, design and implementation of systems and data solutions (including package selection).

References

1. "Technically recoverable shale oil and shale gas resources: an assessment of 137 shale formations in 41 countries outside the United States," U.S. Energy Information Administration, June 2013, www.eia.gov/analysis/studies/worldshalegas/.

2. Ibid.

3. YPF investor presentation, March 2014, www.ypf.com/InversoresAccionistas/Documents/YPF_Investor_Presentation.pdf; Total unconventional assets: http://total.com/en/energies-expertise/oil-gas/exploration-production/strategic-sectors/unconventional-gas/shale-gas-1/international-deployment/worldwide.

4. "China's First Large-scale Shale Gas Field Enters into Commercial Production Ahead of Schedule," Sinopec press release, 24 March 2014, www.sinopecgroup.com/group/Resource/Pdf/201403241737.pdf.

5. "Lewino-1G2: Successful Vertical Frac Leads To Horizontal Well," San Leon Energy press release, 23 January 2014, http://www.sanleonenergy.com/media-centre/news-releases/2014/january/23/lewino-1g2-successful-vertical-frac-leads-to-horizontal-well.aspx.

6. "Further shale gas success at Moomba-194 in the Cooper Basin," Santos press release, 19 Dec 2013, www.santos.com/Archive/NewsDetail.aspx?id=1408.

7. "Technically recoverable shale oil and shale gas resources: an assessment of 137 shale formations in 41 countries outside the United States," U.S. Energy Information Administration, June 2013, www.eia.gov/analysis/studies/worldshalegas/.

8. "Technically recoverable shale oil and shale gas resources: an assessment of 137 shale formations in 41 countries outside the United States," U.S. Energy Information Administration, June 2013, www.eia.gov/analysis/studies/worldshalegas/; Saudi Arabia reserve figure: "Saudi kings of oil join the shale gas revolution," Reuters News, 3 April 2013, Factiva, Inc. All Rights Reserved.

9. "Argentina Oil's Bonanza Helping Too Few Led by Political Friends," Bloomberg, 6 March 2014, Factiva, Inc. All Rights Reserved.

10. YPF investor presentation, March 2014, www.ypf.com/InversoresAccionistas/Documents/YPF_Investor_Presentation.pdf.

11. At the end of 2013, China drilled 285 shale gas wells, CSGCN, http://www.csgcn.com.cn/news/show-36270.html.

12. "China's First Large-scale Shale Gas Field Enters into Commercial Production Ahead of Schedule," Sinopec press release, 24 March 2014, www.sinopecgroup.com/group/Resource/Pdf/201403241737.pdf.

13. "Santos announces start of Australia's first commercial shale gas production," Santos press release, 19 Oct 2012, www.santos.com/Archive/NewsDetail.aspx?id=1347.

14. Corporate Update, 3Legs Resources press release, 26 November 2013, www.3legsresources.com/wpcontent/uploads/2013/11/Corporateupdate-26-Nov-2013.pdf.

15. "Lewino-1G2: Successful Vertical Frac Leads To Horizontal Well," San Leon Energy press release, 23 January 2014, http://www.sanleonenergy.com/media-centre/news-releases/2014/january/23/lewino-1g2-successful-vertical-frac-leads-to-horizontal-well.aspx.

16. Russia overview, U.S. Energy Information Administration, www.eia.gov/countries/analysisbriefs/Russia/russia.pdf.

17. "Rosneft and BP Sign Agreement on Development of Domanik Formations," BP press release, 24 May 2014, http://www.bp.com/en/global/corporate/press/press-releases/rosneft-bp-sign-agreement-development-domanik-formations.html.

18. "Rosneft and ExxonMobil Sign Agreement for Western Siberia Tight Oil Pilot Project," ExxonMobil press release, 6 December 2012, http://news.exxonmobil.com/press-release/rosneft-and-exxonmobil-sign-agreement-western-siberia-tight-oil-pilot-project#sthash.4SzPFIUe.dpuf.

19. "Statoil signs cooperation agreement with Rosneft," Statoil press release, 5 May 2005, www.statoil.com/en/newsandmedia/news/2012/pages/statoilrosneftmay2012.aspx.

20. "Gazprom and Shell agreed to co-operate in Arctic offshore and development of liquids-rich shales in West Siberia," Gazprom Neft press release, 8 April 2013: http://www.gazprom-neft.com/press-center/news/1094254/?sphrase_id=65337

21. "Shell says won't jump into new Russia projects amid Ukraine crisis," Reuters, 1 May 2014, Factiva, Inc. All Rights Reserved.

22. "Statoil, Rosneft delay Siberian drilling, while CEO Sechin added to international sanction list," Barents Observer, 29 April 2014, Factiva, Inc. All Rights Reserved.

23. "Total combines efforts with Lukoil to explore and develop tight oil in the Bazhenov," Total press release, 23 May 2014, http://total.com/en/media/news/press-releases/20140523-Russia-Total-combines-efforts-with-Lukoil-to-explore-and-develop-tight-oil-in-the-Bazhenov

24. "UKCS Oil and Gas Production Projections," Department of Energy and Climate Change (DECC), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/287001/production_projections.pdf.

25. "Harnessing the potential of the UK's natural resources: a fiscal regime for shale gas," HM Treasury, https://www.gov.uk/government/consultations/harnessingthe-potential-of-the-uks-naturalresources-a-fiscal-regime-for-shale-gas.

26. "Local councils to receive millions in business rates from shale gas developments," UK Prime Minister's office: https://www.gov.uk/government/news/local-councils-to-receive-millions-in-business-rates-from-shale-gas-developments.

27. "No slacking on fracking," Utility Week, 13 September 2013, Factiva, Inc. All Rights Reserved.

28. "Mexico's Pemex to drill just 10 shale test wells in 2014," Reuters, 26 February 2014, Factiva, Inc. All Rights Reserved.

29. "Saudi Arabia to drill shale gas wells," Middle East Energy, Oil & Gas, 19 March 2013, Factiva, Inc. All Rights Reserved.

Authors

Melissa Stark
Global Managing Director New Energy

Shengkai Zhao
UK, China

Pablo Pereira
Argentina

Nick Heyes
Australia

Doreen Deng
China

Fernando Blanco
Mexico

Jaroslaw Chudziak
Poland

Michael David
Russia

Kenan Nouwailati
Saudi Arabia

Stephan Kornelius
South Africa

Visit: accenture.com/energy


Follow: @AccentureEnergy

About Accenture

Accenture is a global management consulting, technology services and outsourcing company, with approximately 289,000 people serving clients in more than 120 countries. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. The company generated net revenues of US$28.6 billion for the fiscal year ended Aug. 31, 2013. Its home page is www.accenture.com.

14-2981/02-8967