

Opportunity still knocks for China's vast shale

The country's unconventional gas sector has struggled to live up to its promise. But its resource is too big to be left in the ground indefinitely

IT'S easy to knock the progress of China's shale-gas development, or rather the lack of it.

Of course it is unlikely Beijing will hit its wildly ambitious shale-gas production goals. But that's beside the point. The targets – 60 billion-100 billion cubic metres (cm) by 2020 – epitomized China's ambition.

And it's this dogged determination that sets China apart. Not forgetting its Sichuan basin is the most active play outside of North America.

However, even a modest 2015 output target of 6.5 billion cm seems unachievable.

"It's fair to say there maybe some disappointments along the way," says Toby Hewitt, former general counsel at unconventional specialist Dart Energy. "But China will get there because it's in its strategic interest to do so and the central government, which usually gets what it wants, will do the necessary to make it work."

By all accounts, China is sitting on the largest estimated technically recoverable shale-gas resources in the world – pegged at 1,337 trillion cubic feet (cf) by the US Energy Information Administration (EIA) in its latest report – and nearly twice the estimated size of the US' cache.

Quite simply, the resource – at over 30 billion tonnes of oil equivalent – is too big for China to ignore.

China knows it has to make shale gas work as it strives to shift from its reliance on dirtier fossil fuels, such as coal, to help cut the deadly pollution that chokes its cities.

But production last year stood at a meagre 30 million cm, data from national oil company (NOC) China National Petroleum Corporation (CNPC) showed. That pales in comparison to US shale-gas production, which after around ten years of accelerated development is running at over 225 billion cm per year (cm/y).

However, unlike the US, China arguably lacks some of the crucial ingredients that sparked the phenomenal leap in shale volumes. Its geology is more difficult, because

the shales are generally deeper and more faulted; it lacks pipeline infrastructure to transport potential production; its oilfield services sector is too immature to support development; it has a high density of land use as well as mountainous terrain; and water supplies, crucial to the drilling process, are limited in some areas.

Best source rocks

On the other hand China has some of the best source rocks, but technically it remains to be seen if developers can crack the code for optimal well productivity, says Dylan Mair, an Asian upstream specialist at consultancy IHS.

"This means the total organic carbon is good, but the way to frack these shales has not been determined yet," Mair says.

In a nutshell, China is completely missing the engineering challenge.

Similar technical issues have curbed China's production of coal-bed methane (CBM), which after 20 years of commercial development is running at 2.5 billion cm/y. Far from the 16 billion cm/y 2015 government target.

The naysayers blame sluggish progress on the domination of China's NOCs – particularly CNPC and China Petroleum & Chemical Corporation (Sinopec) – that control the best shale acreage, but lack the entrepreneurial zest that advanced the US plays.

The NOCs, led by CNPC, hold about 80% of China's shale-gas blocks, which are not listed by the ministry of land and resources for auction.

But for their part, the NOCs are reluctant to devote resources to shale gas after experiencing hefty exploration costs for low output during pilot drilling.

Instead, they prefer to focus on tight gas and conventional fields.

In China around 10 billion yuan (\$1.6 billion) has been spent to drill around 130 shale-gas wells, most of which were sunk by CNPC and Sinopec.

Only a handful of those wells are

pumping over 40,000 cubic metres per day (cm/d), deemed a break-even level for the \$13 million-16 million each well costs, officials say.

Shale auctions

For now, the lack of competition, as well as two disappointing shale-licensing rounds, has tempered the wildly optimistic production targets and initial enthusiasm for the sector.

The first round in 2011, which was only open to Chinese state-backed firms, resulted in two of four blocks offered being awarded. Sinopec won a block and Henan Provincial Coal Seam Gas Development and Utilization Company (Henan CBM) won the other.

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The second round in 2012, which was open to private companies in an effort to spur development, saw 16 Chinese firms win 19 of the 20 blocks offered. One month before bidding it was announced that Sino-foreign joint ventures controlled by Chinese partners could bid, however there was inadequate time for new entities to be set up.

None of the latest round's winners had ever drilled a conventional well, let alone a shale-gas well. But they did promise to spend at least \$2 billion over three years to pump gas from shale.

To date the non-oil companies have barely started seismic work and will need to buy the expertise they lack. At the end of August 2013, only China Huadian, which won four blocks, had started drilling.

Winners of the first two rounds were awarded a three-year study period and if commercial quantities of shale-gas are found they can get a production licence, but it's not clear what the terms of that PSC will be, says Nicholas Song, a Beijing-based lawyer with Vinson and Elkins.

A third round is expected, largely

covering the northern basins, but the timeline is unclear for now. Considering the lack of success so far, Song expects the government will encourage further foreign participation, most likely through joint ventures with local companies.

Foreign participation

For now though, Song says it's best for investors to explore opportunities with the NOCs.

Tony Regan, an Asian-gas specialist at Singapore-based consultancy Tri-Zen, agrees, saying that it would be extremely frustrating for investors to hook up with the inexperienced winners of the second acreage release, which covered some 20,000 square kms.

Almost all foreign involvement in China's shale-gas development starts with a joint study, followed by multi-phase pilot programmes rather than a direct PSC.

The international oil companies, eager to get a foothold in the nascent sector, are busy tying up with the NOCs.

Shell and CNPC were granted China's first foreign-invested production sharing contract (PSC) for shale gas earlier this year at the Fushun-Yongchuan Block. The move forms part of Shell's \$1 billion per year investment programme in China's unconventional space.

The Anglo-Dutch supermajor is also drilling wells with Sinopec to test the shale potential in central China, where scant exploration has been done.

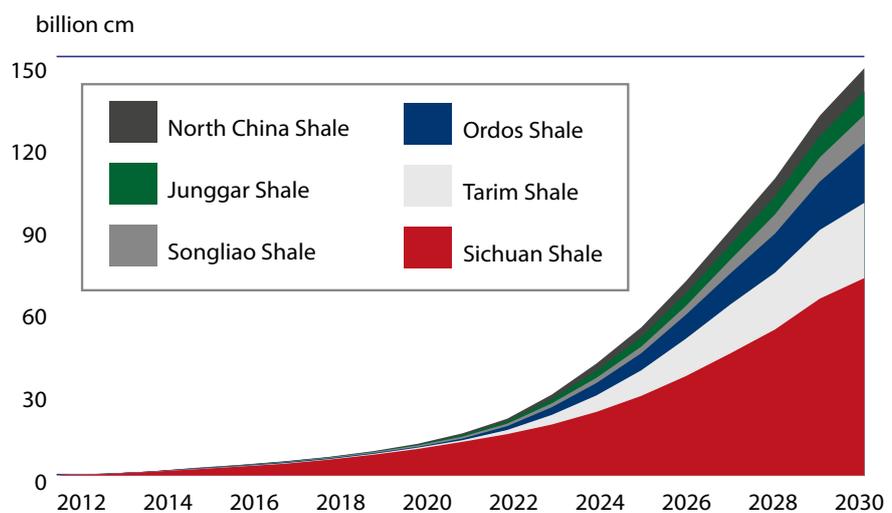
The pair is carrying out a joint evaluation at the Xiang E Xi (XEX) block, at the junction of central Hunan, Hubei and Jiangxi provinces in east central China. Results from hydraulic fracturing at the first well, Liye-1, were disappointing.

A second well, Engye-1, is being drilled and a third one is also planned.

ExxonMobil, Eni, Chevron, Hess, and Total are all carrying out joint study agreements with CNPC or Sinopec. Chevron is drilling at Sinopec's Qiannan shale-gas block.

Foreign independents are eager

Figure 1: China shale gas production (bcm)



Source: Wood Mackenzie

to join the party too. Leading service providers, including Schlumberger and Halliburton, are also forming strategic partnerships with either local governments or NOCs.

The government recognises it needs more foreign participation and is encouraging the joint venture model for Sino-foreign cooperation.

But the shale regulatory framework is still a work in progress with some grey areas surrounding joint study arrangements.

Beijing is considering two possible models to develop shale-gas projects. The PSC model, where the Chinese company holds the block license, and then enters into a PSC with a foreign player, or the joint-venture model.

Each model has issues says Song. The PSC will have to be adapted to meet shale-gas requirements, and may be less flexible. The joint venture model has issues regarding funding, default remedies and cost recovery.

The lack of clear regulations and

investment models is holding back foreign investment, adds Song.

Opportunity

But for savvy investors this could present an opportunity.

Hewitt, now an independent consultant based in Singapore, says that companies can look on regulatory grey areas as an opportunity, rather than a drawback.

"The government's policy and regulatory development are an iterative process. This offers companies the chance to shape future regulations through dialogue with government and massive state-owned entities".

But he says the emerging sector does not suit everyone.

"Some would find it just too uncertain and too risky. But with established relationships it's workable or at least there is a work-around".

That is not to say that companies should seek to avoid in place regulations, it's just the way they are interpreted or applied in practice can make the difference between a

Shale gas

project that is commercially viable and one that is not, he adds.

Indeed, for a company like Dart, the perceived above-ground risk in China is less than in the Australian state of New South Wales, where regulatory flux has ground their unconventional campaign to a halt.

But in China investors need to be well plugged into the business environment and understand how to operate.

“Understanding Chinese culture, as well as your way through the systems, is crucial to success and definitely a challenge,” says Justin Walta, chief operating officer at Dart Energy.

But Walta, who has spent eight years working in China and has experience probing tight-gas sands at depths of 4,000 metres – which offers a similar challenge to shale wells – says that contrary to popular belief, access to technology and drilling equipment is no problem whatsoever.

“We never had trouble finding rigs or frack spreads. I think in that aspect China could actually be well ahead of the curve”.

The Australian-listed explorer, along with other foreign independents such as Green Dragon Gas, Sino Gas & Energy, and Far Eastern Energy, all have established relationships in the unconventional space, largely built in the CBM sector.

Shale access

Dart has leveraged its background in China to access shale-gas acreage in the Sichuan basin. Last September, the company, in partnership with the Hong Kong and China Gas Company, signed a shale-gas PSC with Henan CBM in the Xiushan Block.

Henan has split the block, awarded as part of China’s maiden auction, into four prospects, one of which Dart has snapped up.

Walta expects Dart, as joint operator with its Hong Kong listed partner, to be operationally active early next year, but only after the PSC is officially approved.

Although China’s basins still need to be proven, Dart’s analysis shows the economics look encouraging and a wellhead gas price of \$7-8 per million British thermal unit (Btu) should provide a decent margin.

The government no longer sets wellhead prices but when they announced the latest pricing policy, which tied domestic gas prices to an oil basket, they predicted wellhead prices would climb from 1.1 yuan/

Figure 1: Shale gas in China



Source: Petroleum Economist

cm to 1.4 yuan/cm. This equates to about a \$1.25/million Btu rise to \$6.25/million Btu.

This is great news for legacy producers but not such good news for shale developers, whose costs are rising faster than the increase to well-head prices, says Regan.

But shale developers do get a subsidy of 0.4 yuan/cm, which means they get a wellhead price closer to \$8.2/million Btu. Prices are expected to rise further.

The latest move, in July, was a step towards market pricing and the government has committed to taking another step soon, which Regan expects in 2014.

But China has pretty good supply cover out to 2016, so they might be tempted to delay the next increase, he cautions.

Nevertheless, official prices are not crucial for unconventional producers. Being outside the regulated market means they can sell gas at whatever price a buyer is willing to pay.

Prices can be high, but invariably buyers will take gas into regulated markets and come up against government limits.

As a result it's common for CBM developers to compress or liquefy

their production and truck it to the unregulated markets.

For now Chinese shale development is focused on the Sichuan basin – the nation’s premier shale-gas area. The basin, which is a dedicated government pilot area, already has pipelines, plentiful water supplies, and lies close to major markets.

Exploration is concentrated in the southwest of the basin, which is relatively less faulted and low in hydrogen sulfide – a poisonous and highly flammable gas present elsewhere.

But exploration results have been mixed. Flows averaging up to 2 million cf/d have been achieved at some wells, while results from others have been discouraging, leading to inconclusive findings.

PetroChina’s first horizontal shale well took 11 months to drill and produced a disappointing initial rate of 560,000 cf/d. A similar operation would have taken two weeks in the US.

In October 2012, the CNPC-Shell joint venture reported flow rates of up to 15 million cf/d at its Yang 201-H2 well targeting the Longmaxi shale in Luzhou, Sichuan, making it the highest flowing single shale well in China. It might only be one well, but its flow rate is better than even

some of the most prolific basins in North America.

Ultimately, development of Chinese shale gas will depend on flow rates and reserves per well, costs and gas prices.

Some analysts suggest that shale plays in China will have similar, if not better flow rates relative to US wells, given that they are significantly deeper. But deeper also means more expensive to drill.

Chinese shale-gas drilling costs are a contentious issue. Developers tend to cherry-pick the best numbers and the methodology behind estimates is unclear.

Sinopec, which has a pilot project at its Fuling Block, is spending an estimated \$10 million-13 million per well. Flow rates are estimated to range between 4.8 million to 8 million cf/d, laying the foundation for commercial production in the area.

According to data from oil-service companies, the cost of drilling a shale well in the Sichuan basin varies from \$8 million-11 million for a five-to-eight stage horizontal well with a 1,000 metre lateral section.

However, Scott Stevens, senior vice president of US consultancy Advanced Resources International (ARI), says shale-gas wells in China probably cost on average at least \$30 million.

He says that because of faulting, developers have to drill a vertical pilot well first to understand the geology, which is cheaper than a horizontal. But the true cost becomes the horizontal plus the vertical well, which is even higher than his estimate.

Nonetheless, Stevens expects costs will fall to about \$15 million by 2018, as operators benefit from economies of scale and experience. This is still relatively high compared to the US experience, however, where it costs about \$9 million to drill a shale well.

As a rule of thumb at least 100 wells are needed to prove a shale play. To date only about 130 wells have been drilled in the entire Greater Sichuan basin, which represents more than one play.

Developers say initial drilling has confirmed the resource potential, but China's shales are still far from understood.

According to the latest report released in June by the EIA, the bulk of technically recoverable shale-gas resources sit in the marine and lacustrine source rocks of the Sichuan (626 trillion cf), Tarim (216 trillion cf), Junggar (36 trillion cf) and Songliao (16 trillion cf) basins.

Foreign companies in China's shale sector

ConocoPhillips

Joint study agreement with CNPC at the Neijiang-Dazu block.

Joint study agreement with Sinopec for Qijiang in southwestern Sichuan province. The US major will carry out a 2-D seismic sweep and drill two wells.

Shell

Joint study agreement with Sinopec at Xiang E Xi Block. One exploration well, Liye-1 already drilled. The second well, Engye-1, expected to be completed around January 2014.

The Anglo-Dutch supermajor is starting a "significant drilling season" this and next year at its Fushun Block, as well as its tight-gas Block in Jinqiu, both in Sichuan province, to find "sweet spots" for longer-term production scheme.

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Eni

Joint study agreement with CNPC at the 2,000 square kms Rongchang Block in Sichuan province. The block lies next to Shell's Fushun block.

Total

Joint study agreement with Sinopec for a block in Anhui province. Expected to drill three wells.

ExxonMobil

Joint study agreement with Sinopec for the Wuzhishan-Meigu block covering 3,643 square kms in southwestern Sichuan province.

Chevron

Joint study agreement at the Qiannan basin in southwestern Guizhou province. The US major, has not identified its partner, but state media identified Sinopec. It is drilling the second and third wells in the basin this year.

Hess

The US independent signed a study agreement with Sinopec to assess shale-gas and oil potential in the Shengli oilfield in east China.

BP

Reported that BP and Sinopec held talks over potential cooperation at the 2,000 square kms shale-gas block in Kaili in Huizhou province and a 1,000 square kms block in Huangqia, northern Jiangsu province.

Dart Energy

Dart Energy signed a PSC with Henan CBM to develop shale gas in the Xiushan Block in Sichuan province.

The contract covers 720 square kms, which was awarded as part of the first shale-gas auction.

Dart is still waiting government approval but hopes to start drilling next year. ●

Another 222 trillion cf of technically recoverable resources exist in the smaller, structurally more complex Yangtze Platform, Jiangnan and Subei basins. These plays lie near major demand centres and are still considered prospective.

Relative to the US, the shales of the Sichuan and Tarim basins are potentially enormous and, if successful, could rival the Marcellus in terms of absolute scale.

However, the Chinese plays do have a much lower gas concentration than the Marcellus, and are more analogous to the Barnett or

Haynesville in overall reserves concentration. Depth of shale is largely greater in China, although similar to the Haynesville, meaning there is the potential for these plays to be economic.

For now though, the focus on the Greater Sichuan area is understandable, given the Tarim basin is much farther away from the markets in eastern China. Not to mention its shales are much deeper, potentially rendering them uneconomic. A lack of water supplies poses a serious challenge to development of the Tarim basin in western China too. **DE ●**