Industry Overview

Equity | Hong Kong | Gas Utilities
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CBM - Another green solution

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Efforts to diversify fuel mix

China intends to diversify its energy consumption fuel mix and wants to use cleaner fuels, in response to the negative impact of fast-paced economic growth on the environment. Moreover, it wants to preserve natural resources, especially coal, which would get depleted over time. It has targeted to reduce its contribution of coal for energy consumption by 2010 to 63%, down 3ppt from 2005.

Unconventional environmentally friendly gas resources

China hopes to reduce carbon dioxide (CO_2) emissions and aggressively promote production of clean energy. Coal Bed Methane (CBM), a natural gas extracted from coal seams, when let out into the atmosphere is no doubt harmful to the environment, but is a highly clean fuel when burnt. This is because CBM combustion does not produce sulfur dioxide (SO_2) or particulates, and emits merely 50% of the CO_2 emitted through coal combustion.

China targets increase in usage of natural gas (thus CBM)

China plans to increase energy consumption from natural gas, including CBM, to 8% of energy consumption by end 2010, from 3% as of end 2005 (from 48bn cubic meters (bcm) to 100bcm). CBM accounted for 1.4bcm as of end-2006 (or 3% of gas consumption) and this should rise to 10bcm (10% of total) by 2010. Innovative drilling methods have made CBM into a reliable source of competitively priced natural gas for power generation or for supply to industrial and residential markets.

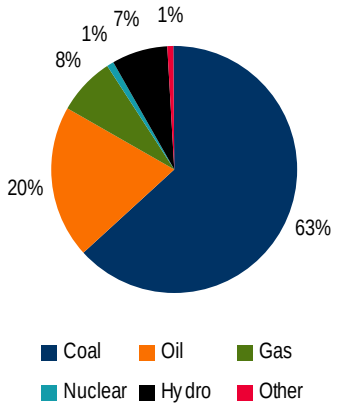
Government keen to develop CBM resources

The CBM industry in China is currently at an embryonic stage of development in terms of investment and existing capacity. We view CBM as a key part of China's energy future. Higher gas prices and the threat of global warming have made cleaner and cheaper gas sources increasingly attractive. CBM reserves are currently estimated at 1,050Tcf, about 3x that in the US, where it accounts for about 10% of natural gas production.

Growth in gas market provides compelling economics

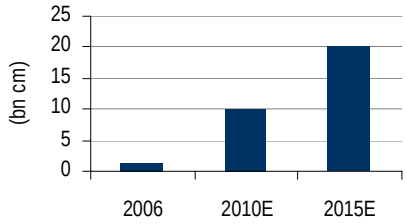
CBM prices are currently deregulated in China. We believe there are strong drivers that point towards gas price inflation in this booming but coal-dominated energy economy. The elimination of methane, which represents overall 20% of the global greenhouse gasses (GHG), also enables tradable carbon credits to be produced. Surplus credits could be sold in the global market.

Chart 1: The development of energy resources in the 11th Five Year Plan



Note: 10th Five Year Plan was from 2001 to 2005 and 11th Five Year Plan was from 2006 to 2010. Source: National Development & Reform Commission April 2007

Chart 2: China CBM production



Source: China United Coal Bed Methane Corporation

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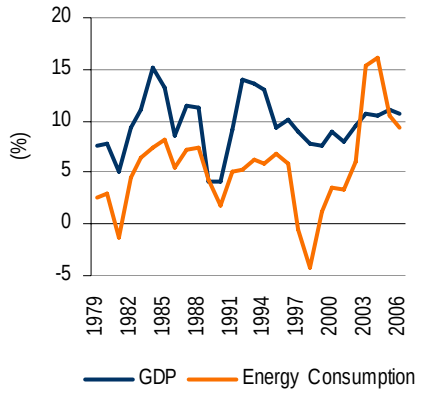
Refer to important disclosures on page 27.

Contents

Chart 3: China's energy consumption YoY growth vs GDP YoY growth



Source: CEIC

Efforts to diversify fuel mix

China has sacrificed the environment for fast-paced economic development over the last two decades, akin to what the US and several European nations did a few decades ago. In the last five years alone, energy consumption has risen at a medium rate of 11% to keep pace with a similarly paced GDP growth rate.

We believe a sharp growth in energy consumption is due and China is building up its basic industries towards it. For instance, severe electric power shortages earlier this decade led to China accelerating the build up of new power plants and in 2006, China commissioned more than 100,000MW in new installed capacity, an astounding growth rate of over 20% YoY.

Today China is undertaking aggressive efforts towards cleaning up the environment. The key is that energy consumption has been far too reliant on coal. As of end 2005, coal consumption accounted for 75% of its total energy production and for slightly over two-thirds of energy consumption. China targets to reduce the proportion of coal to 73% of energy production, down by 2ppt, and to 63% of energy consumption, down 3ppt by end 2010.

It intends to reduce its reliance on coal by sharply increasing energy consumption from:

- Natural gas - from 5.3% to 7.8% of the total;
- Hydro - from 6.8% to 7.4% of the total; and
- Renewable energy sources - from 0.4% to 0.7% of the total.

Table 1: The development of energy resources in the 11th Five Year Plan

		10th Five Year Plan	11th Five Year Plan	*ppt change*	*% change*
Production					
	Coal	74.7	72.9	(1.8)	(2.4)
	Oil	11.3	10.0	(1.3)	(11.5)
	Gas	5.0	6.8	1.8	36.0
	Nuclear	1.0	1.1	0.1	10.0
	Hydro	7.5	8.3	0.8	10.7
	Other	0.5	0.9	0.4	80.0
Consumption					
	Coal	66.1	63.1	(3.0)	(4.5)
	Oil	20.5	20.0	(0.5)	(2.4)
	Gas	5.3	7.8	2.5	47.2
	Nuclear	0.9	1.0	0.1	11.1
	Hydro	6.8	7.4	0.6	8.8
	Other	0.4	0.7	0.3	75.0

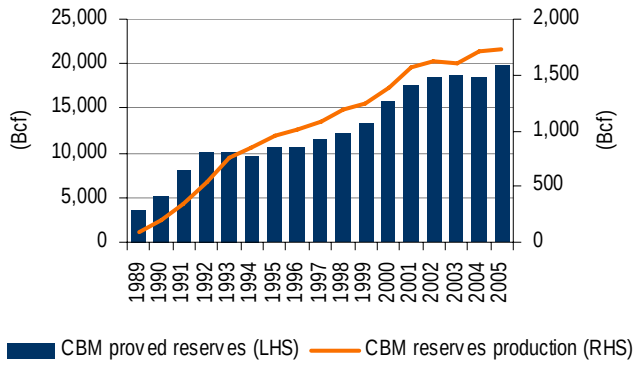
Note: 10th Five Year Plan was from 2001 to 2005 and 11th Five Year Plan was from 2006 to 2010.
Source: National Development & Reform Commission April 2007

CBM holds huge potential for China

Coal Bed Methane (CBM), a natural gas, offers tremendous potential for China's energy development, in our view. Although it is detrimental to the environment when vented to the atmosphere, is a highly clean fuel when burnt. This is because CBM combustion does not produce sulfur dioxide (SO_2) or particulates, and emits merely 50% of the CO_2 emitted through coal combustion. In many countries, including China, methane produced by coal mines is vented, becoming a wasted resource.

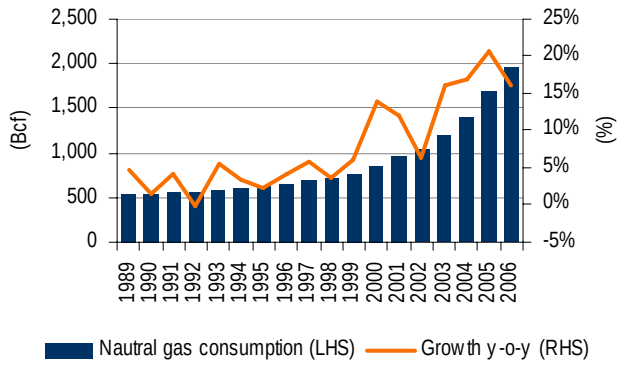
Given China's heavy reliance on coal, coupled with its current plans to construct new mines and the trend toward mining deeper, gassier coal seams, it is likely that methane emissions from coal mining will continue to rise. The recovered CBM can greatly contribute to China's energy sector as well as the environment.

Chart 4: US: CBM proved reserves and production



Source: Energy Information Administration

Chart 5: China: Natural gas consumption



Source: CEIC

Chart 6: CBM: Global occurrences

Source: Oilfield Review

In the US, surface wells are used to recover CBM from non-mining areas and a variety of techniques are employed for recovery from mining areas. Several factors have aided the commercial development of CBM in the US, namely the presence of large and suitable coal basins, a fully-integrated natural gas pipeline system, strong R&D capability and a favorable tax regime. In the US, production began in 1989 and has increased to more than 50bcm in 2005, exceeding the current production of natural gas in China.

CBM resources in China's explored coal areas

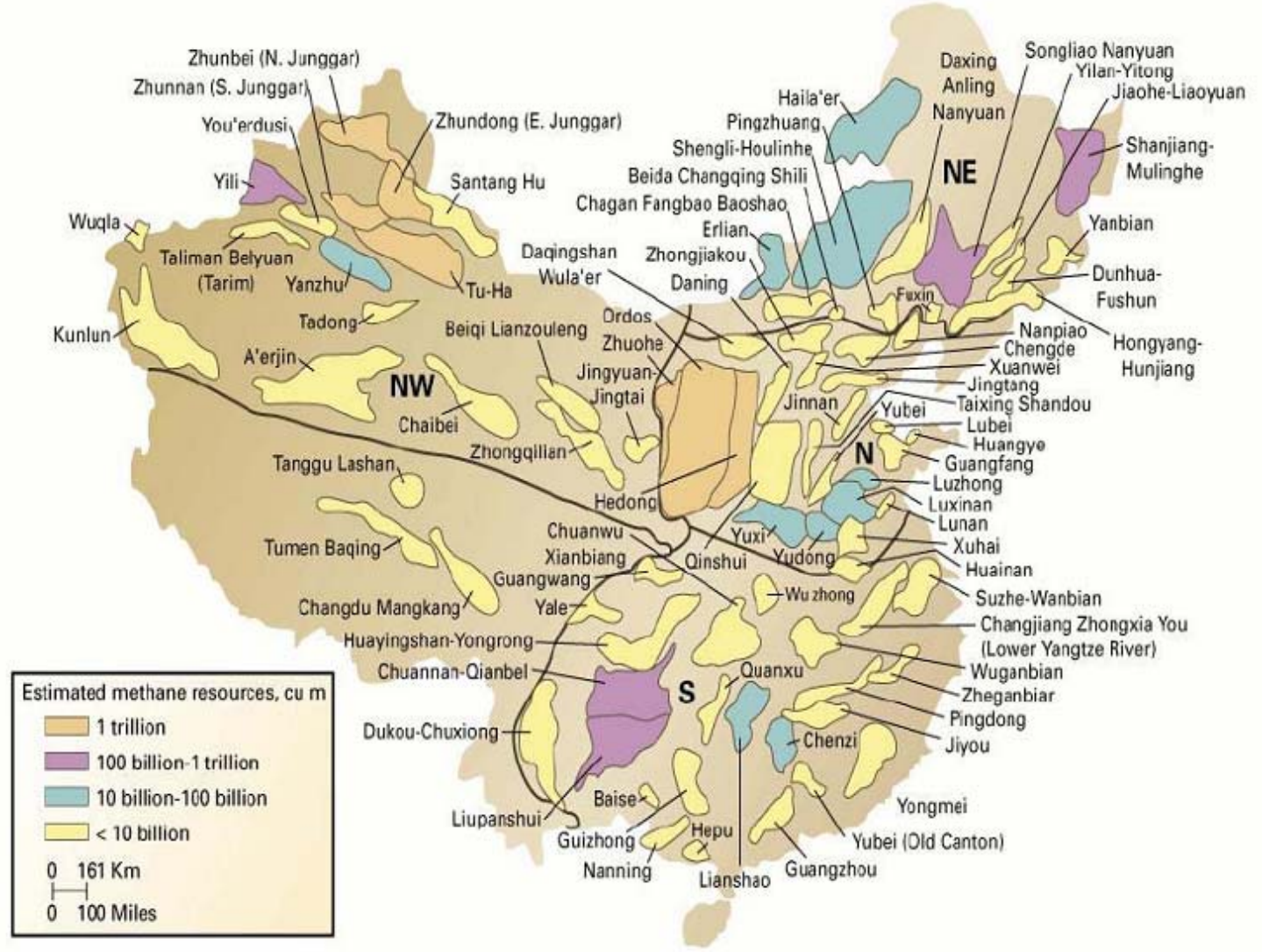
China has extensive coal deposits and is heavily dependent on coal as a primary energy source. Mining activities release large quantities of gas, which contributes significantly to atmospheric greenhouse gas emissions. Gassy coal mines in China are also exposed to unacceptably high explosion risk.

Table 2: China: CBM reserves

Development methods	Units	Proved areas (km^2)	Proved reserves (Tcf)	Recovered reserves (Tcf)	Recovery (%)
Surface development	CUCBM	164	402	218	54%
	CNPC	182	352	176	50%
Total		346	754	395	
Subsurface extraction	Tiefa Coal Mine	135	77		
	Yangquan Coal Mine	94	191	75	39%
Total		230	269		
Grand total		576	1,023		

Source: China United Coal Bed Methane Corporation

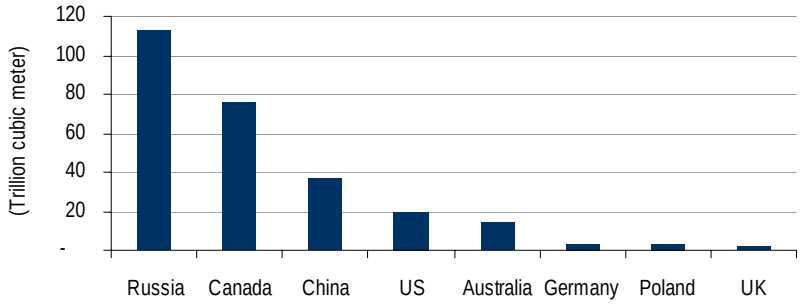
Chart 7: China: Coal basins and CBM resources



Source: Diverso Management

CBM resources *(refer to Appendix for difference between resources and reserves)* in China's explored coal areas, up to a depth of 2,000m, are estimated at 310tn cubic meters (tcm). Proven reserves of CBM are approximately 35tcm. Although CBM drilling in China started in the early 1980s, there was little success until 1996 when a pilot well field was developed in Shanxi Province under the auspices of the United Nations Development Programme (UNDP).

Chart 8: CBM: Global resources

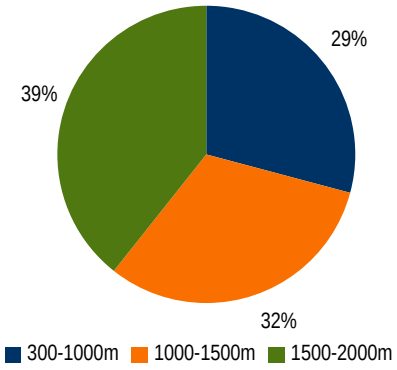


Source: China United Coal Bed Methane Corporation

China targets to produce 10bcm of CBM by 2010

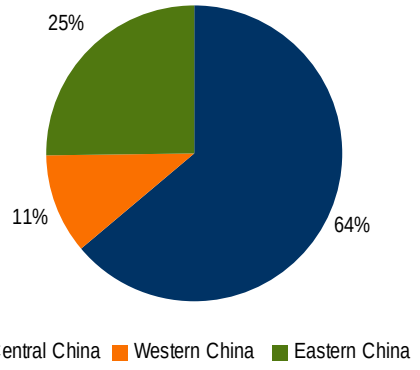
CBM deposits are found in various parts of China, with 25% in the west, 64% in the central region and 11% in the east. Shanxi, Shaanxi and Inner Mongolia are the largest sources. For the development of the CBM industry, China had set a target to produce 1.4bcm annually until 2006, increasing to 10bcm by 2010 and to 20bcm by 2015. Currently, more than 1.3bcm of CBM is emitted each year without being used and is thereby wasted.

Chart 9: China: CBM distribution in different depths



Source: China United Coal Bed Methane Corporation

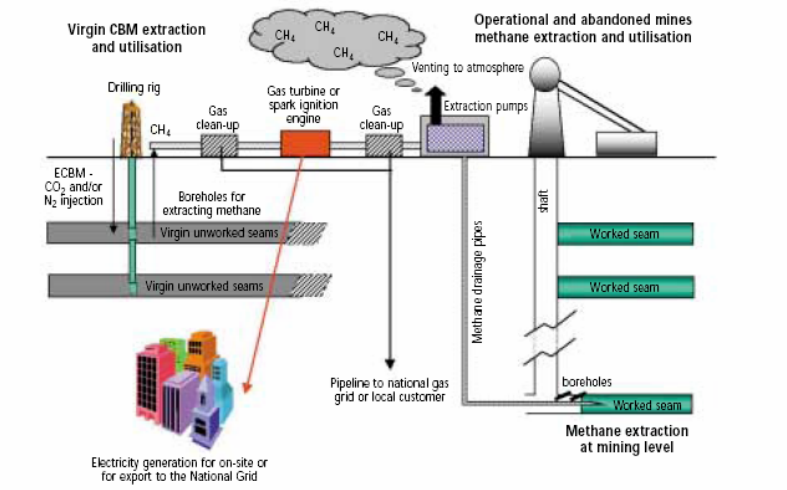
Chart 10: China: CBM distribution in different areas



Source: China United Coal Bed Methane Corporation

CBM production entails both environmental benefits and concerns. Improvement in air quality due to burning of CBM, rather than venting into the atmosphere, released as a result of coal mining activities (methane is 21 times more potent a greenhouse gas than CO_2) poses a benefit, as clean-burning methane substitutes the dirtier fuels.

Chart 11: Options for methane extraction and utilization



Source: Department of Trade & Industry

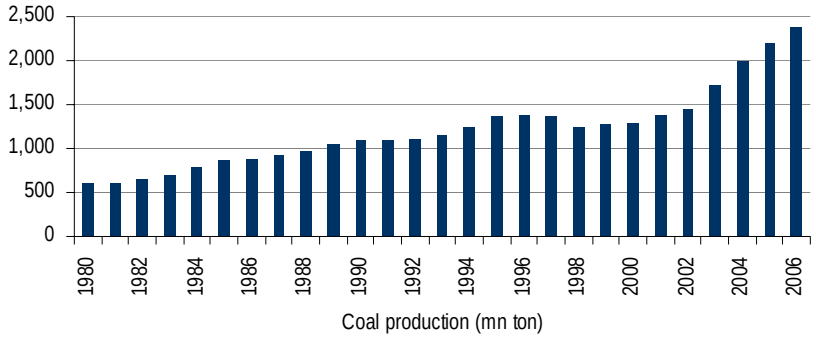
Goals of the CBM industry

The stated-owned firms in China dominate the CBM sector and the country's CBM resources are largely controlled by China United Coal Bed Methane Corporation (CUCBM), although local government and oil companies too are into CBM activities.

By 2010, China's CBM industry plans to achieve the following four goals:

- Nationwide production to touch 10bcm, including 5bcm from the ground and 5bcm from mine wells.
- Nationwide utilization to reach 8bn cu m, including 5bcm from the ground and 3bcm from mine wells.
- Proven reserves to increase to 300bcm; and
- Building an industrial system for CBM development.

Chart 12: China - coal production



Source: CEIC

Government supports clean coal initiatives

The Chinese government is encouraging the development of coal processing, coal blending and coal briquette technologies in its efforts to develop clean coal technology. It hopes to improve coal selection and processing, as well as the use of advanced coal-burning and environmentally friendly technologies to raise utilization rates and lower the emission of pollutants. The government also actively encourages the comprehensive utilization of coal resources by developing the usage of coal gangue, coal slurry, CBM, the surface water and other by-products, as well as developing low thermal coal-fired electric power generators and building materials.

Chart 13: China - Distribution of coal resources

Source: International Energy Agency; Note: unit in million tons

Chinese authorities assertive on CBM

There are several key reasons as to why the Chinese authorities are aggressive about developing the CBM market.

An additional natural gas resource

One of the goals of China's energy development strategy is to expand the production and use of natural gas. CBM resources are concentrated in major coal-producing regions, which are also thickly populated and large industrial centers. Recognizing the potential contribution of CBM as an energy resource, the government plans to increase CBM as part of its energy development strategy.

Improved mine safety and profitability

Previously, coal mines viewed the release of CBM into the mine workings as a safety hazard, and vented Coal Mine Methane (CMM) into the atmosphere. Mining coal at increasing depths generally imply higher methane concentrations, which raise safety hazards resulting in higher mining costs and the need for larger ventilation systems. CBM drainage reduces the risk of methane explosions and sudden outbursts of coal and gas, thus improving safety conditions. Methane recovery also enhances coal production, thereby raising mine profits. This is because mines can safely produce more coal without delays in trying to reduce excess levels of methane.

Improved environmental quality locally

CBM is a clean-burning fuel. When burnt, methane emits essentially no sulfur or ash, but only a small percentage of nitrogen oxide, carbon dioxide and volatile constituents emitted due to the burning of coal. CBM has the potential to offset the use of coal by industrial and residential consumers and improving local air quality. A high degree of coal combustion is common in China's cities, which could hamper public health.

Table 3: China: Coal-bearing regions and associated CBM resources

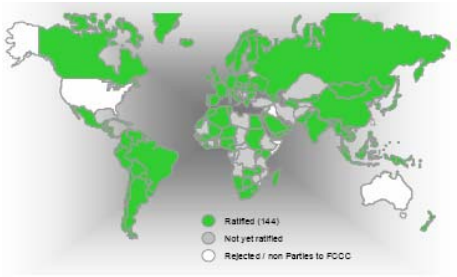
Name	Region of the country	Provinces	Resources (bn cu m)
Sanjiang-Mulenghe Basin	Northeast	Helongjiang	401
Pohaiwan Basin	East	Shandong, Henan, Hebei	1,375
Nanhuabei Basin	East	Jiangsu, Anhui, Henan	1,678
Jinzhongnan Coalfield	Central	Shanxi	4,837
Pinle Basin	South	Jiangxi and Hunan	44
Xiangzhongnan Coal-Bearing Area	South	Hunan	18
E'erdousi Basin	West	Inner Mongolia, Ningxia, Shannxi, Shanxi	11,324
Sichuan Basin	Southwest	Sichuan	145
Sichuan-Guizhou Coal-Bearing Area	Southwest	Sichuan and Guizhou	1,121
Liupanshui Coal- Bearing Area	Southwest	Guizhou	1,334
Zhunger Basin	Northwest	Xinjiang	2,997
Tuha Basin	Northwest	Xinjiang	4,647
Yini Basin	Northwest	Xinjiang	925

Source: China United Coal Bed Methane Corporation

China's role in UN FCCC and the Kyoto Protocol

The UN Framework Convention on Climate Change (FCCC) and the Kyoto Protocol were negotiated in response to concerns on global climatic changes. The Kyoto Protocol set targets for industrialized countries to reduce the emission of greenhouse gases (GHG). To help meet these targets, the protocol also adopted market mechanisms, including the clean development mechanism (CDM).

Chart 14: Status of the Kyoto Protocol



Source: United Nations Framework Convention on Climate Change

These mechanisms have made available additional finance for emission reduction projects worldwide. Industrialized countries can now achieve their promised emission reduction targets globally, wherever they are the cheapest. Thus, the Kyoto Protocol has created a global market for emission reduction. China is a party to the UN FCCC and has ratified the Kyoto Protocol. As a developing country, it has no compulsory methane (CH_4) emission targets.

The Kyoto Protocol became effective on 16 February 2005, post ratification by about 140 countries. Despite the absence of the US and Australia, demand for emission reduction is soaring, and "carbon finance" is available for "clean" projects, including CMM utilization schemes. This project has helped develop a mode concept for CMM schemes under the CDM with some success.

Beijing set on reducing environmental damage

China does realize the cost of environmental pollution and damage to the economy, and is very serious in its commitment toward improving the environment. The country's pollution problems are well known, which provides impetus to the authorities to promote an emission-free energy industry.

While politically the energy security facet is the primordial motivator behind the emphasis on clean energy, we believe the more serious issue is pollution, which is regularly highlighted by the local and global media. Pollution-related costs to the environment are great and within this the issues are:

- China has six of the world's 10 most polluted cities (World Bank).
- Pollution may cost US$54bn/year in environmental damage and health problems (World Bank).
- Acid rainfalls on one-third of the land (World Bank).

Others have highlighted that China is the world's second-largest producer of GHG, with two-thirds of its cities having poor-quality air due to coal dust from the power plants. Also, according to the World Health Organization, air pollution kills about 4mn people every year in China.

Table 4: Top 10 emitters of GHG

		% of world GHG emissions	Tons per capita	2003 pop (mn)
1	United States	24.4	20.1	293
2	China	12.1	2.7	1,300
3	Russia	6.2	9.9	145
4	Japan	5.2	9.4	128
5	India	4.7	1.2	1,071
6	Germany	3.4	9.8	83
7	Britain	2.5	9.2	59
8=	Italy	1.9	7.5	58
8=	Canada	1.9	16.5	32
8=	South Korea	1.9	9.4	48
	Sub-total	64.2		3,217
	World	100.0	3.6	6,313

Source: United Nations Human Development Report 2005

In October 2005, when the 11th Five-Year Plan was released, and again in early December 2005 at the Central Economic Work Meeting, China's leaders indicated that China's targets for the 11th Five-Year Plan would be implemented from 2006 to 2010. One key target is to improve the utilization of resources.

The leadership highlighted that "promoting the conservation of energy and resources is an important measure to alleviate the imbalance in the supply and demand of energy and resources, and it is also an important means to reduce pollution and improve the ecological environment at the source. The central economic work meeting has defined the conservation of energy and resources as one of the main tasks of the economic work for next year. It also outlined the explicit demand that clear results should be achieved next year."[1] [2006].

More recently, Premier Wen Jiabao was also quoted as saying that he has put "sustainable growth and environmental protection at the top of (the government's) agenda"[2]. He added that "it is a very tough task, but (the government is) determined and confident of fulfilling it."

In 2006, the cost of environmental damage made headlines almost every day. A few highlights:

- The China Meteorological Administration said that environmental disasters such as drought, floods and others reduce annual GDP by 3-6%. (10 November 2006)
- In first half of 2006, sulfur dioxide emissions rose 4.2%, implying that Beijing's efforts to cut pollution had so far not been successful. (11 November 2006)
- Beijing's Water Bureau mentioned that China's per capita water resources are less than one-third of the global average and much of the water is polluted. For example, 90% of Beijing's underground water resources are polluted. (23 September 2006)

Energy security - stable supply of energy fuels

We believe that the Chinese leadership is increasingly concerned about securing a stable supply of energy fuels. We throw light on a few happenings in the past:

- **Oil:** China became worried when it turned a net importer of oil in the mid-1990s and the concerns became prominent, following the staggering rise in oil prices in the last couple of years. The government aims to reduce energy consumption per unit GDP by at least 20% by 2010, based on 2005 levels. This implies that it is targeting primary energy consumption of 35-40mmbpd and petroleum consumption of 8-9mmbpd by 2010 (2.9-4.5% CAGR from 2004). These new growth targets appear more reasonable in our view, than the government's earlier conservative estimates. However, we expect larger savings potential from coal than oil. China's petroleum consumption may overshoot the government's target and reach 9-10mmbpd by 2010 (implying a CAGR of 6.2% from 2004).
- **Coal:** China has the second-largest proven coal reserves in the world. But a sharp upturn in demand and downturn in growth have in the past caused chronic supply disruptions in some areas and a steep increase in thermal coal price. Demand for electric power rose significantly since 2003, higher than that expected by the authorities, prompting concerns that China was overly dependent on thermal coal-fired electric power generation. This led to

[1] "*Chinese economic work meeting stresses invigorating rural economy*", 3 December 2005, BBC Monitoring Asia Pacific

[2] "*Wen bullish on meeting pollution cut targets*", 11 November 2006, South China Morning Post

a sharp rise in thermal coal prices from 2H 2003, mostly due to transport infrastructure bottlenecks. The situation turned so severe that some thermal coal plants in Eastern and Southern China did not have sufficient coal to generate power and had to temporarily shut down.

- **Natural gas:** With China anticipated to face a shortfall of 20bcm in gas by 2010, the country will need to primarily rely on supply based on LNG or natural gas transported along long-distance pipelines. During President Vladimir Putin's state visit to Beijing, the two countries signed an agreement to develop two pipeline projects with an eventual capacity of 60-80bcm. The agreement between China National Petroleum Corp. (CNPC) and Russian gas monopoly, Gazprom, would potentially result in gas exports from 2011.

The above is a brief background to the energy security concerns the Chinese authorities have been grappling with over the last two years. Related policies have been instituted to counter the situation and we cite five examples below.

- **Natural gas supply:** The National Development and Reform Commission and other administrative bodies, as well as China's three key oil majors and key natural gas distribution companies like Hong Kong and China Gas, XinAo Gas, Panva Gas and China Gas, are studying ways to speed up the development of natural gas supply infrastructure.

- **Sourcing from overseas:** China has stepped up diplomatic efforts with resource-rich countries in Southeast Asia, North Asia, the Middle East, Africa and South America, offering aid on technology, medical care, education and low-cost financing in exchange for resources.

- **Strategic oil reserves:** The Chinese authorities have focused on building Strategic Petroleum Reserves (SPRs). For example, a tank farm in Zhenhai is already operational with a total storage capacity of 30mmbbls. Total SPR capacity is designed to reach 500mmbbls (more than 80 days of net imports) and all sites will be operational by early 2010.

- **Shipping channels:** China intends to develop a national fleet to import resource products. Currently, about 80% of its crude oil imports are transported by foreign carriers. The government aims to cut this to 50% by 2010 and 20% by 2015. Thus, many Chinese shipping companies are building tanker fleets, including Very Large Crude Carrier tankers (typically 200,000-300,000 DWT).

- **Developing clean and renewable energy sources:** The authorities have aggressively encouraged the development of alternative energy sources, which include ethanol, fuel ethanol, bio-fuels, wind and solar as well as Coal-To-Gas, Coal-To-Liquids and CBM projects. For electric power generation, for example, China is targeting to rapidly increase renewable energy sources as a percentage of its installed capacity over the next 15 years. Evidence of the government's commitment toward renewable energy includes the introduction of the Renewable Energy Law in February 2005, which was enacted in January 2006, as well as the many public policy speeches by senior government officials. The government has said that it would be issuing formal targets and clarifications on renewable energy targets and the tariff mechanism.

Table 5: China: Generation targets by type

(GW)	End 2004A	2010E	Change (x)	2020E	Change (x)
Renewable energy target (total)	10.0	60.0	*6.0*	130.0	*2.2*
Renewable energy target (Merrill Lynch calculated)	9.7-9.8	60.5	*6.2*	130.0-141.0	*2.2-2.3*
Small hydro plants	7.0	50.0	*7.1*	79.0	*1.6*
Wind	0.76	4.0	*5.2*	30.0-40.0	*5.0-10.0*
Biomass	1.9-2.0	6.0	*3.0-3.2*	20.0	*3.3*
Solar PV	0.05	0.45	*9.0*	1.0-2.0	*2.2-4.4*

Source: Merrill Lynch estimates, National Development and Reform Commission, Speech of Energy Bureau in World Renewable Energy Conference 2004, China Sustainable Energy Program

Approval of CBM projects

Prior to 1995, ambiguity surrounded the administration of CBM in China with several government organizations claiming control. During this period, the Ministry of Coal Industry (MOCI) and Ministry of Geology & Mineral Resources (MGMR), and CNPC, as well as several provincial and municipal entities, conducted independent CBM development programs and signed preliminary contracts with foreign partners.

Table 6: China: CBM wells as of 2005

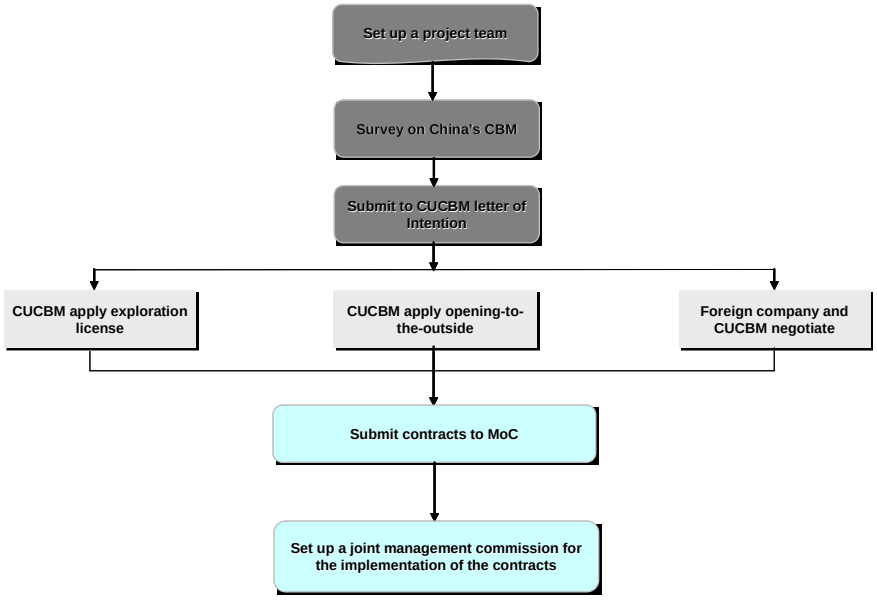
Units	Wells	Percentage
CUCBM	415	70%
Greka	22	4%
CNPC	83	14%
Sinopec	6	1%
Fuxin City	8	1%
GACCG	25	4%
UNDP	12	2%
Others	20	3%
Total	591	100%

Source: China United Coal Bed Methane Corporation

In May 1996, the State Council established the China United Coal Bed Methane Company, Ltd (CUCBM) as a single, trans-sectoral agency, responsible for restructuring the CBM sector by commercializing the exploration, development, marketing, transportation and utilization of CBM. CUCBM is owned equally by Petrochina Company Ltd and China National Coal Group Corporation.

The State Council has also granted CUCBM exclusive rights to undertake the exploration, development and production of CBM in cooperation with foreign partners. CUCBM will jointly map out target areas for international cooperation and will put forth invitations for overseas bidding, negotiation, and signing and execution of contracts for proposed projects upon approval by the State Planning Commission. The government actively encourages foreign participation in CBM blocks via production sharing contracts (PSCs) with CUCBM. The PSC structure enables foreign investors to bring in capital and the best technologies for the extraction of CBM.

Chart 15: CBM project: Approval procedure



Source: China United Coal Bed Methane Corporation

China's CBM contracts are based on the country's onshore petroleum contracts but added features include incentives such as a two-year income tax holiday and reduced value-added tax and royalty.

Table 7: CBM: Foreign cooperative exploration and development

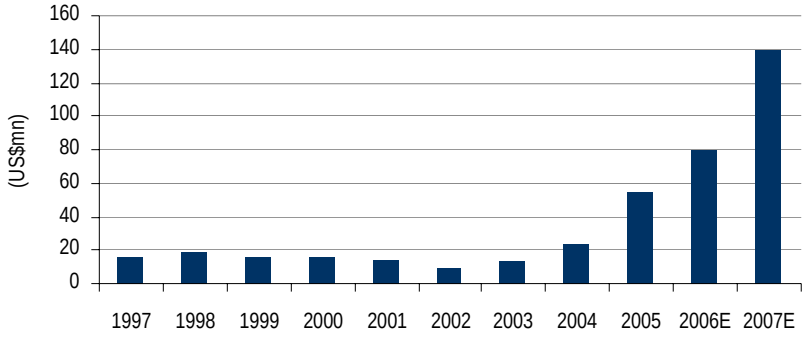
	2006
Total signed PSC	27
Foreign companies	16
Minimum exploration expenditures	US$100mn
Actual expenditures	US$200mn

Source: China United Coal Bed Methane Corporation

A CBM exploration block is typically 2,500 sq km in size and multiple blocks can be leased to cover larger areas. A typical contract structure requires an initial 1-3 year exploration period with a drilling commitment of several wells. Minimum expenditures would total about US$4mn over three years for a 2,500-sq-km block.

The operator can then decide whether to proceed with further work, which might involve long-term production testing of one or more five well pilots. Once the project becomes commercial, CUCBM has the option to opt for majority ownership by contributing its share of total project costs. Gas prices and development costs will be market determined.

Chart 16: China: Foreign investments in the CBM market



Source: China United Coal Bed Methane Corporation

By April 2006, CUCBM signed contracts for 26 blocks with overseas companies, covering a total area of 37,000 sq km, and a total investment of more than US$150mn. By 2006, a total of US$200mn had been invested in CBM development – US$50mn from domestic companies and US$150mn from foreign companies.

In general, most of the high-gas mining areas lack complete natural gas pipeline systems. A short-distance gas pipeline can be used to supply CBM to nearby users and the Tangshan Mine of the Kailuan CMA currently injects CBM into its city gas system. As several of China's CMAs are close to residential and industrial areas, they are ideally suited for construction of a local pipeline network to these users. Before initiating pipeline projects however, several issues must be considered, including transmission costs, distances from production sites to gas markets, and the productive life of the resource.

Table 8: China - Foreign investors in CBM projects

Item	Project name	Contract area ('000 sq km)	Reserves (bcm)	Time of signing	Foreign partner	Province
1	Huaibei	2,663	60	Jan-98	Chevron Texaco	Anhui
2	Sanjiao	448	64	Jun-98	Chevron Texaco	Shanxi
3	North Sanjiao	1,126	55	Jun-98	Chevron Texaco	Shanxi
4	Shilou	3,602	175	Jun-98	Chevron Texaco	Shanxi
5	Linxing	3,325	300	Jun-98	Chevron Texaco	Shanxi
6	Fengcheng	1,541	37	Aug-98	Greka Energy	Jiangxi
7	Liulin	198	30	Nov-99	Lowell	Shanxi
8	Zhungeer	2,817	400	Nov-00	Chevron Texaco	Inner Mongolia
9	Baode	1,079	120	Nov-00	Chevron Texaco	Shanxi
10	Shenfu	3,001	600	Nov-00	Chevron Texaco	Shaanxi
11	Hengshanbao	1,807	230	Jan-01	Virgin	Ningxia
12	Qingshui	2,317	450	Apr-02	Philips	Shanxi
13	Shouyang	1,963	230	Apr-02	Philips	Shanxi
14	Laocheng, Enhong	1,072	140	Dec-02	Far-East Energy	Yunnan
15	Qingyuan	3,665	550	Mar/03	Greka Energy	Shanxi
16	Panxie	584	20	Mar/03	Greka Energy	Anhui
17	South Shizhuang	455	90	Mar/03	Greka Energy	Shanxi
18	North Shizhuang	375	75	Mar/03	Greka Energy	Shanxi
19	Jincheng	151	26	Mar-03	Sino-America Energy	Shanxi
20	Huangshi	305	5	Oct-03	Gladstone	Hubei
21	Mabi	1,371	240	Jul-04	Asian American Coal	Shanxi
22	Baotain-Qingshan	947	160	Sep-05	AsiaCanada Energy	Guizhou
23	Junggar Basin	654	35	Dec-05	TerraWest Energy	Xinjiang
24	Shilou South	1,011	189	Feb-06	Reflection Oil & Gas Partner	Shanxi
25	Suzhou	856	120	Mar-06	Ivana Ventures	Anhui
26	Sanjiao	462	60	Apr-06	Orion Energy International	Shanxi
Total		37,795	4,461			

Source: China United Coal Bed Methane Corporation

In 2005, China built 330 drawing wells for CBM. This exceeded the total number of wells built nationwide over the last 10 years. Most of the CBM wells are found in Shanxi, Shaanxi and Inner Mongolia, which collectively make up 56% of the total wells in the country.

China's gas delivery infrastructure

China's main natural gas backbone, the West to East Gas Pipeline (W2E), began construction in July 2002 and sought to correct the imbalance in the allocation of gas resources. The 4,000-km-long W2E pipeline commenced operation on 1 October 2004, supplying 12bcm of natural gas to 10 provinces across China's Eastern and Western regions. The plan is to increase its capacity to 17bcm by end 2007, which would necessitate the building of 10 new gas compressor stations and upgrading eight existing stations.

Chart 17: China - Gas transport infrastructure

Source: International Energy Agency

With the completion of important pipelines such as W2E pipeline and the Zhongwu pipeline, PetroChina plans to form a national trunk pipeline network by connecting, step-by-step, the main pipelines from the four gas resources – first, W2E pipeline, second Shaanjing pipeline, then Zhongwu pipeline and finally, Seninglan pipeline.

Altogether, four CBM pipeline networks are planned with three running from north to east and one, from north to south in the Shanxi province.

- The north line: Xingxian County–Shuoxian County–Datong City.
- The middle line: Liulin–Jie (xiu) Ping (yao)–Taiyuan–Yangquan–Shijiazhuang.

- The south line: Yuncheng city–Houma city–Jincheng city–Changzhi–Handan.
- The central north-south line: Yuanping–Taiyuan–Jiexiu–Yuncheng city.

Two more pipelines in the offing

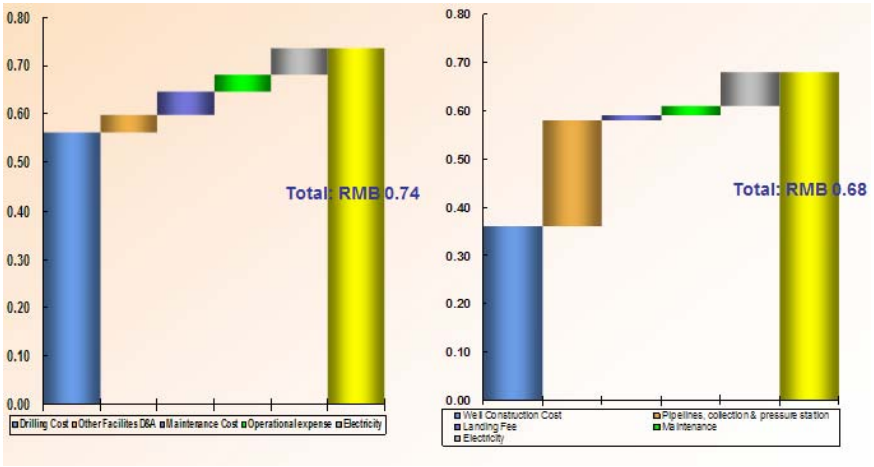
As part of its 11th Five-Year Plan (covering 2006-10), China plans to spend US$375mn to build two pipelines with a total length of 1,390km for coal-bed gas transmission. The first pipeline – linking Qinshui County in Shanxi Province, northern China, to Boai County in Henan Province, to the south – will be connected to the pipeline pumping natural gas from energy-rich West China to East China. The second pipeline will transmit coal-bed gas from Songzao in southwestern Chongqing. Each pipeline is designed to have an annual gas transmission capacity of approximately 30-35bcf.

In Shanxi, an international consortium, including Sinopec, is planning to invest US$1.14bn over the next five years to develop CBM to supply 189MW of power generation. China's first commercial production from the Panhe CBM project in Shanxi Province started in November 2005. Production from Shanxi is expected to reach approximately 175bcf pa by 2010.

China's gas pricing profile

Unlike conventional natural gas, CBM pricing is outside of government regulation and therefore subject to market forces. Rapid economic growth in eastern China has brought to the fore the imbalanced energy distribution between the country's western and eastern regions, with the east experiencing an undersupply of gas. It has been reported that lack of gas supplies in the east has caused significant gas-fired power generation capacities to remain idle. The W2E pipeline commenced commercial operation in October 2003 and feasibility studies are underway for a second west-east pipeline.

Chart 18: CBM production cost per cu m – Vertical well vs horizontal well



Source: Zhongyu Gas

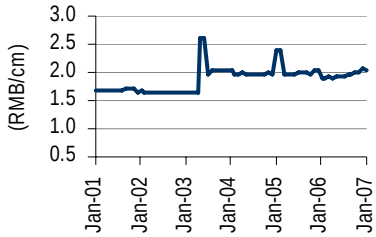
Historically, natural gas prices doubled in response to the operation of the W2E project in late 2003 for higher tube transportation fee, and the rise in W2E out-factory price from RMB0.48/m^3 to RMB0.52/m^3 in April 2005 to RMB0.56/m^3 effective February 2006.

Table 9: China: Natural gas prices in cities near natural gas fields and along pipelines

	Sichuan Basin		W2E					Shaanjing I	Zhong Wu	
(RMB/m^3)	Chengdu	Chongqing	Zhengzhou	Hefei	Nanjing	Fengcheng	Shanghai	Beijing	Wuhan	Changsha
Ex-plant price	0.69-0.92	0.69-0.93	0.52	0.52	0.52	0.52	0.52	0.71-0.77	0.91	0.91
Fertilizer	0.69	0.69						0.71		
Industrial	0.88	0.88						0.73		
City gas	0.92	0.92						0.77		
City gate price				1.20	1.27		1.62	1.35	1.26	1.26
Residential	1.43	1.40	1.60	2.10	2.20	3.80	2.10	2.05	2.30	2.36
Non-residential							3.20×(1±30%)	2.45-3.40		c.2.00
Industrial	1.23	1.00	1.80		2.00	3.90		1.95		2.28
Commercial	2.08	2.05	2.00		3.00	4.00				2.65
Public Service	1.72	1.54	1.75			2.40		2.55		2.55
Vehicular	2.07	1.67	3.00		2.70			2.55		

Source: National Development & Reform Commission ; Local price bureaus

Chart 19: Average natural gas prices in residential areas



Source: CEIC

Natural gas price has been on an uptrend. As seen in other countries, China's government too prices natural gas at a low level in the early stages of natural gas development, in an effort to make it competitive vis-à-vis traditional energy sources. However, with the increasing demand, as also depending on user-affordability, natural gas prices are slated to see a gradual rise. In addition, limited resources of natural gas in China and the government's energy conservation-oriented policies are also expected to drive up the price of natural gas. The rise in oil and gas resources tax in August 2005 too reflects signs of further increase in the price of natural gas.

Compared with other major countries, China's piped natural gas gate price is among the lowest in the world. In terms of retail prices, residential prices are among the lowest, averaging around US$0.25/$m^3$, while non-residential prices are among the highest, averaging about US$0.30/$m^3$, close to the level in the US. As a result, profit margin for sales to commercial users is much wider than that to residential users and better than the global average.

Table 10: Natural gas prices in selected countries

	LNG	Natural gas				
In USD/mmbtu	Japan CIF	European Union CIF	UK Heren NBP index†	USA Henry Hub‡	Canada Alberta‡	China W2E[1]
2000	4.7	3.3	2.7	4.2	3.7	-
2001	4.6	4.2	3.2	4.1	3.6	-
2002	4.3	3.5	2.6	3.3	2.6	-
2003	4.8	4.4	3.3	5.6	4.8	3.7
2004	5.2	4.6	4.7	5.9	5.0	3.7
2005	6.1	6.3	6.7	8.8	7.3	3.8

Source: Merrill Lynch Research, Heren Energy Ltd.; Natural Gas Week; (1) City gate price

NDRC circular to propel the price and use of natural gas…

On 26 December 2005, the NDRC released a circular, which highlighted the reform in pricing mechanism of natural gas and increase in the wellhead price of natural gas. As per the notice, ex-factory prices (wellhead gas tariffs) of natural gas to be used for urban utilities and industry were to be hiked in the range of RMB0.05-0.15/m^3. City gate price for the downstream gas companies were to be increased by 4-12%. NDRC allowed a moderate increase in gas price for residential users.

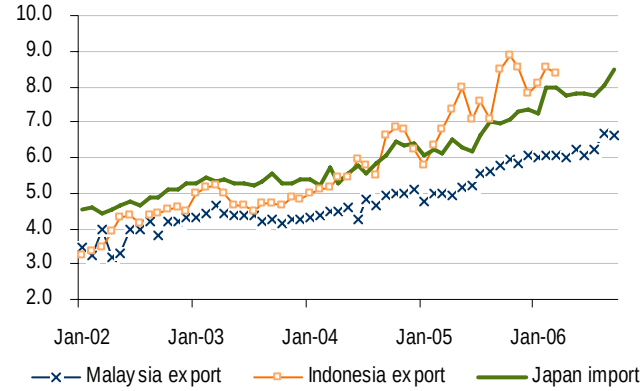
The aim is to optimize the use of gas by improving the policy on gas pricing. NDRC cited that the existing gas pricing system is faced the problem of "double standard" prices, which is unfair to one set of gas users, and a low price level for producers, which discourages them from investing more in gas field development and production. The objective is to gradually abolish the present "double standard" pricing system, gradually increase ex-factory gas prices, introduce market competition step-by-step, and speed up market-oriented price reform by introducing a pricing system that links all related energy prices, including those of coal, oil, gas and electricity.

…also prompted by improving affordability

Affordability seems no longer a key barrier for gas price increases in China. A look at historical gas prices in Korea (Chart 21) reveals that the current gas user prices in China are only equivalent to the price levels in Korea in early 1990s. In fact, the household income gap between many Chinese and Korean cities is diminishing, compared to that seen in the past 10-15 years of economic development.

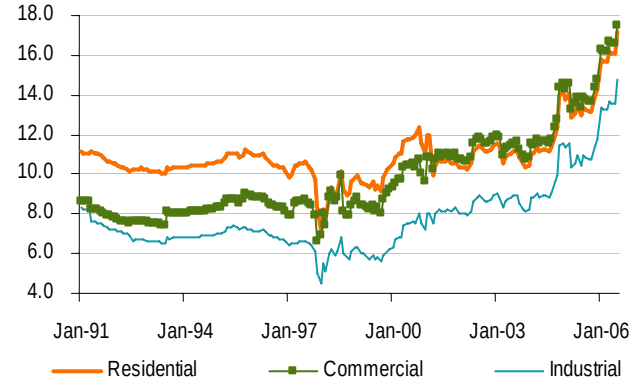
Apart from price hikes, we believe China will reform gas pricing from a volume basis to an energy content basis. A market-oriented "net-back" pricing mechanism could also replace the existing "cost plus" pricing formulas. This is a crucial step in the entire reform course, which will create a few gas distribution hubs and make LNG import price a relevant benchmark for domestic wellhead gas prices.

Chart 20: LNG prices in Asia, based on customs data (US$/mcf)



Source: Merrill Lynch, CEIC

Chart 21: Korea town gas prices by consumer groups

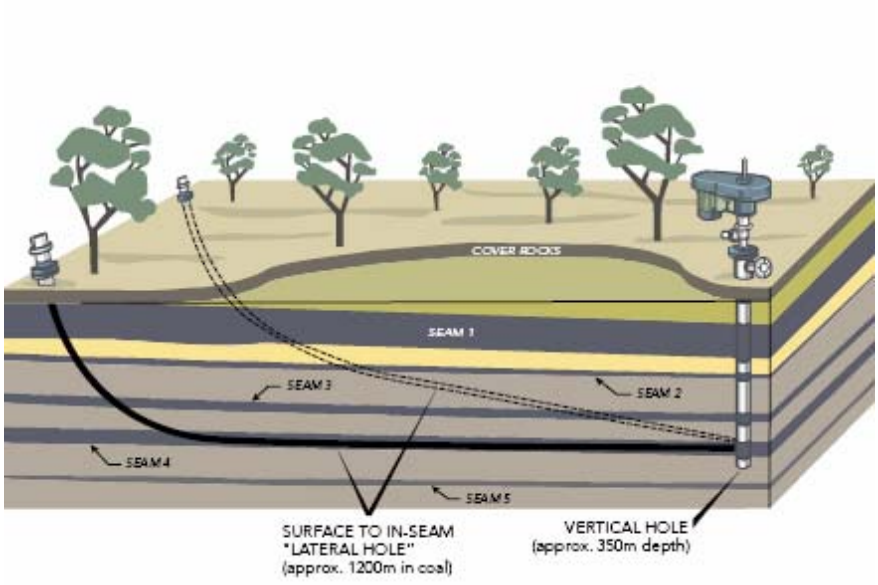


Source: Merrill Lynch, CEIC

Appendix: The dynamics of CBM

Methane (CH_4) is the primary energy source of natural gas and Coal Bed Methane (CBM) is simply methane found in coal seams. Although CBM is sold and used much like traditional natural gas, it is produced very differently. CBM is generally held in place by water pressure and extraction involves drilling a well into the coal seam and perforating and fracturing it to increase local permeability. Water is then pumped out of the coal seam, thereby reducing the pressure and allowing the gas to leave the coal and migrate through fracture systems into the well.

Chart 22: Typical stratigraphic section and lateral well trajectory



Source: www.ch4.com.au

Difference between CBM resources and CBM reserves

It is important to distinguish between CBM resources and CBM reserves. The former comprises gas-in-place whereas the latter represents the proportion of the resource that can be demonstrated as economically recoverable. Only established reserves have a commercial value. Much of the world's proven reserves of CBM is associated with coal mining operations. These reserves are relatively smaller compared with the total CBM resource identified, which could be huge.

Difference between CBM and other natural gas projects

A typical CBM project is akin to a typical natural gas project; both share common production methods and advanced exploration technologies, as well as employ drilling equipment, pipelines and compressor systems. But CBM projects are different from other natural gas projects in the following ways:

- CBM wells are usually shallower and therefore often require smaller rigs and involve smaller surface areas.
- CBM wells are spaced closer together to ensure optimum production and increase gas recovery.

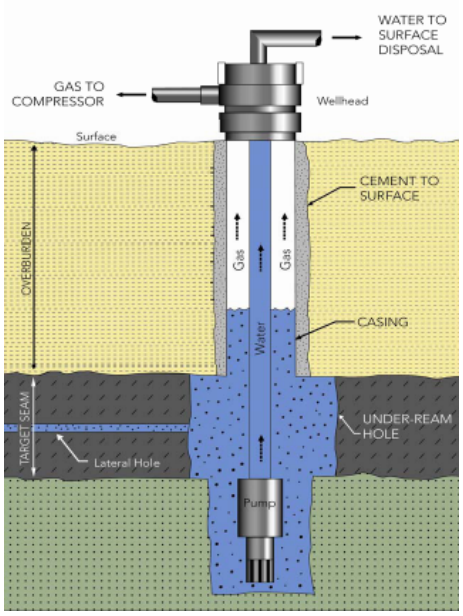
- CBM wells have a longer lifespan of 10-40 years vs an average of 25 years for a conventional well.
- CBM wells produce less gas at a much lower rate than a conventional well.
- A company into CBM drilling may not begin to make money months or years after a successful well while a company into drilling of natural gas generates peak revenue almost immediately.

Table 11: CBM: Comparison with natural gas

	Conventional natural gas	CBM
Heat content	0.036	0.034
Reserves depth	Usually > 1,500 meters	Usually <1,500 meters
Reserves detection	Reliable	Unreliable
Methods of exploration and extraction	Extract after the exploration or in the same time	Extract during the exploration
Existing status	Free gas	Absorbed in the surface of coal
Component	Mainly C1-C4	More than 95% CH_4
Extraction area	A circled area	A large block
Distance among wells	Long, single well	Short, wells net
Output of each well in early stages	High	Low
Methods to improve output	No need usually	Must have
Drilling and producing technology	Ordinary	Complex
Upstream gross margin	18-20%	20-50%

Source: China United Coal Bed Methane Corporation

Chart 23: Vertical drill method to extract CBM



Source: www.ch4.com.au

Recovery of CBM and...

Innovative drilling methods have been successful to the extent that CBM is now a proven and reliable source of competitively priced natural gas for power generation or for supply to industrial and residential markets. Methane is generated during coal formation and is contained in the coal microstructure. Typical recovery entails pumping water out of the coal to allow the gas to escape. As methane is the principal component of natural gas in CBM, the latter can be added to natural gas pipelines without any special treatment.

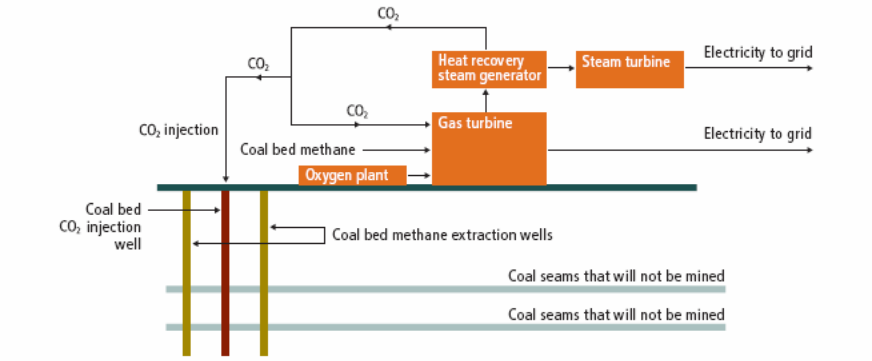
Table 12: CBM: Features of a high-grade site

1. High methane content in coal, ideally greater than 7 cm per tonne.
2. Substantial total coal thickness.
3. Possible permeability enhancement ,eg, by previous longwall mining of a single seam at depth.
4. An anticlinal or other geological hydrocarbon trap structure.
5. Well-jointed, fractured or permeable strata with hydrocarbon reservoir potential.
6. A local customer for modest quantities of high quality gas.
7. No environmentally sensitive features.
8. Good access for drilling.
9. Low-cost water disposal facilities.

Source: University of Nottingham, North China Bureau of Petroleum, China Coal Research Institute

CBM is also used for electricity generation and the carbon dioxide produced through gas combustion may be captured and sequestered into the same coal seams from which the CBM is extracted. Theoretically, coal seams can absorb more than twice as much carbon dioxide (by volume) as the methane extracted from them, offering a unique way of reducing greenhouse gas emissions from electricity production.

Chart 24: Coal bed methane and zero carbon power



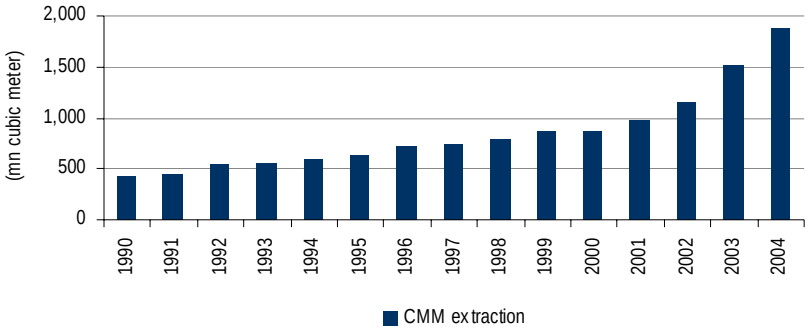
With coal bed methane mixed with oxygen as fuel for the gas turbine, the flue gas becomes pure carbon dioxide (plus water and NO_x)

Source: BHP Billiton

...benefit of CMM

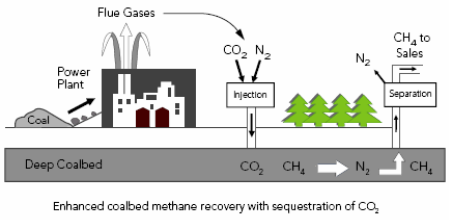
Coal Mine Methane (CMM) is methane released from coal seams during coal mining. CBM is methane trapped within coal seams that have not, or will not, be mined. CMM is a greenhouse gas that is over 20 times more potent than carbon dioxide. Though emitted in much smaller quantities, methane is the second-most harmful greenhouse gas after carbon dioxide. The capture and use of CMM will benefit the local and global environment by mitigating greenhouse gas emission and utilizing an otherwise wasted clean energy resource.

Chart 25: CMM: Extraction from coal mines



Source: China United Coal Bed Methane Corporation

Chart 26: Typical ECBM development

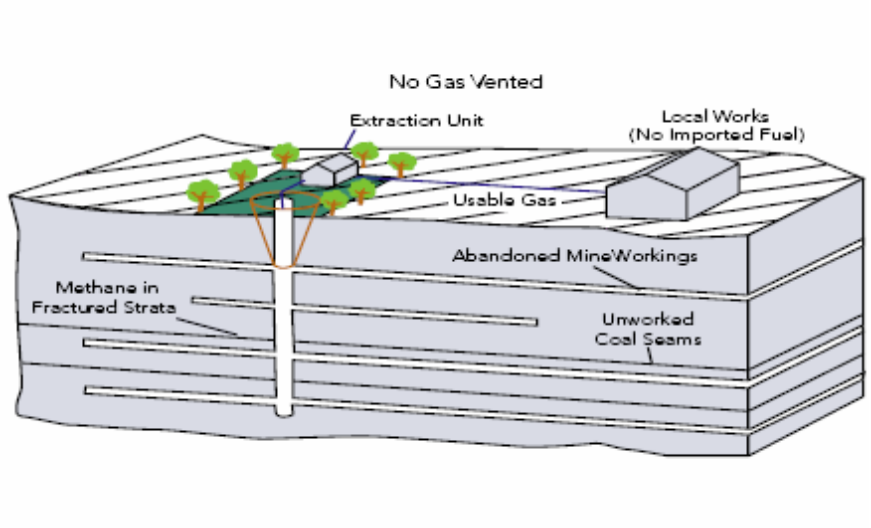


Enhanced coalbed methane recovery with sequestration of CO_2

Source: International Energy Agency

Methane is removed from gassy underground coal mines by large ventilation fans. In some cases, mine ventilation is supplemented by a degasification system that removes the methane prior to mining or during mining activities, or even post mining. When removed in advance of mining, the methane is drained through vertical boreholes drilled into the coal seam. This type of CMM recovery often occurs years ahead of the mining activity. This is very similar to conventional natural gas drilling and production. The methane that is removed in advance of mining is often of very high quality and acceptable for injection into natural gas pipelines.

Chart 27: Typical CMM development



Source: International Energy Agency

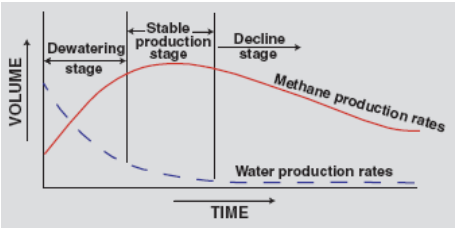
Methane is highly explosive and has to be drained during mining operations to keep working conditions safe. At active underground mines, large-scale ventilation systems move massive quantities of air through the mine, keeping the mine safe but also releasing methane into the atmosphere at very low concentrations. Some active and abandoned mines produce methane from degasification systems, also known as gas drainage systems, which use wells to recover methane.

Table 13: CMM: Extraction and utilization of key coal mines in the state

	2000	2001	2002	2003	2004
CMM extraction (mn m³)	870	980	1,150	1,520	1,866
YoY change (%)		13%	17%	32%	23%
CMM utilization (mn m³)	318	458	`456	629	700
CMM utilization factor (%)	37%	47%	40%	41%	38%

Source: China United Coal Bed Methane Corporation

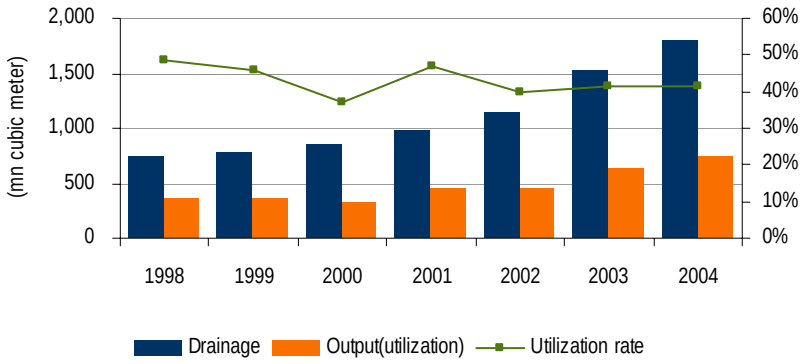
Chart 28: Typical production curve for a CBM well



Source: United States Geological Survey

The quantity of CBM that can be extracted depends on the properties of the coal and the drilling density, but the energy content of the gas will not generally exceed 1% of the total energy content of the host coal. In other words, CBM is a way of obtaining some energy in a readily marketable form, but it is not equivalent to actually mining that coal. All things considered, it is a useful energy resource, given that known coal reserves are an order of magnitude greater than known gas reserves. CBM is also a means of obtaining energy from coal seams that are not suitable for conventional mining.

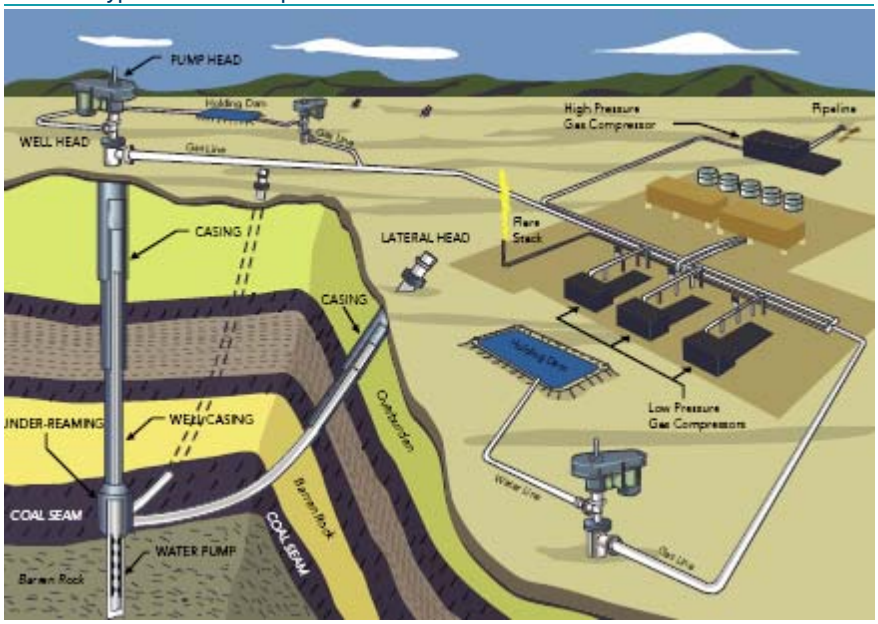
Chart 29: CMM: Drainage, output and utilization rates in China



Source: China Coal Information Institute & National Institute for Occupational Safety

Vertical and/or horizontal wells are used to recover gob gas. Gob gas is initially of high quality; however, over time its quality declines as the methane mixes with air. In some cases, the quality of gob gas may be high enough to be injected directly into pipelines, but in others, it must be processed to remove contaminants or to be used for electricity production or heating.

Chart 30: Typical CBM development



Source: www.ch4.com.au

CBM production entails both environmental benefits and concerns. Extraction of CBM involves pumping large volumes of water from the saturated coal seam in order to release the water pressure holding the gas in the coal seam. What is to be done with this volume of often marginal-quality CBM product water is a source of much debate. Each well produces 5 to 20 gallons of water per minute. At 12 gallons per minute, one well produces a total of 17,280 gallons of water per day. The disposal of large volumes of water from CBM wells in a way that is environmentally acceptable and yet economically feasible is a question. Depending on the characteristics of the site and the chemistry of the water produced, the water may be re-injected into the subsurface, dispersed on the surface, pumped into evaporation ponds, or released directly into local streams.

Table 14: Main CBM Cooperation projects with overseas companies

Item	Project Name	JV Partners	Contract Signing	Block Location	Contract block area (km^2)	CBM resources (bn m^3)
1	Sanjiao, Shanxi CBM Project	China United Coalbed Methane Corp Ltd. Orion Energy International Inc. (US)	Apr-06	Sanjiao area Lishi city of Shanxi Province	462	60
2	Suzhou, Anhui CBM Project	China United Coalbed Methane Corp.Ltd. Ivana Ventures Inc. (Canada)	9-Mar-06	Suzhou city of Anhui Province	856	120
3	Shilou South, Shanxi CBM Project	China United Coalbed Methane Corp.Ltd. Reflection Oil & Gas Partners Ltd. (UK)	22-Feb-06	Shilou South, Luliang area of Shanxi Province	1,011	189
4	Junggar Basin, Xinjiang CBM Project	China United Coalbed Methane Corp.Ltd. TerraWest Energy Corp. (Canada)	30-Dec-05	South of Junggar Basin in Xinjiang Uygur Autonomous Region	654	35
5	Baotain-Qingshan, Guizhou CBM Project	China United Coalbed Methane Corp.Ltd. AsiaCanada Energy Inc.	20-Sep-05	Baotain-Qingshan area of Guizhou Province	947	160
6	Mabi, Shanxi CBM Project	China United Coalbed Methane Corp.Ltd. Asian American Coal Inc. (US)	16-Jul-04	Mabi area of Shanxi Province	1,371	240
7	Huangshi, Hubei CBM Project	China United Coalbed Methane Corp.Ltd. Gladstone Power Energy Corp. (US)	Oct-03	Huangshi area of Hubei Province	304	more than 5
8	Qinshui, Shanxi CBM Project	China United Coalbed Methane Corp.Ltd. Sino-American Energy Co. (US)	3-Mar-03	Qinshui county of Shanxi Province	106	30
9	Four Areas CBM Project	China United Coalbed Methane Corp.Ltd. Greka Energy (Internation) BV (US)	8-Jan-03	Shizhuang South, Shizhuang North and Qinyuan blocks in Shanxi Province and Panxie East block in Anhui Province	5,079	900
10	Yunnan Enhong & Laochang CBM Project	China United Coalbed Methane Corp.Ltd. Fat East Energy Corp. (US)	3-Dec-02	Qujing and Fuyang County, consists of the Enhong, Laochang Yuwang and Laochang Daobanfang blocks in Yunnan Province	1,072	140

Source: Hydrocarbon Asia

Important Disclosures

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