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The Great Shale Wall: China Struggles To Emulate U.S. Success

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On a recent visit to Yan'an, a mountainous north-central city in China, analysts got a firsthand glimpse of just how tough the country's terrain could be on shale drillers. James West, a Barclays Capital analyst, described a harrowing trip to a work site along winding, cliff-hugging roads ridden with potholes.

"At one point, the envoy even had to dodge a hog that was being guided up the road by one of the villagers," West said.

To complete the hydraulic fracturing of a well, oilfield services companies would have to make the same precarious trip, truck by truck, 40 times – for each stage of the frac.

Terrain is just one of the many problems China faces in its nascent venture into shale territory. The country also faces water shortages, limited infrastructure and state-owned companies that want to keep foreign entities at arm's length.

China wants and needs to meet those challenges. The world's most populous country is also the center of the world's coal production, imports and consumption.

Coal is the country's main fuel, supplying 70% of China's energy and half of worldwide consumption. China's CO2 emissions accounted for 27% of the world total in 2012, roughly 9,620 million tonnes of C02, data from the U.S. Carbon Dioxide Information Analysis Center show.

Pollution is so bad in some cities that cars collide in the smog and people wear protective masks on the streets.

The country has escalated its natural gas use rapidly in recent years through imports via pipeline and liquefied natural gas (LNG). But the scale of coal in the Chinese economy is simply incomparable to fuel use anywhere else on Earth.

"Replacing coal with gas in Chinese power generation would require twice the volume of all global LNG trade," said Maria van der Hoeven, executive director, International Energy Agency.

The United States' story has been one of retreat in the face of an energy revolution. Shale gas prices have weakened because of moderate winters, meaning coal has been supplanted by gas for electrical generation.

So it's with envy that China looks to the success of the United States' gas surplus, said Dave McCurdy, president and CEO of the American Gas Association and a former Congressman.

"They think we have won the global lottery," he said.

Nevertheless, China's leaders have every reason to believe they can replicate the U.S. success story. The country's resources are second to none. The U.S. Energy Information Administration (EIA) estimates that China's technically recoverable shale gas resources are 1,275 trillion cubic feet (Tcf).

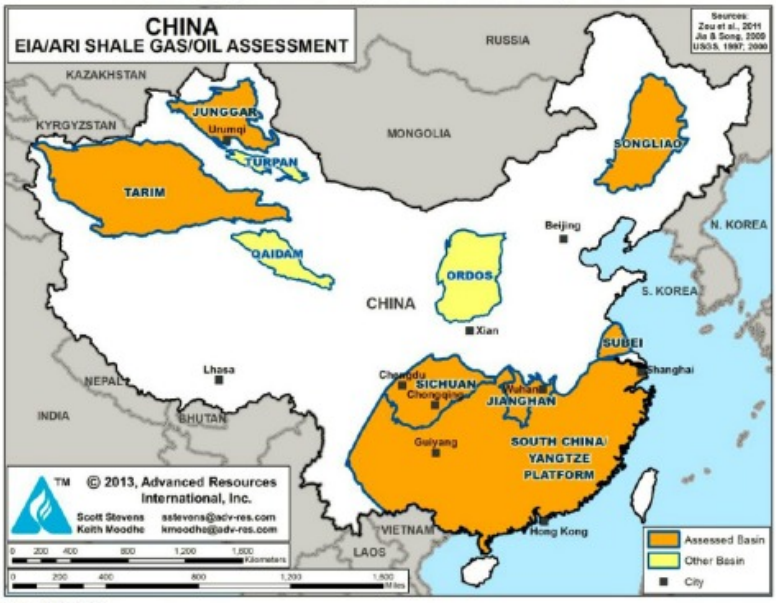
Fundamentals in China are strong and technology adoption is improving after years of snubbing foreign practices, West said.

Yet China is just beginning to make its plunge into the basins.

"If it's the second or third inning in the U.S. shale revolution, it's like batting practice in China," said Jason Bordoff, a professor and director of the Center on Global Energy Policy at Columbia University.

China's risked, technically recoverable shale gas is mainly in marine- and lacustrine-deposited source rock shales in the Sichuan (626 Tcf), Tarim (216 Tcf), Junggar (36 Tcf) and Songliao (16 Tcf) basins.

Figure XX-1. China's Seven Most Prospective Shale Gas and Shale Oil Basins are the Jianghan, Junggar, Sichuan, Songliao, Subei, Tarim, and Yangtze Platform.



Source: ARI, 2013.

Lofty Goals

China's ambitious but "probably unachievable target" for shale gas production is 5.8 to 9.7 billion cubic feet per day (Bcf/d) by 2020," according to a May 2013 report by the EIA.

Shale gas leasing and exploration drilling are underway, focused in Sichuan and the Yangtze Platform areas by PetroChina, Sinopec and Shell.

"While the country's previously stated goal … seems aggressive, we think substantial capital and outside expertise will be diverted to the challenge," West said.

Overall, the country has set a goal of boosting natural gas to 7.5% of domestic energy consumption by 2015 and 10% by 2020 from 5% today.

However, about two-thirds of the 2015 supply will likely come from piped gas and LNG imports, leaving the rest to come from increased domestic production.

For all its efforts, Chinese shale is largely in a pilot phase.

Chinese energy giant PetroChina aims to produce nearly 53 billion cubic feet of commercial shale gas by 2015. By comparison, the northeastern United States produces that amount of gas every four days.

West said the country can significantly boost its tight gas production in the coming years, with help from western service companies.

But first it has to let that help in the door.

Control

China lacks the incentives and open market financing that helped push the U.S. shale boom.

Private ownership of mineral rights, a vibrant E&P sector and deep financial markets willing to fund pioneers such as George Mitchell all played a role.

Even then, "It took a lot of innovation, a lot of trial and error and lot of entrepreneurship before we could figure it out here," Bordoff said.

On the surface, China's sovereign treasure, vast shale resources and desirable marine shale would seem to make its production goals feasible. Yet the country lacks the U.S. right to individuals' ownership of mineral rights.

The country has been partners with many foreign companies such as Total, Chesapeake Energy, Shell and Conoco-Phillips. Even U.S. government agencies such as the U.S. Trade and Development Agency have tried to promote the development of China's shale gas sector so that U.S. companies have new opportunities to invest, apply their expertise, and help China meet its energy needs with cleaner-burning natural gas, officials said.

But the country has shown an unwillingness to give up control of assets. For example, an October 2010 auction of six shale gas exploration blocks was only extended to Chinese national oil companies (NOCs), according to Deloitte.

Some winning companies never drilled gas wells before, let alone shale wells, says Jeff Layman, partner and chief representative in Baker Botts LLP's Beijing office. As of September, some firms had just begun seismic imaging, he said.

And troubles getting shale drilling up and running are beginning to hit home. Recently, Shell became the first company to win a production sharing contract in China.

Layman said the best prospective acreage in China is held by the NOCs rather than international oil companies (IOCs).

"IOCs cannot hold acreage on their own," he said. "IOCs should be given greater access to prospective acreage to enable them to have greater participation in the shale gas development in China."

And China needs IOCs to invest.

But Bordoff said that the country will have to open itself up to increased foreign investment.

"I think that they will need international companies, particularly U.S. companies, to be involved in figuring out how to make shale work in China," Bordoff says.

The Shut-Out

China's well costs are staggering by U.S. standards – roughly $19.7 million. With improvements in processes and drilling efficiencies, the costs could eventually be reduced to about $8 million per well, said Zhang Dingyu, director, Chongqing Land and Resource Bureau, at the November World Shale Oil & Gas Summit held in Houston.

Chongqing's target is to bring 150 to 200 shale-gas wells online by 2015.

China's inexperience puts it behind the curve, as does its secrecy. Basic geologic and well data commonly publicly available in other countries – and essential for resource and prospect evaluation – is considered by China to be state secrets, EIA reported.

Oilfield service companies could help, but significant Chinese commercial production appears some years in the future.

Zhu Xingshan, senior director of strategy and planning division, China National Petroleum Corp. (CNPC), said that since 2009, 129 shale wells have been drilled by China's Ministry of Land and Resources, national oil companies and others.

That includes 46 vertical wells for geological surveying; 55 verticals for exploration and 28 horizontal wells for evaluation.

In contrast the Eagle Ford shale alone operated 2,137 producing wells in 2012.

The location of the shale, particularly in mountainous Sichuan, is also more costly to explore, develop and produce, McCurdy said.

Drilling has crept along for the most part. And not all shale is created equal.

Schlumberger has noted the basins in China have markedly higher levels of horizontal stress than in the U.S. That has led to uneven results. Most Chinese shale basins are tectonically complex with numerous faults – some seismically active are not conducive to shale development, the EIA said.

"China's service sector is just beginning to acquire the necessary capability for large-scale horizontal drilling combined with massive multi-stage hydraulic stimulation," the EIA reported. "Only a small number of horizontal shale gas and oil wells have been tested thus far, with generally low but at least meaningful production rates."

A Short History Of China Shale	
2009	China's Ministry of Land and Resources drills shale delineation wells in the Sichuan Basin.
November 2009	Shell signs agreement with PetroChina to jointly explore for shale gas at the Fushun block, southern Sichuan Basin; received production sharing contract (PSC) in March 2012.
May 2010	Sinopec reports the first successful use of fracing technology in China in Guizhou province.
December 2010	Shell spuds first well, focusing on the Silurian Longmaxi.
April 2012	

	Shell has drilled five deep exploration wells: one vertical data well, two vertical frac wells and two horizontal. One vertical exploration well reportedly flowed at 2.1 MMcf/d.
July 2011	Chevron initiated seismic acquisition and spud first test well in first quarter 2012.
March 2012	Earlier this year Shell and CNPC were awarded the Fushun-Yongchuan block, located in the southern Sichuan close to a legacy Shell tight gas exploration block. The block is China's first foreign-invested production sharing contract for shale gas.
Source: EIA, Deloitte	

The demand for services in China is apparent, West said.

Schlumberger has made deep inroads and continues to serve national oil companies, though it's not clear how large a role they will play in shale development.

"Schlumberger has been active in China for decades and they're at the forefront of trying to figure this out," Bordoff said.

Royal Dutch Shell has developed technologies to produce unconventional gas in remote and difficult Chinese locations. Shell is also working with PetroChina in Sichuan Province on a tight-gas project and a shale-gas project.

Chevron has expanded operations in China through subsidiaries and has a production-sharing contract with China National Petroleum Corp. for the joint development of the natural gas area in the Sichuan Basin.

Some North American shale gas operators, such as *Newfield Exploration*, opted out of working in China while EOG Resources has kept mum on their plans, keeping a presence in China since it acquired rights in the Sichuan Basin in July 2008.

Despite the hunger for new technology, China's national oil companies have been reluctant to accept advice, change or embrace new methods, according to Hong Kong-listed Anton Oil, an oilfield services company that spoke to West. The company has operations in Xi'an and Chongqing, a city where shale gas is being heavily pursued.

In 2013, Anton spent three months convincing Sinopec International Petroleum Exploration and Production Corp. to accept its coiled-tubing fracturing services. Before that, it spent two years winning Sinopec over to open-hole, multistage fracturing technology.

West said state-owned companies come with "a smaller appetite to take on risk and to embrace change."

In the past, Halliburton tried to introduce new technology but was rebuffed because it was considered too expensive and "unproven," West said.

China is exploring the adoption of new technologies by Halliburton and Schlumberger, Dingyu said. The Chongqing Institute of Geology & Mineral Resources is facilitating work by Schlumberger (Singapore).

Dingyu also countered that years of practices, technologies and experience in shale gas development have been "accumulated and specialized personnel have been trained."

Likely that's come through billions of dollars of investment in North American shale projects.

PetroChina and Sinopec are both part of joint ventures in North America. Sinochem, a Chinese company, entered into a $1.7 billion joint venture in early 2013 with Pioneer Natural Resources to acquire a stake in the Wolfcamp shale play in West Texas. CNOOC spent $18 billion to acquire Canada's Nexen Inc. in February. And Sinopec paid more than $1 billion to create a joint venture with Chesapeake Energy in its Mississippi Lime acreage in July.

Motivating Monopolies

On an October trip to Beijing, McCurdy said he saw his first clear sky in the city in 20 years.

But to the north, he visited a city where visibility was just 10 meters the week he was there.

"They are choking themselves to death," he said. "People are running around with masks on their faces," he said. Reports have also emerged of children developing lung cancer.

China's state-capitalist economy does not view its shale reserves the same way that companies in the U.S. do. It is the land of massive government subsidies, giving away so much money to " strategically important" industries that about 30% of company profits

come from government hand-outs, says Usha Haley, professor of management at West Virginia University and author of “Subsidies to Chinese Industry: State Capitalism, Business Strategy & Trade Policy.”

Should China meet its modest 2015 production goals, it has a long way to go to cut costs and drill more efficiently. It also has to solve transportation challenges.

Extraction is one problem; moving the gas is yet another.

As of March 2013, drilling 130 shale gas wells in China required an investment of $1.2 billion, Dingyu said. The top 10 wells produced roughly 3.5 million cubic feet per day (MMcf/d). The average Marcellus well produced about 6 MMcf/d in November, the EIA reported.

The United States is tied together by 2.4 million miles of natural gas pipeline. China has about 300,000 miles of pipeline, says McCurdy said.

“The Chinese have fewer constraints on permitting—permitting doesn’t seem to really stand in the way there,” he says. “However, they only have one pipeline company.”

The company is slow, bureaucratic and inefficient but “they can build infrastructure, and when they decide they’re going to do it, they do it,” he added.

So when will they decided? In China, Sinopec, PetroChina and others are better understood as government bureaucracies than companies, Haley said.

“Their motivations are not profits,” Haley says. “Their motivations are to grow as big as possible and to dominate the industry.”

Although shale development has sparked large amounts of Chinese investment in the U.S., primarily to acquire cutting-edge technology and top-tier energy resources, those opportunities likely won’t be reciprocated for U.S. investors any time soon, Haley says.

China “does not want foreign companies dominating domestic exploitation of shale if it can be helped and so that will not happen within five years. Currently, Western companies offer technology and sell equipment, but the Chinese control their shale.”

However, the government has pledged to allow markets to play “a decisive role in allocating resources” which West believe will be key to making China's tight-gas and shale-gas opportunity into a major reality.

Barclays Capital | International Energy Agency | American Gas Association | U.S. Energy Information Administration | Center on Global Energy Policy | PetroChina | Sinopec | Shell | Total | Chesapeake Energy | Shell | Conoco-Phillips | U.S. Trade and Development Agency | Deloitte | Baker Botts LLP | Chongqing Land and Resource Bureau | China National Petroleum Corp. | Schlumberger | Chevron | Royal Dutch Shell | EOG Resources | Anton Oil | Sinopec International Petroleum Exploration and Production Corp. | Halliburton | The Chongqing Institute of Geology & Mineral Resources | Schlumberger (Singapore) | Sinochem | Pioneer Natural Resources | CNOOC | Nexen Inc. | West Virginia University

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