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China's Growing Natural Gas Insecurity and the Potential of Chinese Shale Gas

John Seaman

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Executive Summary

China is poised for a dramatic increase in its demand for natural gas. As total energy demand has risen to record levels in the last five years, China has found itself in an increasingly difficult bind: the social and environmental burden from coal is becoming too heavy to bear and a growing dependence on foreign oil is becoming strategically more risky with the passage of time. China's policy-makers and strategists continue to favor indigenous resources whenever possible, but projected increases in demand are so great and the cost of nuclear and renewable energy sources still so high that natural gas has become an increasingly natural choice. The country's gas demand is projected to double in the next three years, reaching 260 billion cubic meters per year (bcm/y) by 2015 as Beijing has set a target to increase the part of natural gas from 4% of China's energy mix today to more than 8% by the end of the 12th Five Year Plan (2011-2015). Further projections show that Chinese gas demand could reach 400 bcm/y in 2020 and 550 bcm/y or more in 2030.

While this growing demand for gas will help China achieve its goals of reducing the carbon intensity of its GDP and cut much of the pollution from coal, it is also leading China further down a path it has long hoped to avoid: greater dependence on strategic energy imports. A pipeline project to pump gas from Turkmenistan through Central Asia began delivering supplies in 2009 and is expected to reach 40 bcm/y in the near future and possibly even 65 bcm/y or more by 2020. Another pipeline from Myanmar is expected to enter into service in 2013 and would be capable of delivering up to 12 bcm/y. Negotiations with Russia for pipelines that could deliver anywhere from 30-70 bcm/y are deadlocked over pricing, but the construction of LNG import terminals suggests that China could be capable of importing between 40-50 bcm/y of this sea-borne gas by 2015 and possibly even 100 bcm/y or more by 2020.

China's increasing reliance on imports is creating a deepening sense of energy insecurity among many policymakers and strategists in Beijing. While there is an element of supply security in the diversification of sources, each of these options comes with its own risks: increasing vulnerability to various geopolitical interests, price volatility and instability in supply regions or along transit routes.

In this context, the success of the United States in revolutionizing its energy supply by producing large quantities of indigenous gas from shale plays has sparked the imagination of China's energy planners. Recent estimates suggest that China has the largest recoverable reserves of shale gas in the world. Hoping to

spur a shale gas revolution of its own, China's authorities have set ambitious plans produce 6.5 bcm/y by 2015 and between 60-100 bcm/y by 2020.

But given the sheer size of China's total energy demand and its projected growth, shale gas will not be a golden ticket to energy-independence, and it is unlikely that ambitious production goals will be met within the established time frame. Nevertheless, production from shale and other unconventional sources will play an important role in helping to diversify the country's energy mix, influence energy prices and lessen the overall environmental burden from coal.

The degree of impact will depend on China's ability to overcome a number of environmental, social, logistical and regulatory challenges. Many regions of the country such as the North and West will see their development stifled by water scarcity. Other basins in the South, where water availability is less of an issue, such as Sichuan, will still have to deal with the issues of population density, land access and pollution. These challenges are becoming more complicated given a context of increasing tension over land rights and over the effects of development projects on local human health and environmental sustainability. Moreover, logistical hurdles related to, among other things, a complex geology, inadequate infrastructure and insufficient human capital will also have to be overcome. An uncertain regulatory framework governing the shale gas sector must also be clarified – a task that will undoubtedly be influenced by the willingness for and directionality of a broader reform agenda on the part of China's new leadership. Among the regulatory issues to be dealt with for a smoother development of the shale gas industry are: the role of private and foreign enterprises and their relationship with state-owned companies; questions over land management and pipeline access; and the matter of price liberalization. If China is going to adequately deal with these challenges, it will most likely need more time than Beijing's current set of targets is hoping for.

In the absence of significant development of China's shale gas resources in the next decade, import demand from China will be a major driver of both regional and global gas demand. As a consequence, China will have an increasing need to deepen its bilateral relationships with current and potential suppliers, particularly of LNG. This means greater competition with Asia's other major gas consumers – Japan, South Korea and India – but also a growing importance for regional LNG suppliers such as Australia and others further abroad such as the GCC countries in the Persian Gulf. In the long term, China's development of shale and other unconventional gases may temper its growing need for imports, but will by no means erase it.

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Introduction

China has more than doubled its energy demand in the last ten years to become the world's largest direct consumer of primary energy. If this growth continues as projected, it could account for 30% of the world's growth in energy demand over the next thirty years.[1] As such, the composition of China's energy mix will not only be a determining factor in the struggle to limit global warming, it will also have a profound impact on regional and global energy markets and the choices that will be available to other energy consumers in the future.

In an effort to diversify away from coal and oil, natural gas has been flagged as an increasingly important resource in China's energy mix – increasing from 4% today to more than 8% by 2015, while demand for gas could quadruple by 2030. But rising demand for natural gas will also mean an increasing reliance on imports, raising the degree of risk to China's economy from supply disruptions and increasingly volatile prices.

In this context, Chinese leaders and strategists have watched closely and with much anticipation the development of gas supplies from previously unmanageable shale rock formations deep underground in the United States. New extraction methods such as horizontal drilling and the hydraulic fracturing of shale have allowed what is often coined as a "game changer" for the American energy market. Whereas only 5 years ago the US was set to drive global demand for liquefied natural gas (LNG), the country increased its domestic production of gas by 27% between 2005-2011 and has begun a potential transition towards becoming a net gas exporter – as it currently produces 94% of its natural gas needs and production is projected to rise in the years to come. Shale gas currently accounts for more than 20% of US natural gas production while it is projected to account for nearly 50% of the country's production in 2035.[2] This resource has also driven US natural gas prices to historic lows and saved energy consumers an estimated $103 billion per year in recent

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[1] Assuming the IEA's "New Policies Scenario" in the *World Energy Outlook 2011*.

[2] US Energy Information Administration, "What is shale gas and why is it important?", www.eia.gov, 9 July 2012

years.[3] China is believed to have the largest reserves of shale gas in the world, even larger than the United States, but whether or not China will be able to turn these reserves into a boon for its economy remains a matter of great debate.

This paper will undertake two primary analyses: First, it will examine further the motivations behind China's favoring of natural gas in the energy mix and the risks associated with rising imports. Second, it will assess the potential of shale gas to provide an added amount of supply security to support China's natural gas boom. These analyses will ultimately lead to preliminary conclusions on how China's rising gas demand will continue to influence regional relationships and the country's increasing need to become more deeply engaged in affairs beyond its borders. As such, China's ability to develop unconventional sources of gas will have an impact on its role in regional and global energy relationships and is therefore of broad significance to both energy consumers and producers.

[3] Christopher Helman, "The arithmetic of shale gas", Forbes, 22 June 2012

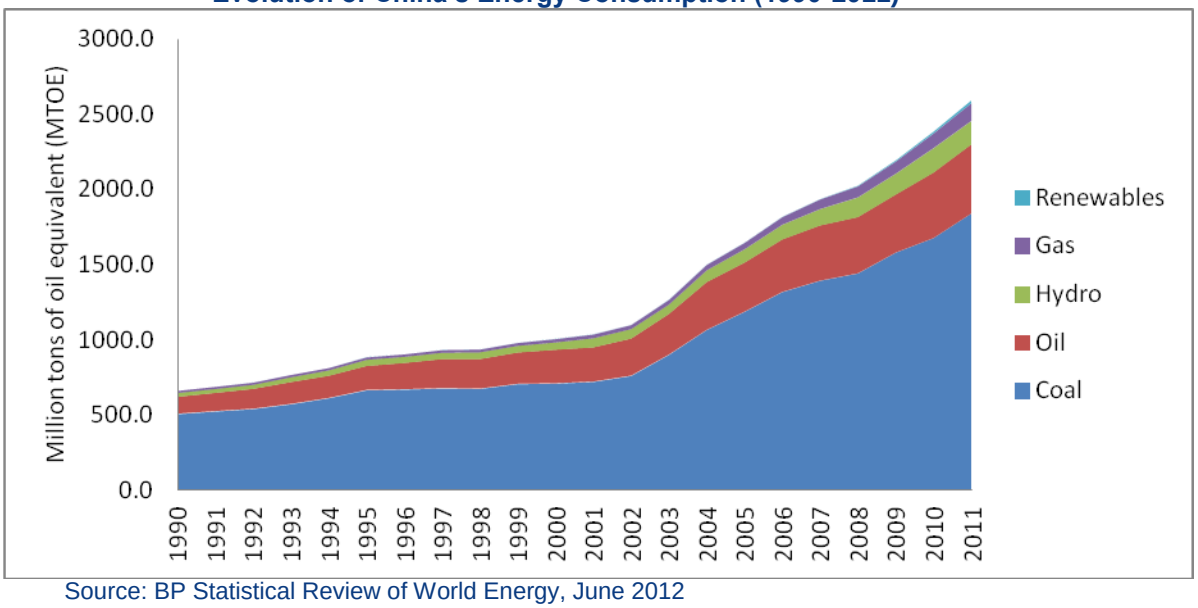
China's shift to natural gas and perceived risks for energy security

The need for China to diversify its energy mix is becoming increasingly urgent. Ensuring reliable, affordable, and increasingly cleaner supplies of energy to fuel growing demands is essential for securing the country's economic progress, social order and, by extension, political stability. In recent decades, maintaining access to vast amounts of cheap, indigenous coal and increasing supplies of imported oil have been decisive factors in the country's economic success story. Coal has been the bedrock of industrialization and has hardly dropped below 70% of the energy mix of modern China.4 Oil has also facilitated the growth of industry and allowed for the rapid development of various means of transit to move people and goods and enhance the society's wealth. But each of these resources has also become increasingly burdensome for China. Dramatic increases of coal production have clogged the nation's transportation routes and been the source of widespread degradation of the environment and human health.5 While also chocking China's cities with pollution, oil has the added burden of increasing the country's reliance on imports, and as such the whims of foreign interests, volatile pricing, long and vulnerable maritime shipping lanes and political instability in supply regions. Both coal and oil will continue to play key roles for China in the decades to come, but the problems associated with them have made finding viable alternatives essential goals in the coming years and decades.

[4] For analysis of China's coal industry, see Tu, Kevin Jianjun, "Industrial Organization of the Chinese Coal Industry", *Working Paper #103*, Freeman Spogli Institute for International Studies, Stanford University, July 2011.

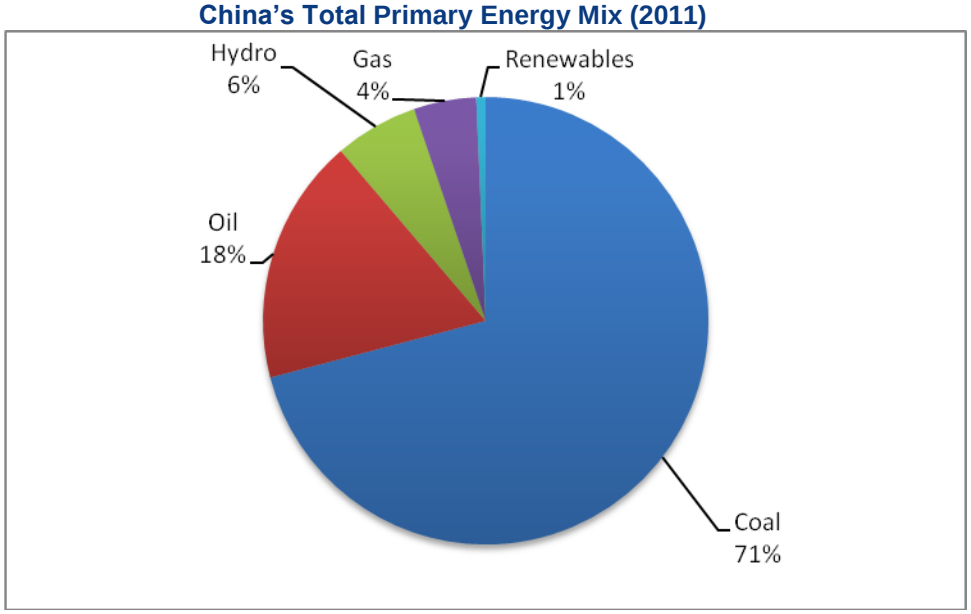
[5] For analysis on the challenges related to progress towards cleaner coal, see John Seaman, "China and Cleaner Coal: A marriage of necessity destined for failure?", *Asie.Visions 52*, April 2012.

Evolution of China's Energy Consumption (1990-2011)



Source: BP Statistical Review of World Energy, June 2012

China's Total Primary Energy Mix (2011)



Source: BP Statistical Review of World Energy, June 2012

Drivers in the search for alternatives to coal and oil

Three general rules are governing this search for alternatives. The first is the notion of greater energy autonomy. During the Mao Zedong era, when ideology pitted China against the principles of the West and relations with the Soviet Union had soured, the legitimacy of the Communist Party hinged in part on the notion that it was the Party that had broken a one-hundred-year cycle of domination by foreign powers. In this context, national autonomy – and in particular resource autonomy for the nation – became a fundamental principle. Despite China's dramatic transformation and engagement with the global economy, maintaining a degree of energy independence is still a guiding principle of energy policy. Since China became a net oil importer in the 1990s the voices of those concerned about the country's increasing vulnerability have grown alongside the deepening dependence on foreign energy sources and supply routes. The more China can rely on its own resources, the more secure China will be.

Another crucial factor is price. Despite having the second largest economy in the world, China's per capita income is just under $5,500 per year and wealth disparities are significant and widening. Much of China still lives on the edge of relative poverty and keeping inflation in check and maintaining controls on residential energy prices is crucial for preserving social stability. Controlling production costs for industry, the largest energy consumer by sector, has also been an important factor in forging China's competitiveness in the global market place and attracting foreign investment. Ultimately, for China to remain stable and competitive, energy must remain affordable.

A final and increasingly important driver is improved sustainability and the reduction of the environmental impact of energy use. While China is often chided for its lack of transparency in environmental reporting – on air quality in Beijing and other major cities, for example – Chinese officials are increasingly aware of the burdens that reliance on coal and oil has placed on the country's environment and human health and of the growing threat of climate change. China's 12th Five Year Plan (2011-2015) is often hailed as the greenest in the country's history. On the energy front, Beijing has launched ambitious initiatives to improve energy efficiency of the economy and reduce energy intensity per unit of GDP in 2020 by 20-25% of 2005 levels. It has also reiterated its goals from the 2009 Copenhagen summit on climate change to reduce the carbon intensity of GDP by 40-45% in 2020. The drive to lessen the environmental burden of energy use was also a central theme in the latest white paper on China's Energy Policy 2012, released by

China's State Council in October 2012.6 Whatever alternatives can be found to oil and coal, they must also be cleaner.

China's natural gas boom and a growing dependence on imports

In this context, natural gas has emerged as an increasingly natural choice for China. While Beijing has launched ambitious goals to improve energy efficiency and increase the part of renewable sources and nuclear energy in the overall mix, the problems of cost, productivity and regulation are proving to be complex hurdles while the sheer size of projected demand requires a large range of inputs. Even in more ambitious scenarios of the International Energy Agency (IEA) through 2035, a combination of hydro, biomass, waste and other renewable sources such as wind and solar would only be able to account for a combined 20% of China's total energy mix, while nuclear power would weigh in at 13%. A more modest scenario from the same agency would indicate 13% and 6% of 2035 energy demand respectively.[7]

While natural gas is by no means a perfect energy source, it is a much cleaner alternative to coal and oil. It stands to bring about significant gains in reducing potential emissions of CO_2 and a range of toxic pollutants.[8] Natural gas is also a tried and tested fuel that can provide a stable base energy to respond to intermittency and predictability issues that are common with most renewable energy technologies. As such, a premium has been placed on boosting natural gas consumption. Major infrastructure projects including the construction of 50,000km of pipelines have been undertaken for much of the last 10 years to accommodate growing gas demand. Both consumption and production have already increased dramatically, nearly doubling between 2006 and 2011. On the demand side, this trend is projected to accelerate in the coming years. China's government has set plans to double natural gas requirements by 2015 – in just 3 years' time – from a rate of 130 bcm per year in 2011

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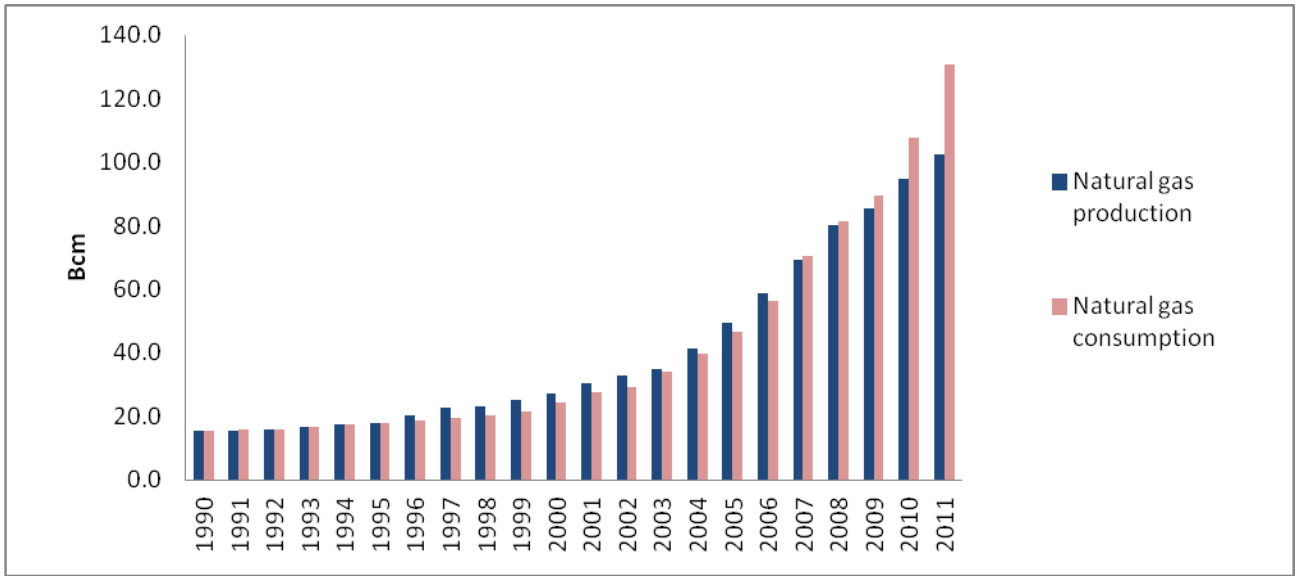
[6] State Council of China, China's Energy Policy 2012, 24 October 2012, http://www.china.org.cn/government/whitepaper/node_7170375.htm

[7] Based on calculations from the ambitious '450 Scenario' and the more modest 'New Policies Scenario' of the IEA's *World Energy Outlook 2011* (p. 592-3).

[8] Carbon dioxide emissions from natural gas burned in power generation are generally believed to be 40-50% lower than those of coal (carbon capture and storage not taken into account). However, a debate over the total lifecycle emissions of greenhouse gases from natural gas use is emerging, particularly in relation to methane emissions shale. See for example Mark Fulton et al. "Comparing the Lifecycle Greenhouse Gas Emissions from Natural Gas and Coal", Deutch Bank Group and the Worldwatch Institute, 25 August 2011, http://www.worldwatch.org/system/files/pdf/Natural_Gas_LCA_Update_082511.pdf

to 260 bcm, as the 12th Five Year Plan has established a target of 8.3% for natural gas in the energy mix in 2015.[9] While there is broad speculation about the feasibility of such a leap, the impetus to increase the lot of natural gas is clear. Further estimates for annual gas demand by 2020 range anywhere from 300 to 400 bcm, depending on the degree of success in transitioning towards a greater use of this resource.

Consumption and Production of Natural Gas in China (1990-2011)



Source: BP Statistical Review of World Energy, June 2012

But while natural gas can play an important role in reducing the burden of coal, a major concern in China is the increasing reliance on foreign suppliers. While China's proven, exploitable reserves of conventional natural gas in 2011 were estimated at 3.1 trillion cubic meters (tcm), it has been widely believed for the better part of a decade that increased demand will have to be met to a large degree by imports. Natural gas production in China has risen sharply in the last decade to roughly 100 bcm/y, but has failed to keep pace with growing demand. While projections show that China could, under ideal conditions, increase *conventional* production to 130 bcm/y by 2020, most long-term scenarios see a decline from these sources towards 80 bcm/y by 2035.[10] As discussed further below, unconventional sources will therefore be crucial in reducing import dependency moving forward. Meanwhile, China first became a net importer of gas in 2006 and its import dependence has risen ever since. In 2011 the country imported roughly 30 bcm of gas, or over

[9] By comparison, natural gas consumption in the European Union in 2011 was 490 bcm.
[10] International Energy Agency, Golden Rules for a Golden Age of Gas, 2012.

20% of its needs. By 2020 China's dependence on these imports could rise to more than 50%.[11]

As a consequence, China has been actively pursuing supply contracts from foreign producers. In 2006 a major contract was signed with Turkmenistan to deliver 20-25 bcm/y via pipeline by 2012. In 2011 roughly 14.5 bcm of Turkmen gas was sold and delivered to China. The contract was subsequently renegotiated in November 2011 to increase the potential volume of Turkmen gas to 65 bcm per year, which could be complemented by another 10 bcm of potential annual supplies from Uzbekistan and 2-5 bcm from Kazakhstan.[12] A deal was also reached with Myanmar in late 2008 to build a gas pipeline northward to China's Yunnan province and supply 12 bcm of gas per year from offshore wells in the Bay of Bengal by 2013. Still, many analysts expect that production constraints will keep deliveries at or below 4 bcm/y by 2015.[13] Negotiations with Russia have also been ongoing since 2006 to construct two pipelines that could deliver up to 70 bcm of gas from Western Siberia (30 bcm) and the Russian Far East (38-40 bcm). As will be further discussed below, these negotiations have been repeatedly stalled.

Meanwhile, imports of LNG have risen rapidly since they first arrived in China in 2006, totaling 12.7 bcm in 2010 and more than 16.5 bcm in 2011. Last year Australia, Qatar, Indonesia and Malaysia accounted for over 78% of China's LNG imports.[14] China has been working frantically to ramp up its receiving capacity by building new terminals. It currently has 5 terminals in operation with a re-gasification capacity of 29 bcm, while 6-8 terminals are under construction or being expanded in order to raise receiving capacity to 50-60 bcm by 2015.[15] The country's LNG receiving capacity could certainly increase more rapidly as the estimated time of construction for a terminal is 3 years and press reports have estimated that China could have at least 20 LNG terminals by 2020 and a potential receiving capacity from 70 to 110 bcm.[16]

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[11] According the IEA's "low unconventional scenario" in IEA, *Golden Rules for a Golden Age of Gas,* 2012

[12] John Roberts, "Russia & China: The great gas failure", *Energy Economist*, 1 May 2012.

[13] International Energy Agency, *Gas Pricing and Regulation: China's Challenges and IEA Experience*, September 2012, p.26

[14] BP Statistical Review of World Energy, June 2012

[15] International Energy Agency, *Gas Pricing and Regulation: China's Challenges and IEA Experience*, September 2012, p.25 and Fan Gao, "Will There Be a Shale Gas Revolution in China by 2020?", *NG 61*, The Oxford Institute for Energy Studies, April 2012, p.3-4.

[16] Platts, 26 September 2012, and James Henderson, "The Pricing Debate over Russian Gas Exports to China", NG 56, The Oxford Institute for Energy Studies, September 2011, p. 14.

China's Major Natural Gas Infrastructure

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: IEA, Gas Pricing and Regulation: China's Challenges and IEA Experience, September 2012, p.16

China's Estimated Natural Gas Import Capacity to 2020 (bcm)

	2011 (actual imports)	**2015** (estimated capacity)	**2020** (estimated capacity)
Pipelines	**14.5**	**52**	**107 – 147**
Central Asia	*(14.5)*	*(40)*	*(65)*
Myanmar	*(X)*	*(12)*	*(12)*
Russia	*(X)*	*(X)*	*(30-70)*
LNG	**16.5**	**40-50**	**70-110**
Total	**31**	**92 – 102**	**177 – 257**

Source: Author's estimates based on BP Statistical Review of World Energy 2012 and press reports

Risks for energy security and price stability

With import volumes set to increase dramatically, various geopolitical interests, increasing price volatility and the risk of instability in supply regions or along transit routes are increasing the risks for China's energy security and becoming a growing cause for concern in Beijing.

One major risk factor as seen from Chinese strategists is the emerging geopolitical rivalry with the United States. Rising tensions in the East and South China seas and uncertainty over the motivations behind the announced strategic "rebalancing" of US interests towards the Asia-Pacific are adding to a sense of nervousness among analysts and policy makers over the China's growing dependency on maritime shipping routes. Indeed, concerns over an underlying "containment" strategy on the part of the United States and its network of alliances in the region have festered in China to varying degrees since the end of the Cold War. This view has now gained momentum as the Obama Administration has sought to build or deepen military cooperation with various partners in the region, to include Singapore, Vietnam, the Philippines and Australia, on top of its traditional security alliances with South Korea and Japan and the sheer weight of the American Pacific fleet on its own.

Both local and geopolitical developments have also added an element of risk for gas supplies from the Myanmar pipeline, not to mention its parallel oil pipeline. Beyond technical aspects that could slow the development of the project below its goal of 12 bcm – as alluded to above – political reforms in Myanmar have allowed a window of opportunity for American engagement, symbolized by the historic visit of Secretary of State Hillary Clinton to Myanmar in late 2011.[17] Reinforcing this newfound engagement, Barack Obama made the first ever visit by a US president to the country in mid-November 2012 as American sanctions on the country have been drastically scaled back. For Beijing, this increases the risk that Myanmar could become a proxy battleground in a larger geopolitical struggle that would put China's strategic investments at risk should relations with the United States become more conflictual. But beyond the Sino-American rivalry, China has faced increasing problems of its own regarding the development of energy projects south of its border. In September 2011, Myanmar's new civilian president, Thein Sein, halted a major Chinese-driven hydroelectric project on the Irrawaddy River and its tributaries in the restive Kachin State following strong protests and contained violence by the local population. China's state-owned China Power Investment Corporation (CPI) had invested $25 billion in the project that would have generated 20 gigawatts (GW) of electricity, 18 GW of which would be used to power needs on

[17] Li Xiguang, "China-Myanmar ties challenged by US moves", People's Daily Online, 30 November 2011, and Michael Bristow, "China troubled by warming US-Burmese relations", BBC News, 1 December 2011,

the Chinese side of the border.[18] This sudden reversal of fortune for China has sparked concerns about the viability of CNPC's twin oil and gas pipelines as they pass through regions in Myanmar's Shan State where the central government exercises little real control and former rebel groups reportedly continue to operate with relative freedom.[19]

Relations with Russia are also a complex mixture of geopolitics and business. An initial agreement to supply Russian gas to China was inked between CNPC and OAO Gazprom in 2006 but has been continuously delayed with no clear end in sight. The primary dispute has been over price. Russia's primary export market is Europe, where gas prices are linked to the price of oil and have now reached an estimated $11.3-12.7/mmbtu ($400-450/mcm) that China can scarcely afford to pay. In its initial deal with Turkmenistan, for example, China is thought to have secured a price of anywhere from $5.4-6.9/mmbtu ($190-245/mcm) by the time the gas reaches the Chinese border in Xinjiang, or roughly half of the price that Russia hopes to receive.[20] Furthermore, the pipeline from Western Siberia that would pump 30 bcm per year into Xinjiang would draw gas from the same fields and pipeline network as supplies destined for European markets. Once this gas crosses the border it would then also have to make the long, expensive journey to consumption centers to the south and east. China is hoping that greater diversification of supply options – including an increase in volumes from Central Asia in particular – and a weakening European market will increase its negotiating power. Meanwhile, Russia also has a keen interest in exploiting gas reserves in its largely underdeveloped Far East and China would seemingly be an ideal candidate. But gas delivered to China's northeast regions would have to compete with low-priced coal while the prospects of a broader and potentially more lucrative East Asian LNG market are providing a strong incentive for Russia to hold out.[21] In December 2012 Russia was rumored to have ceded to China's preference for the Far Eastern route. During Xi Jinping's visit to Russia in March 2013 – his first trip abroad as newly-anointed President – a memorandum of understanding was signed between Gazprom and CNPC to deliver 38 bcm per year of gas to China for 30 years starting in 2018, with an option to increase this amount to 60 bcm. Nevertheless, no formal contract has been signed to date and speculation remains over whether pricing will not continue to hinder the final conclusion of the deal.

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[18] Yang Meng, "Chinese Power, Burmese Politics", Chinadialogue.org, 2 April 2012

[19] Yin Hongwei, "Pipeline in the Crossfire", Chinadialogue.org, 7 May 2012, and Shavindana H., "China's Pipelines in Myanmar", *ISDA Comment*, Institute for Defence Studies and Analyses, New Delhi, 10 January 2012,

[20] James Henderson (2011), corroborated by interviews July-October 2012

[21] For analysis of Sino-Russian gas negotiations see James Henderson, "The Pricing Debate over Russian Gas Exports to China", NG 56, The Oxford Institute for Energy Studies, September 2011.

Supplies from Turkmenistan and Central Asia, on the other hand, have proven to be a more secure investment, as a suitable match between supplier and consumer has been found. China desperately needs new sources of gas while Central Asian states have been eager to diversify away from their dependence on Russia's pipeline network and efforts to conclude a pipeline project to Europe have seemingly gone nowhere. Nevertheless, gas imports from Central Asia still present pricing problems. Turkmen gas import prices are thought to be linked to the price of oil – and therefore variable – while transport has also proven costly. Once the gas has passed through 1,800 km of pipeline in Central Asia, it then has to travel up to 5,000km additional kilometers or more to its final destination. By the time it reaches the gates of Shanghai, for example, its price has increased by 80% or more.[22] CNPC reportedly lost $7 billion importing Central Asian gas in 2012 due to the low cap on the sale-price of gas in China.[23]

While the price of pipeline gas is becoming problematic for China, the volatility for imported LNG prices is also posing a problem. An initial deal negotiated in 2003 by China's CNOOC to import LNG from Australia was concluded at a bargain price of $3/mmbtu for 25 years. This deal is considered exceptional given the low price, but also highlights the volatility of LNG in that prices are indexed on the market price of oil. Industry sources confirm that China now pays more than $8/mmbtu for the same Australian gas and that contracts signed since are nowhere near as advantageous for China. Relying on the spot market has proven to be even more risky. Japanese buyers, for instance, have recently been cited as paying between $15-20/mmbtu on the spot market as Japan's gas demand has skyrocketed following the nuclear accident at Fukushima. China's initial deal with Australia, which provided 20% of China's LNG imports in 2011, has so far helped to average out the overall cost of importing LNG. Yet, as Chinese demand for gas grows, so too do the demands of others in Asia, particularly Japan. China is likely to face much higher prices for imported LNG in the future. While there is hope that the US will open its vast shale gas resources for export and that this could help ease the price, many interviewed during the course of this study explain that the high cost of liquefaction and shipping from the Gulf of Mexico to Asia will lessen the impact. Moreover, the high and rising level of demand could overpower the effect of the potential increase in supply from the US.

Plans to liberalize gas prices in China, while considered necessary for gas importers and distributers, may further compound the problem. Under pressure from companies seeking to pass along price increases to consumers rather than operate at a loss under

[22] International Energy Agency, *Gas Pricing and Regulation: China's Challenges and IEA Experience*, September 2012

[23] Erica Downs, "Money Talks: China-Russia Energy Relations after Xi Jinping's Visit to Moscow", Up Front - Brookings Institution blog, 1 April 2013.

what has become an overly complex pricing system, the Chinese government began pilot price liberalization programs in Guangdong and Guangxi in late 2011. If successful, these programs could be incrementally phased into a nation-wide liberalization of gas prices by 2014-2015. Ultimately, this could mean that industries, businesses and possibly even residential consumers could be exposed to potentially volatile oil-indexed gas pricing.

While the increasing diversity of natural gas sources has comforted Chinese policymakers by reducing the systemic risks from a supply disruption of any one source, Beijing has reason to be concerned about the relative security and ultimate cost of each of its supply options. In this sense, the growing reliance on natural gas will lead to a greater overall risk to energy security, economic growth, and ultimately social and political stability. But this risk could be abated if China is able to find the key to unlocking its potentially vast reserves of unconventional gas.

The potential of shale and other unconventional gases

At a time when China is in clear need of reducing its dependence on coal and curbing the risks associated with rapidly increasing imports, new, seemingly revolutionary possibilities have risen from domestic sources of unconventional gas. China's reserves have been estimated in recent years at between 40 tcm and 50 tcm of exploitable gas that include 9 tcm of coal bed methane and 3 tcm of so-called tight gas.[24] But among these, the greatest potential lies in the 25 tcm – 36 tcm of estimated shale gas reserves that could prove to be the largest of their kind in the world.[25] While the presence of shale gas has been known for some time, the demonstrated success of hydraulic fracturing and horizontal drilling methods used to unlock vast amounts of natural gas from shale plays in the United States are now driving policy in China. There is new hope that the country could soon be able to turn a page on its coal dependence while minimizing the growth of imports and keeping prices in check. Indeed, the break-even price for shale gas production in China is estimated at $\$0.24/m^3$ versus an average import price that is currently estimated at $\$0.42/m^3$ of gas.[26] Nevertheless, despite this newfound enthusiasm, major hurdles remain before China can hope to turn its shale gas and other unconventional resources into a boon for a more secure, cleaner energy future. China's ultimate success or failure in this endeavor will depend on factors that are both within and beyond Beijing's control.

[24] IEA, "Golden Rules for a Golden Age of Gas", 2012, p. 115.

[25] The US Energy Information Administration has estimated 36.1 tcm worth of exploitable natural gas while China's Ministry of Land Resources put the figure at a more modest 25 tcm as of March 2012. Many of those interviewed believe that estimates will ultimately be adjusted downward, though some have argued that, as in the case of the US, more focused survey work could reveal more exploitable reserves than what has been currently estimated. For an example of the latter, see Kenneth B. Medlock and Peter R. Hartley (2011), p.10.

[26] Figure proposed by Thomas Hilboldt of the Hongkong and Shanghai Banking Co. during the Second Asia Shale Gas Summit in Shanghai on October 17-18, cited in Platts Commodity News, 18 October 2012

Major Unconventional Gas Resources in China

Source: IEA, "Golden Rules for a Golden Age of Gas", 2012, p. 116.

Between ambitious goals and the voices of moderation

Unconventional gas is nothing new to China, and shale gas is certainly not the only option. Efforts to survey and extract methane from coal deposits have been developing for more than 20 years and were an important feature of energy production targets in China's 11th Five Year Plan (2006-2011).[27] Still the potential for exploiting gas from shale deposits has opened new possibilities and raised hopes that America's success can be replicated. Ambitious targets were proposed by the Ministry of Land Resources (MLR) in 2009 to produce 6.5 bcm/y of shale gas while increasing the part of this resource in the overall gas mix to 10-15% by 2020. The 12th Five Year Plan (2011-2015) subsequently validated the 6.5 bcm target for 2015 but raised the stakes to between 60 and 100 bcm/y by 2020. The National Development and Reform Commission (NDRC), China's economic planning body, estimates that China will spend 400-600 billion Yuan drilling 20,000 wells by 2020.[28] Meanwhile, the most

[27] A target of 10 bcm from CBM gas was set for 2010, and 8.5 bcm were ultimately produced. For a discussion on coal bed methane and why China ultimately failed to meet its 2010 target, see Fan Gao (2012), p. 6-15.
[28] "China Shale Gas Auction Attracts 83 Bidders", China Daily, 25 October 2012

optimistic scenarios of the IEA project that total annual unconventional gas production could reach a combined 110 bcm/y by 2020 and up to 390 bcm/y by 2035 – with shale gas leading the way at over 200 bcm/y for the latter period.[29]

This projection by the IEA is based on China's adherence to a broad set of principles that require strict rules for resource management and both social and environmental protection. But shale gas development in China is still in its infancy and the manner in which the industry will develop remains open for discussion. There is indeed a debate in China about the pace that shale gas development should take. On the one hand, many strategists and policymakers have been pushing for a rapid advancement of production out of concern for energy security and the risk of getting caught in a rising price trap. This is reflected in the ambitious targets set for the coming 8 years. A more rapid development of indigenous resources will not only provide greater energy security for China but will increase its bargaining power in negotiations with potential supply partners, such as Russia.

But many in China's oil and gas industry as well as environmental groups are more reticent, as much of the screening, exploration and regulatory work has yet to be done.[30] In general, China's major gas producers tend to favor the development of conventional gas and more proven unconventional resources such as coal bed methane in the short term while allowing a more flexible period for research, exploration and adaptation for shale gas in the long term. Indeed, if one considers the US as an example, shale gas required over 20 years of research and development before it made a significant impact and still many states lack the regulations needed to deal with problems that have arisen.[31]

The debate boils down to an argument for the rapid development of shale gas reserves in order to ensure energy security and affordable prices in the years to come, and another favoring a slower, more prudent approach that has a greater chance of ensuring production in the long-term. But does acting ambitiously today put a healthier, long-term development of the industry at risk? To this end it is worth looking at how China's shale gas industry is developing and the monumental challenges that remain.

[29] Projections under the "Golden Rules" scenario, IEA (2012a), p. 118-119.
[30] Fan Gao (2012), corroborated by interviews in July 2012
[31] Interview with representative of US Department of Energy, 13 July 2012.

Daunting logistical and regulatory challenges

Before shale gas can have a broad commercial and strategic impact, China faces a number of hurdles including geological and technological constraints, industry structure and the establishment of a broader regulatory framework, pricing, infrastructure and, perhaps greatest of all, an array of social and environmental challenges.

Clarifying resources and developing technology

First of all, China's geology is unique and particularly challenging. So far many of the assumptions regarding the availability of shale gas resources have been based on methods and extractive technologies developed for the United States. One important initiative in the 12th Five Year Plan – which began with the MLR's general survey, released in March 2012 – is to conduct more in-depth nation-wide surveys of shale gas resources and subsequently develop appropriate technologies that are specific to China's landscape. In short, nobody is quite sure at the moment just how vast and exploitable China's shale plays are but most analysts are certain that the country will need to blaze its own technological trail. Steps first need to be taken to determine the complex nature of shale gas resources and the technical aspects required to extract them.

Private or state-owned initiatives?

Another issue is the structure of the industry itself – whether it will be dominated by state-owned or private enterprises and to what degree foreign companies will be welcomed to participate. The ultimate answer to this question will likely depend to a large extent on the appetite of China's new leadership for liberalization and will become clearer as the political succession takes shape in the months to come. Nevertheless, while oil and gas extraction in China has traditionally been the domain of state-owned enterprises such CNPC, Sinopec or CNOOC, Beijing is sending signals that private enterprise will have a key role to play in the development of China's shale gas. For much of the last year, China seems to be taking a page out of the American experience in this respect. In the US, the initial stages of shale exploration and development were dominated by small companies that together were capable of generating a broad base of capital up front, in essence distributing the risk among a large number of investors. It wasn't until the industry got on its feet that the more traditional oil and gas majors began buying up small-yet-successful ventures.

China's first round of bidding for exploration blocks that concluded in June 2011 was limited to six hand-picked state-owned enterprises, with Sinopec and the Henan Coal Seam Gas Development and Utilization Co. ultimately winning bids. But in December 2011 the State Council approved a petition by the MLR to classify shale gas as a distinct mineral resource that would be subject

to separate rules from traditional oil and gas development. This move opened the field to private enterprise. During the second round of bidding between September and October 2012, 83 companies placed a total of 152 bids on 20 blocks. Only two blocks, both in Guizhou province, went to privately-held firms.[32] The remaining blocks went to various state-owned power companies, coal producers or natural resource investors.[33] Despite the lack of successful bidding from the private sector, the fact that the process was opened to non-state-owned investors is a sign that China is willing to break with tradition in hopes of ensuring a rapid development of this resource. Foreign companies have also been allowed to invest via joint ventures, though they must remain a minority stakeholder.

It is hoped that this influx of private investment and foreign interest will also spur innovation, prodding the industry to develop technological solutions quickly. But incentivizing private investors to undertake the types of long-term research and development projects that will be necessary for driving shale gas development is problematic given China's lack of a clear regulatory environment. Moreover, privately-held firms in China traditionally seek rapid turnarounds on investment and do not generally possess the capital base, technical expertise or drilling experience to successfully conclude a project. Meanwhile, China's three state-owned majors – who have been largely absent from the bidding processes in part because they already own drilling rights to an estimated 70-80% of the most sought-after land – have tended so far to see shale development in China as a peripheral activity, choosing to invest rather in overseas ventures, where international prices make for more attractive profit-making opportunities, or in deep-sea exploration in the case of CNOOC.[34] To assist private firms in overcoming technological hurdles and innovating more quickly, forming joint ventures with foreign firms is seen as crucial.[35] Many of the more qualified foreign investors have reportedly been reticent to invest due to the degree of uncertainty surrounding potential risks.[36]

[32] Namely the Huaying Shanxi Energy Investment Co. and Beijing Taitantongyuan Natural Gas Technology Co

[33] Notably the Huadian Group, Shenhua Group, China Coal Geology Engineering Group (CCGEC) and the State Development and Investment Corporation.

[34] FACTS Global Energy, "Shale Gas Prospect in China: Bloated Government Targets Exposed by a Depressing Reality Check", China Energy Series: Gas Edition, Issue #60, 10 January 2013, p.11.

[35] FACTS Global Energy, *op.cit.* p.6-7.

[36] Kevin Jianju Tu, "Beijing's Problem with Shale", The Wall Street Journal, 24 October 2012,

The problems of pricing, property rights and infrastructure

Among these potential risks are issues of cost and gas pricing. Production costs in China are thought to be higher than in the United States due to geological and topographical constraints that will require elevated capital costs, though these costs could come down as experience improves and China creates economies of scale. Currently, drilling a single well for shale gas extraction in China is estimated at $16 million versus only a few million on average in the US.[37] Meanwhile, price controls leave little room for error, as the cost of producing shale gas is estimated to be roughly equivalent to the national average of wellhead gas prices.[38] Beijing hopes that the prospect of a nation-wide liberalization of gas prices in the coming years will help belay these concerns and promote investment. Indeed, the NDRC announced in December 2011 – corresponding to the opening up of the shale market to private investors and the launching of pilot pricing schemes in Guangdong and Guangxi – that wellhead prices of unconventional gas would be liberalized.[39]

Yet further regulatory concerns that hamper potential investors are the issue of access to land for drilling and pipelines for transport, where state-owned enterprises hold a clear advantage. Geologists estimate that China's national oil companies may already have 70-80% of the country's shale gas reserves within their current acreages.40 CNPC meanwhile has a monopoly on national trunk lines to transport gas to consumption centers and therefore has incentive to prioritize access for its own production. This is compounded by the fact that, while China has been building and improving its 50,000 km pipeline network for nearly 20 years, it has scarcely been able to keep up with growing demand, leaving little room for unconventional gas.41 Building new pipelines or updating existing networks to accommodate a rapidly rising supply will undoubtedly be problematic, though the State Council has just approved plans to construct an additional 44,000km by 2012.42 Ultimately, while the preeminence of state-owned actors does not preclude the success of China's shale gas development, it is likely to influence the pace at which the industry innovates and progresses.

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[37] Kevin Jianju Tu, *op cit*.
[38] John Roberts, "China unlikely to meet shale gas targets: Conference participants", Platts Commodity News, 18 October 2012
[39] Jim Bai and Chen Aizhu, "China reforms shale gas price, pilots new scheme", *Reuters*, 27 December 2011.
[40] Fan Gao (2012), *op. cit*, p. 26; and FACTS Global Energy, op.cit. p. 11
[41] Fan Gao (2012), *op. cit*, p. 18
[42] "China Sets Natural Gas Development Targets" China Daily, 04 December 2012, http://www.chinadaily.com.cn/business/2012-12/04/content_15982791.htm

Significant social and environmental risks

Beyond the more technical issues related to business development, there are major questions remaining about what impact shale gas development will have on various aspects of China's environment and whether local populations will be willing to bear the cost of intense drilling operations.

Water scarcity

Perhaps the greatest concern is one over which China has little control – the availability of water. Water scarcity has plagued China throughout its history but has become a much more serious problem as its economy develops and the demand for water increases. China is currently ranked by the United Nations as one of the 13 countries with the most severe water shortages. An estimated 300 million people live with insufficient access to water while the national average of 2,080 m^3 per capita per year is only one third of the world average of 6,466 m^3/y.[43] The 2030 Water Resources Group, led by the World Bank Group and McKinsey & Company, projects that China's water demand could increase by 40% in the next two decades, reaching 818 bcm of water by 2030 from 586 bcm in 2009.[44] This increase in demand will be largely driven by a doubling in requirements from industry and municipal use and could lead to an overall shortage of 199 bcm/y, or 2.6 times 2009 municipal water use.

Hydraulic fracturing, which has so far proven to be the only economical method for extracting shale gas, is a highly water intensive endeavor. Fan Gao (2012) estimates that maintaining a production of 50 bcm/y of shale gas could require 154 million m^3/y of water, or equal to the entire residential use of 2.6 million urban dwellers.[45] Of the 20 blocks on offer in China's latest round of shale gas bidding across eight provinces, five provinces face water supply problems. Hubei and Zhejiang provinces and the Chongching municipality are considered borderline, with water availability per capita on line with the already low national average. Meanwhile Anhui province is considered to be under water stress while Henan is already classified as having a problem of extreme water scarcity. Another zone which has been identified as potentially promising for development is the Tarim basin in Xinjiang, which is a desert climate with only small pockets of available water supplies. Water availability per capita may be relatively normal, but the region is both vast and

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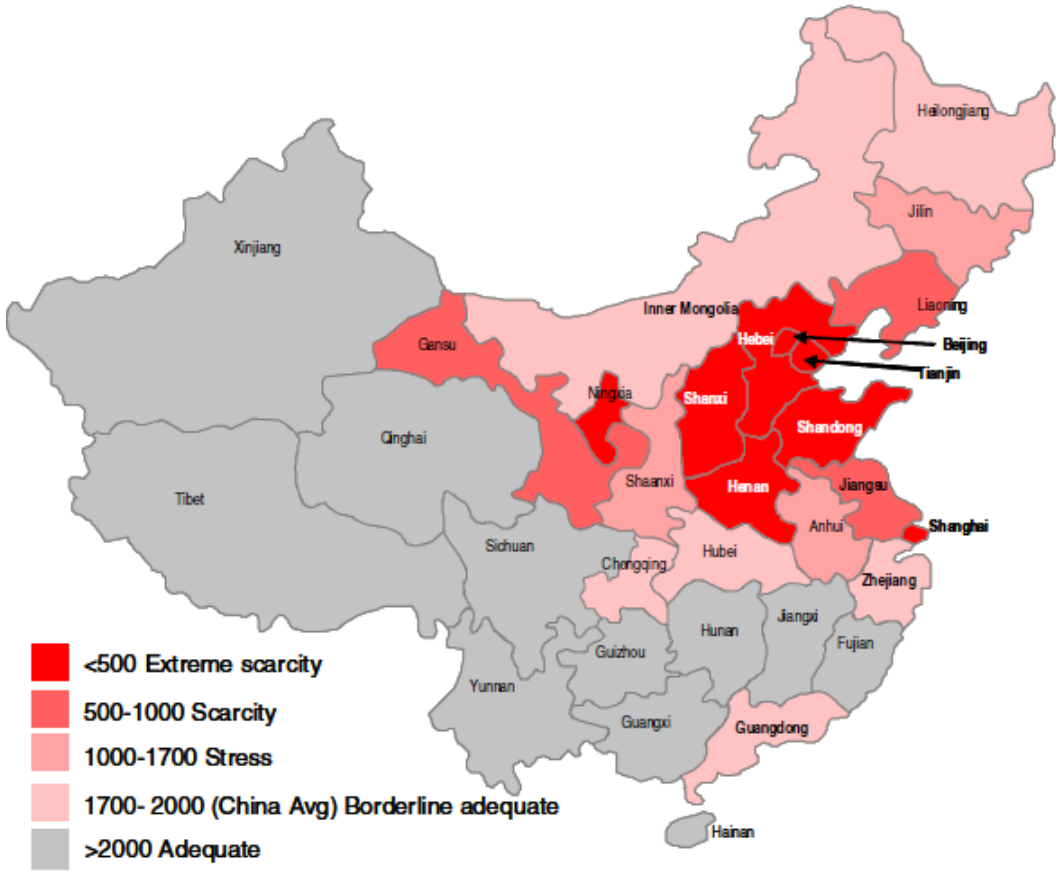
[43] Food and Agriculture Organization of the United Nations, Aquastat, 2009, www.fao.org, and Fan Gao (2012), p. 30.

[44] *Charting Our Water Future: Economic frameworks to inform decision-making*, 2030 Water Resources Group, 2009, p. 9.

[45] Fan Gao (2012), *op. cit*, p.29, based on the US Environmental Protection Agency's high-end figures of 4 billion gallons, or 15,000 m^3 per well in the United States and a wastewater recycling rate of 25%.

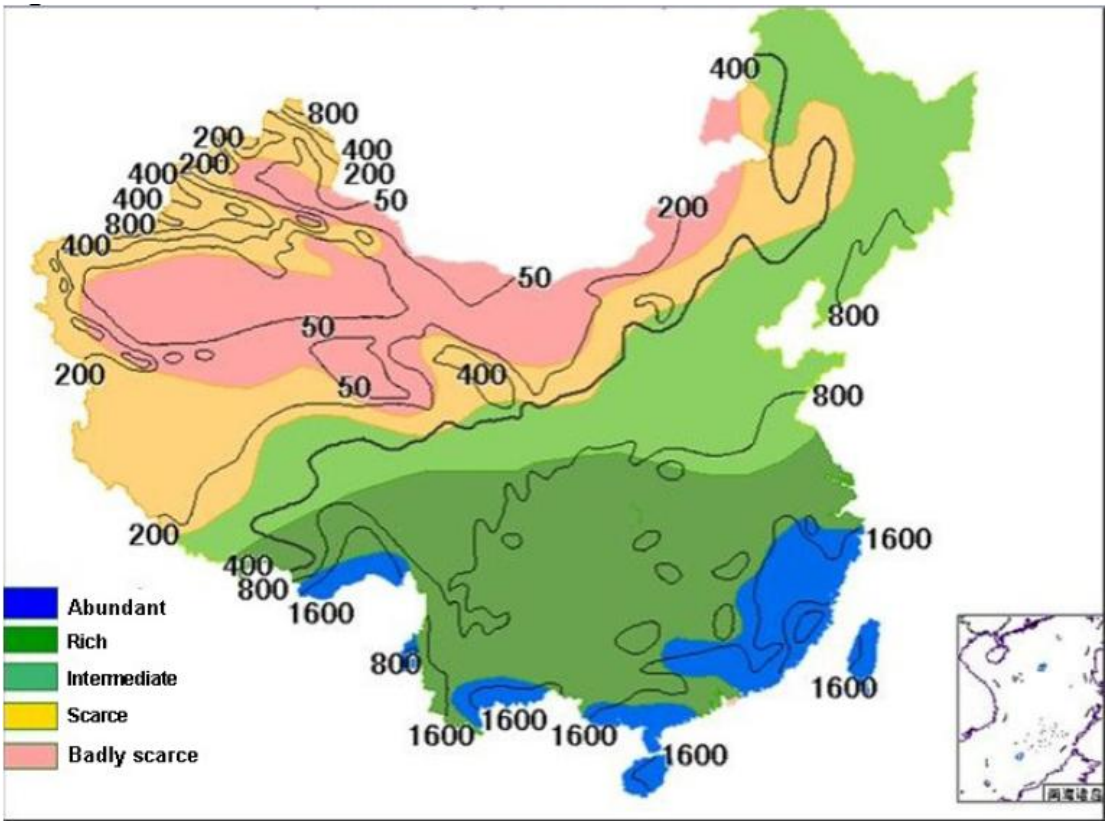
sparsely populated, which often hides the fact that water is extremely scarce in Xinjiang in general. Moreover, managing scarce water supplies in China more broadly is problematic due to the traditionally weak coordination and enforcement capacity of the Ministry of Water Resources.

China's annual water resources per capita (m^3) by province (2003-2010)



Source: HSBC, Chinawaterrisk.org (based on China's National Bureau of Statistics)

Precipitation and Distribution of Water Resources



Source: Fan Gao (2012), p. 32
Original author's note: The areas marked with "abundant" or "rich" are only in the Chinese context. Bear in mind that China's renewable freshwater resource per capita is less than one-third the world average; vast areas of china are water short compared with other countries.

Pollution, population density and the rising risks of social backlash

Where water scarcity is not considered to be a major issue, such as in Sichuan province, there are still a myriad of social and environmental challenges. These include water pollution, unwanted emissions of toxic and greenhouse gases, and issues concerning population density and land rights.

Once water has been pumped into a well, anywhere from 30-70% of it returns to the surface as "flow back". Additional water present underground prior to drilling can also come to the surface in the form of "produced water". In both cases this wastewater contains hazardous chemicals that can pollute local water ways and affect human health. Groundwater sources can also be affected by leakage of wastewater when wells are improperly sealed or via geological

features such as natural faults, porous rock or the proximity of aquifers.[46]

Meanwhile, emissions of locally toxic gases such as hydrogen sulfide (in the case of Sichuan in particular) or so-called volatile organic compounds (VOCs) pose occupational hazards and health risks to local populations.[47] There are also higher concentrations of methane associated with shale gas (which is itself methane) than with conventional gas extraction. Methane is 25 times more potent than carbon dioxide for global warming and inadvertent emissions of this gas during the shale gas extraction process could, if not contained, negate some of the gains from transitioning away from coal.[48]

Population density and issues of land access are another problem that can be particularly troublesome in the case of China. Some of the country's potential development zones are also among the most densely populated areas of the planet, particularly Sichuan at 538 persons/km^2, which also happens to be a major agricultural producer. Other areas such as the South China Basin, North China Basin and Bohaibei Basins also have population densities over 250 persons/km^2. The US example shows that drilling for shale gas can be done in densely populated areas such as Dallas, Texas, but the question remains, can it be done in densely populated areas *in China*?

Both issues of environmental risk and land rights have been a cause for increasing social tension. Land rights and the unjust seizure of land is the single largest source of public protest in China. Among the most notable were the protests in Wukan, Guangdong Province, in late 2011, where local residents protested against land seizures by officials and businesses and eventually forced the intervention of top provincial-level officials.[49] One marked difference between the US case and China in the case of shale gas is the extent of property rights. In the US, property rights extend below the surface to include all subterranean resources, allowing local land owners to make a profit from the extraction of natural resources on their property. This is a crucial factor in gaining the support of local populations for drilling projects. Meanwhile, property rights in China do not extend to the resources that may lie below the surface and as such local citizens and property owners can be left feeling dispossessed by drilling on or

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[46] Merisha Enoe, Yan He and Erica Pohnan, "Lessons Learned: A path towards responsible development of China's shale gas resources", Natural Resources Defense Council, August 2012, p. 6.
[47] Mersha Enoe, et. al, *op cit*, p. 7
[48] Robert W. Howarth, Renee Santoro and Anthony Ingraffea, "Venting and leaking of methane from shale gas development: response to Cathles et al.", *Climate Change*, 1 February 2012, and James Conca, "Fugitive Methane Caught in the Act of Raising GHG", Forbes, 15 July 2012.
[49] Edward Wong, "Demonstrators Who Took Over Chinese Village Halt Protests", The New York Times, 21 December 2011.

near their homes and property. This is particularly the case when the local environment and human health are being affected.

Indeed, environmental concerns have also been a growing cause for Chinese citizens taking to the streets, with a string of highly publicized events as of late that include a the protest of a petrochemicals plant in Ningbo that brought together 10,000 people, and another in Qidong which amassed nearly 100,000 participants from protesting the construction of a sewage pipeline in what ultimately ended in violent clashes. Local Chinese media estimate that environmental protests have risen by 29% per year in recent years.[50]

A wide range of scenarios

Any combination of logistical, regulatory, environmental or social challenges could slow China's overall shale gas development, limit its trajectory and scope, or lead to backlash from local communities that could have consequences for both the projects themselves and local political stability more broadly. Indeed, the scope of challenges facing China have led many analysts to cast doubt on the notion that shale gas could be a "game changer" for China in the way it has been for the United States. Fan Gao of the Oxford Institute of Energy Studies, for example, projects that shale gas production won't surpass 1 bcm before 2015, while only reaching 10 bcm by 2020.[51] Gavin Thompson, head of Asia-Pacific gas research at the energy consulting firm Wood Mackenzie also estimates that China's shale gas production will remain well below stated targets through 2020, likely not exceeding 11 bcm, or less than 4% of the projected 260 bcm demand. Still, according to Thompson, production is likely to ramp up after 2020 and could reach up to 150 bcm/y by 2030, driven primarily by production from the Sichuan and Tarim basins.[52] This suggests that China's time for adaptation will be longer than government targets would hope, but that shale gas could indeed provide a significant quantity of domestic gas in due course.

Projections of the IEA, meanwhile, balance the effects of responsible industry development – the "Golden Rules" scenario – against another in which proper conditions are not established for the industry to sustainably develop – the "Low Unconventional" scenario. The contrast between the two is stark. Under the Golden Rules case

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[50] "Environmental Protests Growing 30% Every Year", Want China Times, 30 October 2012.

[51] The author also expects that coal bed methane, which has a longer history of development, could reach 10 bcm/y by 2015 and 30 bcm/y by 2020

[52] "China: Wood Mackenzie says shale gas will not satisfy demand, requiring CTG and 130 bcm additional imports by 2030", Wood Mackenzie Press Release, 6 June 2012.

the production of unconventional gas as a whole reaches 110 bcm by 2020 and 391 bcm by 2035 – the latter including nearly 200 bcm of shale gas. In this scenario, unconventional gas as a whole accounts for 45% of China's domestic gas production in 2020 and 83% in 2035, while the dependence on gas imports never rises above 20%. This highly optimistic scenario is contrasted by one in which China fails to adequately address the challenges ahead. In the Low Unconventional scenario, gas from unconventional sources as a whole only supplies 37 bcm/y in 2020 and 115 bcm in 2035 while the dependence on gas imports rises above 50% throughout the decade.[53]

Ultimately, what these scenarios suggest is that China can succeed in turning shale gas into a boon for the economy but that adequately responding to the array of challenges is crucial. More than the rapid development of these resources, what is important for the long-term supply of natural gas for China is that the time be taken to adequately survey resources and develop technology, adapt and strengthen regulatory and legal regimes, and ensure environmental safeguards. Without these elements, China's potential shale gas boom could go to bust.

[53] IEA (2012a), p. 119.

Conclusion – Regional and geopolitical implications

In conclusion, there remains a high level of uncertainty regarding the scale and pace of China's shale gas development and whether or not this resource will one day, either sooner or later, provide a significant boost for China, and to the global economy as a consequence. Indeed, global gas demand, but particularly that of Asia, is likely to rise dramatically in the post-Fukushima era. This growth will be led by China – a fact that, given the uncertainty over the country's development of indigenous unconventional resources, will ultimately deepen the country's interest in enhancing relationships with suppliers both in Asia and further abroad, notably the Middle East. As a consequence, China's growing needs and weight as a market for gas will impact upon the level of its engagement and influence in supply regions, increasing competition with other demand-side economies in Asia.

China's growing demand for gas imports has already impacted regional relationships in Asia. Access to energy resources has been a major driver behind China's deepening engagement in Central Asia over the last 15 years (though it is certainly not the only driver) and has had a balancing effect on Russia's influence there. In particular, opening exports to Chinese gas consumers has allowed Turkmenistan to diversify its options and step out of Russia's immediate orbit. Gas exports to China are presenting opportunities for Uzbekistan and Kazakhstan as well, though other resources such as oil and uranium will continue to be of greater importance for the latter. But Russia has also gained from China's growing gas demand. While it is still deadlocked in its negotiations for pipelines, the prospect of Chinese demand is allowing Russia to negotiate harder bargains with Japan, Korea and other prospective LNG buyers from its Sakhalin projects in the north-west Pacific, and supplies linked to proposed pipeline projects from the Russian Far East.[54] Further south, China's deal to obtain gas from Myanmar has also had a broader regional impact. While the project has brought more strategic significance to China's relationship with Myanmar and events that transpire there, China's contract comes in place of other potential buyers. While South Korea had launched a proposal to transform Myanmar's

[54] For analysis of the geopolitics of gas in Northeast Asia, see Keun-Wook Paik, et al., "Through the Dragon Gate? A Window of Opportunity for Northeast Asian Gas Security", Energy, Environment and Resources Breifing Paper 2012/05, Chatham House, December 2012.

offshore gas into LNG for its own domestic markets, India was also cut off from the prospects of a pipeline to supply its increasingly dire needs.[55]

Moving forward, the degree to which China's gas demand will continue to influence regional relationships will depend on the country's ability to offset future import demand with domestic production of unconventional gas. Indeed, there are two major motivations behind China's overly ambitious goals for shale gas production through 2020. The first is to drive the industry forward as quickly as possible and make the most of its indigenous resources, thereby reducing the future need for gas imports and minimizing the social and environmental burden of coal. In this sense, rather than being a hard and fast rule, production targets are a signal to Chinese producers of Beijing's ambition to develop shale gas, thereby spurring investment and innovation. The second motivation is to reinforce China's negotiating position with future suppliers of pipeline gas and LNG. By demonstrating its potential to become a major gas producer, China strengthens its hand. The prospect of losing the Chinese market could then prod Russia into compromising on a pricing deal that would allow pipeline projects to be completed and ultimately start the flow of gas in a matter of years. This becomes even more likely as European gas markets have weakened. Under such conditions, prospective LNG suppliers in the region such as Australia, Indonesia and Malaysia – as well as gas producers in the Persian Gulf such as Qatar, the UAE and Oman – could also be motivated to give Chinese buyers more advantageous long-term deals than would have otherwise been the case.

Nevertheless, given the challenges facing the development of shale gas in China, bringing significant quantities of unconventional Chinese gas online will likely take no less than a decade, during which time demand could nearly triple. Even when these supplies do come online, they will not have the same level of impact that shale gas development has had in the United States. In other words, China will still rely heavily on gas imports. IEA projections show, for example that in an ideal case with high unconventional production China will still need to import 77 bcm/y in 2020 and 119 bcm/y in 2035, or 20% of its needs or more during the whole period. In the more pessimistic "low unconventional" scenario, which is likely to be the case at least until 2020, China's import dependency rises above 50%, passing from 143 bcm/y in 2020 to 262 bcm/y in 2035 (keep in mind that imports in 2011 were only 30 bcm). Even if unconventional gas production in China increases significantly beyond the next decade, the region's other importers, to include Japan, South Korea, and

[55] For an analysis of the role of China and pipelines in shaping regional relationships, see John Seaman "Energy Security, Transnational Pipelines and China's Role in Asia", Asie.Visions 27, April 2010.

increasingly India, will still face increased competition from China during the interim period.

China's rising import demand means that Beijing must deepen its diplomatic and economic engagement with suppliers in order to ensure stable bilateral relationships necessary for maintaining a security of supply. Even if a more optimistic unconventional gas scenario prevails, China must maintain a hedge. This reality will ultimately increase the clout of continental producers such as Russia, Central Asia and Myanmar, as well as the growing number of LNG exporters mentioned above. Indeed, LNG will take on a more pivotal role in the regional energy mix in the coming decade and ultimately give greater sway to suppliers.

The shifting geopolitical dynamics of LNG in Asia makes for two observations. First, China's growing dependence on maritime shipping routes and regional producers such as Australia, a long-time ally of the United States, comes at a time when the US is adopting a much-publicized "rebalancing" of military, economic, and diplomatic engagement both to and within the Asia-Pacific – a policy that many in China see as designed to contain Chinese influence in the region. Meanwhile, the other three major LNG importers in the region, Japan, South Korea and India, are either direct allies of or becoming more closely related to the United States. The second observation is the increasing self-sufficiency of the United States in oil and gas resources and its subsequently transformed interest in energy resource developments in the Middle East moving forward. This contrasts with rapidly growing interest from Asia in regards to LNG and other energy resources from the region. The increasing importance for China in relation to gas supplies, but also the strong and growing engagement by Japan, South Korea and India in the Persian Gulf will contribute to a new regional geopolitical dynamic in the Middle East in the years and decades to come. [56]

Given these elements, China's development of shale gas and other unconventional resources are seemingly crucial for tempering a growing resource competition. Moreover, if exploited properly, these resources could also provide an important base of cleaner alternatives to coal and oil and a bridge towards a more sustainable, long-term future built on viable renewable energy sources. But the road is long and fraught with complications. While each country must adopt its own strategy, valuable lessons can be learned and shared from each new case. A regular forum for dialogue between policymakers in countries producing or wishing to produce unconventional fossil fuel resources must become a key feature of the international energy policy landscape moving forward.

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[56] For a more in-depth review of the deepening relationship between Asia and the Middle East, particularly with regard to energy resources, see Thierry Kellner, "The GCC States of the Persian Gulf and Asia Energy Relations", *Note de l'Ifri*, September 2012.

Such cooperation could also help ease mounting geopolitical tensions. China's nervousness over American objectives and the former's growing dependence on foreign energy supplies presents opportunities for cooperation on shale gas development and a show of good faith that overcoming China's complex energy concerns are in the interests of broader international order – and American, European and other Asian regional interests in particular.

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