



CHATHAM HOUSE

**THE IMPLICATIONS OF CHINA'S GAS
EXPANSION TOWARDS THE NATURAL GAS
MARKET IN ASIA**

**A CHATHAM HOUSE REPORT FOR JAPAN BANK FOR
INTERNATIONAL COOPERATION**

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1. China's Natural Gas Industry

1.1. A Brief Review on the Natural Gas Industry

1.1.1. The Role of Natural Gas in China's Energy Balance

The role of natural gas in China's energy mix is still negligible. As of 2002, the share in China's primary energy production is a mere 3.2%, and the figure is even smaller in China's primary energy consumption. Even though natural gas consumption grew by over 50% during the 1990s, it was overshadowed by the 85% rise in oil consumption during the same period.

During the 1990s oil consumption shifted significantly from industrial fuel to transportation and petrochemical uses, and electricity became the dominant energy form in households. Due to the limited availability of the supply, natural gas for the most part confined to regional markets, continued to be mainly supplied as industrial fuel and fertilizer feedstock.

The Chinese government has made it very clear that it is determined to increase the role of natural gas in China's energy supply mix within the 10th Five Year Plan (2001-2005) years and beyond. Evidence of this determination includes the construction of the country's first Liquefied Natural Gas (LNG) import terminal in Guangdong and the decision to build the 4000 km long West-East Pipeline (WEP) to bring natural gas from the Tarim basin in the country's far west to Shanghai in its far east.

The most intriguing question on the natural gas expansion in China will be how far it can go. The boundary of this expansion will give the clue to the China's energy balance in the coming decades.

Table 1 - Primary Energy Production in China
(Units: million tonnes of coal equivalent)

Year	Total	Coal	Electricity	Oil	Natural Gas	NG share %
1980	628	441	20	149	18	2.9
1985	855	622	37	179	17	2.0
1990	1039	771	50	198	20	2.0
1991	1048	777	49	201	21	2.0
1992	1072	797	50	203	21	2.0
1993	1110	821	59	207	22	2.0
1994	1187	886	69	209	23	2.0
1995	1285	972	75	214	24	1.9
1996	1326	997	82	225	27	2.0
1997	1324	981	91	229	28	2.1
1998	1243	893	93	230	31	2.5
1999	1091	745	83	229	34	3.1
2000	1070	713	83	233	37	3.4
2001	1209	829	105	235	40	3.3
2002	1390	983	124	239	44	3.2

Source: China National Bureau of Statistics, China Statistical Yearbook 2003.

Table 2 - Primary Energy Consumption in China
(Unit: million tonnes of coal equivalent)

Year	Total	Coal	Electricity	Oil	Natural Gas	NG share %
1980	603	435	24	125	19	3.1
1985	767	581	38	131	17	2.2
1990	987	752	50	164	21	2.1
1991	1038	790	50	177	21	2.0
1992	1092	826	53	191	21	1.9
1993	1160	866	60	211	22	1.9
1994	1227	921	70	214	23	1.9
1995	1312	979	80	230	24	1.8
1996	1389	1038	76	250	25	1.8
1997	1378	985	85	281	23	1.7
1998	1322	920	89	284	29	2.2
1999	1301	885	86	302	29	2.2
2000	1303	861	89	321	32	2.5
2001	1349	881	104	328	36	2.7
2002	1480	978	116	346	40	2.7

Source: China National Bureau of Statistics, China Statistical Yearbook 2003.

1.1.2. Resources

China has an onshore and offshore sedimentary deposit area of about 6.7 million sq. km, of which Mesozoic-Cenozoic sedimentary basins (with a sedimentary thickness of over 1,000 metres and single basin area of over 200 sq. km) cover about 5.22 million sq. km, with onshore basins covering 3.782 million sq. km and offshore basins 1.49 million sq. km. The unmetamorphosed Palaeozoic rocks (surface exposure) are spread over an area of 1.3 million sq. km. Natural gas resources have been discovered in sedimentary rocks with both marine and continental facies, with geological ages ranging from Late Paleozoic, Mesozoic to Cenozoic.

According to the second national natural gas resources survey conducted in 1994 by China National Petroleum Corp (CNPC) and China National Offshore Oil Corp (CNOOC) in China's 69 sedimentary basins (excluding basins in the Spratly Islands), China's conventional natural gas geological resources stand at 38.04 trillion cubic metres (tcm), of which 79% or 29.9 tcm are deposited in onshore and the rest 21% or 8.14 tcm in offshore.

Map 1 – See Annex 1

Source: Quan Lan and Keun-Wook Paik, China Natural Gas Report

Of these 38 tcm reserves, around 89% of the geological resources were found in 13 basins: Songliao, Bohai Bay, Odros, Sichuan, Tarim, Junggar, Turpan-Hami, Qaidam, Middle Yangtze River Reaches, East China Sea, Yinggehai, Qiongdongnan, and Pearl River Mouth.

Geologically these 13 basins can be divided into five regions:

- The **eastern region** comprises Songliao and Bohai Bay (onshore are) with natural gas reserves in place of 4.36 tcm, making up 11.5% of the country's total;
- The **central region**, including Ordos and Sichuan, traps geological gas reserves of 11.52 tcm, accounting for 30.3% of the national total;
- The **western region** covers the remote and less developed Tarim, Junggar, Turpan-Hami and Qaidam basins, where combined gas reserves reach 10.74 tcm, 28.2% of the total;
- The **southern region** refers to the Middle Yangtze River Basin with geological reserves of 3.28 tcm, 8.6% of the total;
- The **offshore area**, which until recently was under-explored, includes the Bohai offshore area, the East China Sea basin, the Yiongghehai basin, the Qiongdongnan basin and the Pearl River Mouth basin. The region has natural gas geological reserves of 8.14 tcm, 21.4% of the total.

Among the 13 basins, both Ordos and Sichuan are truly gas provinces as their gas-oil ratios exceed 1 (Ordos being 1:0.46 and Sichuan being 1: 0.15). Basins like Tarim, Xihu Sag in the East China Sea, Yinggehai and Qiongdongnan belong to the category of oil/gas basins with a gas-oil ratio of around 50:50.

From Tables 3 & 4, it is interesting to note that the figures on the remaining recoverable reserves from the State Development Planning Commission (SDPC) are quite different. These figures were presented at the Fourth United State-China Oil and Gas Industry Forum held in Houston in 2002. The figure from the Department of Industrial Development is much more conservative than that of Department of Basic Industries. Both departments belong to the SDPC and are responsible for energy and infrastructure.

Table 3 - Geographical Distribution of Natural Gas Resources in China
(Units: trillion cubic metres)

	Total reserves	Proven reserves			Controlled reserves	Predicted reserves
		Geological	recoverable	Remaining recoverable		
Sichuan	7.1851	0.5787	0.3995	0.2179	0.1238	0.2070
Ordos	4.1797	0.3415	0.1866	0.1844	0.1567	0.4268
Tarim	8.3896	0.2183	0.1435	0.1374	0.2484	0.4013
Yinggehai	2.2390	0.2503	0.1824	0.1691		
E. C. S	2.4803	0.0474	0.0198	0.0198		
Others	12.6003	0.4771	0.2739	0.1934		
China Total	38.1240	2.0605	1.2857	1.0012		

Note: Yinggehai lies in the South China Sea, and E.C.S. means the East China Sea.

Source: Xu Dingming, "China's Natural Gas Industry in Development", presented at the Fourth United States – China Oil and Gas Industry Forum, jointly sponsored by the State Development Planning Commission, The US Department of Energy, and the US Department of Commerce, Houston, July 18-19, 2002.

Table 4 - Geographical Distribution of Natural Gas Resources in China
(Unit: trillion cubic metres)

	Total Reserves	Proven Reserves		
		Geological	Recoverable	Remained Recoverable
Sichuan	7.1851	0.7026	0.4802	0.2824
Ordos	4.1797	0.3924	0.2196	0.2155
Qaidam	1.0500	0.1472	0.0800	0.0795
Tarim	8.3896	0.4909	0.3469	0.3408
S. China Sea	2.2390	0.2510	0.1827	0.1659
E. China Sea	2.4803	0.0842	0.0521	0.0518
Others	12.6003			
China Total	38.1240	2.5512	1.6375	1.3505

Source : Zhang Yuping, "Current Situation, Outlook, and Policies for Natural Gas in China", presented at the Fourth United States – China Oil and Gas Industry Forum (2002)

It is worth noting that where exploration is concerned, Chinese geologists use three concepts to define natural gas reserves : proven, probable, and possible (See Table 5)

- Proven reserves (or Tanming Chuliang) refer to reserves calculated after gas field appraisal;
- Probable reserves (or Kongzhi Chuliang) refer to reserves calculated during the process of gas field appraisal and after industrial gas flows are struck;
- Possible reserves (or Yuce Chuliang) refer to reserves estimated for gas traps based on seismic survey and geological analysis.

Table 5 - Different concepts of Oil Reserves Classification: A Comparison of the United States, the CIS and China.

United States	CIS	China
Proven (measured)	A + B + C1 (partly)	Class I Tanming Chuliang
Probable (indicated)	C1 (partly)	Class II Kongzhi Chuliang
Possible (inferred)	C1 + C2	Class III Yuce Chuliang
Hypothetical (undiscovered)	C2 + D1	Class IV Qianzai Ziyuanliang
Speculative (undiscovered)	D2	Class V Tuce (Ziyuanliang)

Source : Keun-Wook Paik, *Gas and Oil in Northeast Asia : Policies, Projects and Prospects* (London : RIIA, 1995), p. 13.

1.1.3. Governing bodies and Industry Players

National Development and Reform Commission

China's highest planning body, the SDPC (State Development Planning Commission), used to cover the following gas related functions:

- To formulate overall gas E&P plans and coordinate efforts among gas organizations;
- To formulate gas production allocation plans on an annual basis;
- To formulate 5-year development plans for the gas industry and supervise the implementation of the plan;
- To set annual and five year plans for foreign investment;
- To set natural gas prices.

After the government restructuring in March 2003, the majority of SDPC functions were taken over by National Development and Reform Commission (NDRC) responsible for devising industrial policies and plans, price regulation, green field project approval with investment over 200 million yuan, upstream overall development proposal approval.

The Ministry of Geology and Mineral Resources

The Ministry of Geology and Mineral Resources (MGMR) has the authority to overview the exploration and production of the mineral and oil & gas resources within the country, including its territorial waters, as stipulated in the Mineral Resources Law. The MGMR assesses the nation's natural gas reserves. The department related to natural gas under the MGMR is the National Mineral Resources Committee. The Committee, although functioning under the MGMR, reports directly to the State Council. All E&P activities should be registered with and obtain operating permission from the Oil and Gas Office under the Committee.

China National Petroleum Corporation

The China National Petroleum Corporation (CNPC & PetroChina) is a ministerial level company with the following gas functions:

- Dominant player of onshore gas E&P (including islands and adjacent waters up to a depth of five metres);
- To entrust the China National Oil and Gas Exploration and Development Corp (CNODC) to negotiate with foreign companies for onshore gas cooperation. CNODC is authorized to sign contracts with foreign companies;
- As CNPC's main subsidiary, PetroChina controls 71% of China's proven natural gas reserves, and owns 11,516 km of natural gas pipeline as of 1999.

China National Petroleum and Chemicals Corporation

- After the 1998 restructuring, the China National Petroleum and Chemicals Corporation (SINOPEC) secured the asset base in the gas business.
- The acquisition of Star Company opened the door for SINOPEC's E&P activity in Sichuan, Ordos, Tarim basins, Zhongyuan field and East China Sea's Xihu Sag.
- The 1998 industry restructuring helped SINOPEC's entry into the gas business.

- In terms of gas reserves, SINOPEC's position is relatively weak but is pursuing an aggressive market expansion, in particular Yangtze River Delta, Shandong province and Chuanyu region (referring to Sichuan and Chongqing).

China National Offshore Oil Corporation

The China National Offshore Oil Corporation (CNOOC) is a sub-ministerial level corporation with the following gas functions:

- Offshore gas E&P;
- To offer offshore gas acreage for foreign participation;
- To negotiate and sign contracts with foreign companies for the import of LNG;
- CNOOC has four regional E&P subsidiaries.

Table 6 - Governing Bodies and Industry Players in China's Oil and Gas Sector

Year	Governing Bodies	Industry Players
1949	Ministry of Fuel Industry (for oil, coal and power)	
1955	Ministry of Oil	
1970	Ministry of Fuel (oil and coal) and Chemical Industry	
1975	Ministry of Oil and Chemical Industry	
1975	Ministry of Oil	
1980	Ministry of Oil reporting to National Energy Commission which also oversees ministries of coal and power	
1982	Ministry of Oil reporting directly to the State Council. (National Energy Commission was abolished)	• Creation of China National Offshore Oil Corp (CNOOC)
1983	Ministry of Oil	• Creation of China National PetroChemical and Chemicals Corp (SINOPEC)
1988	Ministry of Energy (Ministry of Oil abolished)	• Creation of China National Oil and Natural Gas Corp (CNPC)
1992	State Council via the State Planning Commission (Ministry of Energy was abolished, functions transferred to the SPC)	
1993	State Council via the State Planning Commission (State Economic and Trade Commission was established)	• Creation of China Oil, a JV trading company between CNPC and SINOPEC (China National Chemicals Import and Export Corp) • Creation of UNIPPEC, a JV trading company between SINOPEC and SINOPEC
1996	State Council via the State Planning Commission	• Creation of China National Star Petroleum Corp (CNSPC) by the Ministry of Geology and Mineral Industry

1998	State Administration for Petroleum and Chemical Industries (SAPCI) under the State Economic and Trade Commission (SETC)	Regrouping CNPC and SINOPEC according to geographical partition to form CNPC group and SINOPEC group
1999-2000	SETC, with involvement of State Development Planning Commission (SAPCI was abolished in October 2000)	- Creation in 1999 of CNOOC Ltd by CNOOC - Creation in 1999 and public listing in 2000 of PetroChina by CNPC group - Creation and public listing of SINOPEC Ltd by SINOPEC group - Acquisition of CNSPC by SINOPEC group in 2000
2001	SETC, with involvement of SDPC	Public listing of CNOOC Ltd
2003	NDRC (National Development and Reform Commission), regrouped from SDPC and SETC (both were abolished)	

Source: IEA (2002); China Energy Report and Interfax China Report.

The 1998 and 2003 reform on the roles of institutional players have tried to reflect the necessity of domestic competition and international competitiveness in the energy sector. By the 1998 reform, the upstream/downstream duopolies were abolished, and CNPC and SINOPEC were given monopolistic control of integrated upstream and downstream operations based on a geographical division, with SINOPEC dominating the east and south, and CNPC dominating the northeast and west.

At the time of restructuring, SINOPEC's proven natural gas reserves were only 25 billion cubic metres (bcm) compared to CNPC's 688 bcm, but SINOPEC's figure was increased significantly after SINOPEC group company acquired the China National Star Petroleum Corp (CNSPC) in March 2000. This acquisition expanded SINOPEC's natural gas reserve base by 19%, placing it ahead of CNOOC (As of 2000, however, the proven reserves of CNOOC is bigger than that of SINOPEC). Another important point of 1998 reform was that the restructuring was aimed at separating government administration from operations, thus allowing the two companies to decide on investment and production plans based on financial consideration rather than government fiat.

Since China disbanded its energy ministry in the early 1990s, however, policy has been fragmented between several bodies including the State Development and Planning Commission (SDPC), the State Economic and Trade Commission and the Ministry of Foreign Trade and Economic Cooperation. All three organizations are now defunct. The central government saw the necessity to co-ordinate the policy issues of the energy sector, but it did not lead to an establishment of a new energy ministry. The 2003 March reform witnessed the establishment of the Energy Bureau under the newly established National Development and Reform Commission (NDRC). The State Energy Bureau is headed by Li Tiejun, head of the Macro Economic Institute under the defunct SDPC. Li's past posts also include SDPC deputy secretary-general, as well as head of the SDPC's Economic Forecast Department.

1.1.4. Exploration and Production

Exploration

The history of gas exploration activities in China can be divided into five stages. The first phase can be considered to have started in the 1950s no systematic exploration was conducted until the end of the 1940s. Between 1950 and 1960, Chinese gas exploration teams found ten gas fields in the Sichuan province, bringing the national production of gas from 10 to 290 million cubic metres per year (mcm / y)

The second phase started in the 1960s when the gas exploration activities were enhanced. During the period about 20 new gas fields were discovered in Sichuan. The biggest discovery was the Weiyuan gas fields with reserves of 40 billion cubic metres, located in the Sinian strata of the Sichuan basin. Thereafter China started to sell Weiyuan gas to other areas after purification. Its development ushered in an era of widespread gas consumption in China.

The third phase was in the 1970s when large gas exploration and production increased the number of the gas fields in China from 20 to 80. The annual gas production from those 80 fields reached 12 bcm. Pipeline grids were established in the Sichuan province and northeast China, and the natural gas produced was piped to the country's nine big fertilizer and chemical fibre plants. Several large cities in Sichuan including Chengdu, Zigong and Chongqing began to use gas as a cooking fuel.

The fourth phase began in the 1980s when the number of gas fields increased to 106 and annual gas production rose to 15.2 bcm. New gas-prone structures were discovered in both onshore and offshore areas. A breakthrough discovery was made in 1983 when Yacheng 13-1 in the South China Sea struck high-yield gas flows and later became the country's biggest offshore gas field.

The beginning of the fifth stage of the gas E&P activities lies in the promotion of the 4000 km west-east pipeline. To find enough gas resources for this long distance pipeline, CNPC has focused on the gas exploration and development in the Tarim basin. By the end of 2000, China had found 20 larger scale gas fields whose total proven reserves reached 1,420 bcm. Of these 20 gas fields, 15 fields belong to PetroChina with total proven reserves of 1,110 bcm.

As of 2000, around 76% of China's 355 gas fields are small with a proven reserves less than 5 bcm. The rest 85 fields are divided into two groups: one group with over 30 bcm recoverable reserves (5.6% of the total) is made up of the large 20 fields, and the other group with 5-30 bcm recoverable reserves (18.3% of the total) is represented by 65 medium gas fields. In China, the definition of large-scale gas fields is applied to the recoverable reserves over 30 bcm. Consequently, the 20 fields can be classified as large filed.

Table 7 - China's large-scale gas fields, as of 2000

Company	Basin	Field name	Gas Bearing acreage (sq. km)	Proven geological reserves (bcm)
PetroChina	Bohai Bay	Qianmiqiao	29.7	33.3
		Sebei 1	38.9	49.2
	Qaidam	Sebei 2	39.8	42.3
		Tainan	38.8	42.5
	Sichuan	Wei yuan	216.0	40.9
		Wolonghe	29.3	38.1
		Moxi	188.3	37.6
		Wubaiti	151.6	58.7
		Shapingchang	70.6	397.7
	Tarim	Yaha	48.9	357.8
		Hetianhe	143.4	61.7
		Kela 2	47.1	250.6
	Ordos	Yulin	797.9	73.7
		Jingbian	4350.6	238.5
		Wushenqi	583.7	67.2
SINOPEC	Sichuan	Xinchang	183.5	46.2
	East China Sea	Chunxiao	19.3	33.0
CNOOC	Qiongdongnan	Yacheng 13-1	45.2	88.5
	Yinggehai	Dongfang 1-1	287.7	99.7
		Ledong 22-1	165.8	43.1

Source: Ministry of Land and Natural Resources, quoted by China OGP.

It is worth noting that in China there are only four major gas fields – like Shapingchang, Yaha, Kela 2, and Jingbian gas fields- with over 100 bcm proven reserves. Considering that in 2001 the Ministry of Land and Natural Resources verified the proven reserves of Sulige and Mizhi gas field in the Ordos basin are 220.4 bcm and 35.8 bcm respectively, the total number of large fields should stand at 22.

Production

China's formal natural gas production started in 1949 with a mere 16.71 mcm. Since then the production has been growing steadily, exceeding 100 mcm in 1962 and rising to 1.44 bcm in 1968. During 1968-79 period, the annual production growth rate was 23.4% and as a result production in 1979 reached 14.52 bcm. Between 1980 and 1989, however, production was stagnating and in 1982 it even declined to 11.93 bcm. It was only in 1989 that it returned to the level of 1979 (14.5 bmc).

Since then China's gas production has been steadily increasing, and in 1996 the figure reached at 20 bcm level for the first time. As shown in Table 8, the production recorded 33 bcm.

Table 8 - Natural Gas Production in China: by Field & Company
(Unit: billion cubic metres)

	1998	1999	2000	2001
Daqing	2.330	2.235	2.304	2.397
Huabei	0.313	0.351	0.443	0.524
Liaohe	1.201	1.100	1.155	1.273
Xinjiang	1.338	1.500	1.622	1.904
Dagang	0.354	0.378	0.404	0.416
Jilin	0.211	0.234	0.200	0.217
Changqing	0.460	1.207	2.056	3.676
Yumen	0.011	0.011	0.018	0.039
Qinghai	0.268	0.360	0.391	0.642
Sichuan	7.530	7.564	7.995	9.080
Yanchang	-	-	-	-
Jidong	0.046	0.051	0.056	0.056
Tarim	0.261	0.436	0.750	1.184
Tuha	0.659	0.834	0.920	1.091
CNPC Total	14.984	16.260	18.314	22.498
Shengli	0.918	0.733	0.688	0.912
Henan	0.030	0.056	0.053	0.095
Zhongyuan	1.190	1.243	1.338	1.612
Jiangnan	0.082	0.092	0.091	0.084
Jiangsu	0.017	0.022	0.024	0.025
Dian-Qian-Gui	0.087	0.082	0.079	0.086
SINOPEC Total	2.324	2.228	3.926	5.004
CNSPC	0.920	1.415	1.652	2.191
CNOOC & Others	3.863	4.392	5.485	5.846
China Total	22.091	24.296	27.726	33.348

Source: China OGP (Xinhua News Agency), China Natural Gas Report: A 2002 Update, March 2003.

In the wake of the 1998 industry restructuring, CNPC's monopoly on the onshore natural gas production was terminated but CNPC's dominance on China's total gas production still continues. As shown in Table 9, in 2001 SINOPEC's production figure surpassed that of CNOOC. It is mainly because SINOPEC managed to take over CNSPC in March 2000.

Table 9 - Natural Gas Production in China: by Company
(Unit: billion cubic metres/year)

	CNPC	SINOPEC	CNOOC
1995	16.15	-	0.38
1996	16.44	-	2.60
1997	17.18	-	4.05
1998*	14.98	2.32	3.86
1999	16.26	2.23	4.39
2000	18.31	3.93	3.96
2001	20.58	4.61	4.21

Note: CNPC's production figure decline is the result of restructuring in Chinese oil industry having transferred part of CNPC's upstream assets to SINOPEC.

Source: China OGP, China Natural gas Report: A 2002 Update

To satisfy China's growing demand for natural gas, China has come up with a plan for natural gas production in the 10th Five Year Plan period (2001-2005). During the period, China aims at adding 1.905 tcm of proven gas reserves and 1.18 of recoverable gas reserves. At the end of the period, China's cumulative proven reserves should reach 4.467 tcm, of which 2.834 tcm from CNPC, 0.699 tcm from SINOPEC, 0.749 tcm from CNOOC and 0.12 tcm from CBM (coal-bed methane).

Table 10 - Natural Gas Production Target: by Company
(Unit: billion cubic metres/year)

	2005	2010	2015
CNPC	41.9	48.5	60.0
SINOPEC	3.0	5.0	15.0
SINOPEC Star	6.0	9.0	15.0
CNOOC	7.3	15.5	10.0
CUCBM	3.3	10.0	20.0
China Total	61.5	88.0	120.0

Note: The China OGP's original figure of CUCBM in 2010 was 5.0 bcm, and the 2010 total was 83.0 bcm.

Source: China OGP, China Natural Gas Report: A 2002 Update

According to China's plan on natural gas production, China will produce 61.5 bcm of gas in 2005, almost doubling the current gas production. CNPC should produce 41.9 bcm or 68% of the total. The total production target figure in 2010 and 2015 is 83 bcm and 120 bcm respectively. It is worth noting that the Chinese planners aim at producing 20 bcm of coal bed methane by 2015 and it remains to be seen whether the target production can be achieved.

Production Cost

Owing to low gas prices, China's market price could not represent the actual costs involved in the production process which have been increasing since the late 1980s. The gas production cost was only 24.79 yuan / 1000 cm in 1970 and it grew 13.7 time to reach 340.69 yuan / 1000 cm in 1994. During 1975 – 85, the annual growth rate was 8.3% while the figure rose to 13.4% during 1986-90. In particular, from 1991 to 1994, the growth rate was as high as 27%.

It is worth noting that gas production costs during 1980-84 were around 56-62 yuan / 1000 cm, while China's national average gas price remained at 50 yuan / 1000 cm. Surely low gas prices and high production costs contributed to China's gas production stagnation during the 1980s.

The cost of associated gas is generally higher than that of gas field gas. During the period of 1976–85 the average production cost in oil fields was 54.44 yuan / 1000 cm, compared with 49.05 yuan / 1000 cm in the Sichuan gas basin.

Table 11 - China's Gas Production Costs
(Unit: yuan / 1000 cm)

	Daqing	Shengli	Liaohe	Zhongyuan	Sichuan
1985	41.0	58.2	76.1	119.0	60.6
1988	149.0	137.0	70.7	169.0	61.1
1991	171.0	230.0	141.0	266.0	92.1
1994	296.0	350.0	409.0	616.0	87.0

Source: Quan Lan and Keun-Wook Paik, *China Natural Gas Report* (1998).

During 1985-94 Daqing's average gas production cost was 144 yuan / 1000 cm, while that of Sichuan was 115.4 yuan / 1000 cm. During the same period, China's national average production cost was 139.2 yuan / 1000 cm. The lesson from the 1980s when China's gas production was stagnated is not to repeat the failure of reflecting the true cost of production in the market price for China's gas production expansion.

1.1.5. Coal-Bed Methane Resources

China has 35 tcm of coal-bed methane (CBD) resources at depths of less than 2,000 metres providing the potential for utilizing the energy equivalent of 45 billion tonnes of standard coal. Nearly 70% of these resources are found in North China.

There are 19 coal fields with verified CBM reserves of 10 bcm or more, ranging from Hegang in China's far northeast to Songzao in Sichuan in the southwest. Six of these fields are commercially productive, each having at least 100 bcm. Central China and its adjacent areas claim about two-thirds of China's total CBM resource base. The estimated volume in this region is 20 tcm, most of which is trapped in the Hedong and Weibei coal-bearing zone in the Ordos basin, the Heshun-Changzhi coal-bearing zone in the Qinshui basin, the eastern base of the Taihang Mountains, the Pingdingshan area in Henan, the western part of Tianjin and Fuxin in Liaoning. The best prospective areas include Liulin in Shanxi, Hongling in Anyang, and Panji and Chenghe in southern Anhui.

Table 12 - Coal-Bed Methane Reserves in major mining areas

Mining area	Province	Reserves (bcm)	Number of Coal-prone fields
Huainan	Anhui	500.0	60
Yangquan	Shanxi	290.0	54
Hedong	Ordos Basin	220.0	7
Huaibei	Anhui	158.4	57
Tiefa	Liaoning	28.3	4
Kailuan	Hebei	30.0	46
Jincheng	Shanxi	24.0	54
Songzao	Sichuan	22.7	25
Pingdingshan	Henan	17.2	59
Hebi	Henan	10.6	53

Source: Quan Lan and Keun-Wook Paik, *China Natural Gas Report* (1998).

In May 1996 the State Council approved the establishment of the China United Coal-Bed Methane Corp (CUCBM), an institution responsible for the development of China's coal-bed methane resources in the national interest. Jointly set up by the Ministry of Coal

Industry, the Ministry of Geology and Mineral Resources and the China National Petroleum Corp, the CUCBM was granted exclusive rights to undertake exploration, development and production of coal-bed methane in cooperation with foreign partners.

By the end of 2000, a total of 184 large size state-owned coal mines have been equipped with underground CBM drainage system and surface transport system for the extracted coal-bed methane. In 2000, a total of 860 mcm of coal-bed methane was extracted and the coal-bed methane drainage volume in the Fushun coal mine (Liaoning province) and the Yangquan coal mine (Shanxi province) exceeded 100 mcm respectively.

China began to use coal-bed methane in the 1970s. Currently the drained coal-bed methane is mainly used as household fuel and industrial boiler fuel and only a small amount is being used as chemical feedstock and for power generation. In 2000, China consumed about 400 mcm of coal-bed methane, less than half of the total volume of the drained coal-bed methane.

The CUCBM signed its first coal-bed methane PSC (production sharing contract) with Texaco China Ltd in March 1998 for the coal-bed methane exploration and development in Huaibei coal-bearing area in Anhui province. In January 2001, authorization for the first development of scheme in Qinshui basin of Shanxi province was made. The coal-bed methane field in Qinshui contains proven reserves of 40.2 bcm, and the field's production is expected to reach to a 1 bcm/y.

By the end of 2001, CUCBM had signed 11 PSC with seven foreign firms including Texaco, BP, Phillips, Arco, Greka, Virgin and Lowell. These projects mainly located in Shanxi and Inner Mongolia have completed nearly fifty wells and undertaken geological studies of the basins, but none has yet to establish a commercial venture. Including the two contracts with US Phillips for Shouyang and Qinnan blocks in Shanxi province, one contract with Far East Energy (US) for Enhong & Laochang block in Yunnan province, and four contracts with Greka Energy (US) for Shizhuang south and north, Qinyuan blocks in Shanxi province, one contract with Gladstone Power Energy Corp USA Holdings for Huangshi and Yuancang-Nanhu blocks in Hubei province, one contract with Sino-American Energy Inc (US) for Jingcheng block in Shanxi Province, and Panxie East block in Anhui province, CUCBM has signed a total of 20 PSCs until the end of 2003.

Coal-bed methane development in China faces serious challenges that could delay projected production targets of 3-4 bcm in 2005, 10 bcm in 2010 and 20 bcm in 2015. Chinese basins are much more complex and fractured, yields are lower, and fewer detailed geological studies have been undertaken. Technically, CUCBM requires assistance in dealing with water treatment problems and other environmental issues. Besides this, CUCBM also lacks the financial resources to pay for extensive exploration, while potential production is also constrained by the general lack of infrastructure, in particular pipelines. As the infrastructure for conventional natural gas expands, this latter problem could be alleviated.

The construction of the west-east gas pipeline will help coal-bed methane development and utilization significantly. Currently the extracted coal-bed methane is consumed where it is produced. As coal-bed methane has a CH₄ content of more than 95% and a calorific value as high as 8,000-9,000 calorie/cm, coal-bed methane is well positioned to be injected into the west-east pipeline that will pass through areas where coal-bed

methane resources are abundant, and intensive coal-bed methane exploration work has been done in recent years.

In October 2003, CUCBM signed a production sharing contract (PSC) with Gladstone Power Energy Corporation USA Holdings for the development of Huangshi and Yuancang-Nanhu blocks in Hubei province. Huangshi government in Hubei province said that it is trying to utilize clean gas (including coal-bed methane) in power generation and town gas sectors. As Zhongxian-Wuhan gas pipeline, which is to be put into operation in 2004, will travel through the city, the local authority wants to take advantage of the inter-provincial infrastructure development. This will provide a convenient access for the coal-bed methane to be produced by the contracted area and be transported to other markets. The west-east gas pipeline development will help the creation of consumption market for the coal-bed methane.

1.1.6. Consumption

In China the state used to allocate gas production directly to large consumers and to provincial planning committees for re-distribution to local users. The largest consumers were primarily fertilizer production facilities. This allocation systems which has been in operation since 1949 has come under criticism now that China is shifting to a market-oriented economy. The downside of allocation is that it deprives producers of the right to choose consumers or vice versa, and that it is not based on economic demand.

This allocation system together with the absence of a national trunk pipeline grid have to suppressed China's gas consumption. Natural gas is consumed where it is produced. Table 11 & 12 confirms the uneven gas demand, and in 2000 big cities and provinces like Heilongjiang, Liaoning, Shandong, Beijing & Hebei, Chongqing & Sichuan and Henan have consumed over 1 bcm of gas annually.

Table 13 - Energy Demand Balance: by Region in 2000

	Coal (%)	Oil (%)	Natural Gas (%)	Hydro (%)
Northeast China	75.8	18.9	3.4	1.9
Bohai Rim	78.8	19.4	1.5	0.3
Yangtze River Delta	71.3	24.5	1.0	3.2
Mid-South China	77.3	14.2	0.5	8.0
Central China	92.0	6.5	0.4	1.1
Northwest China	66.5	21.0	3.6	8.9
Southwest China	71.2	7.3	7.0	14.5
Southeast Coastal Region	50.3	33.0	2.6	14.1

Note: The definition of National Statistics Bureau's definition is very different from that of DNRC: Northeast (Heilongjiang, Jilin, and Liaoning); Bohai Rim (Beijing, Tianjin, Hebei, and Shandong); Yangtze River (Shanghai, Jiangsu, and Zhejiang); Mid-South (Hubei, Hunan, Anhui, Henan, and Jiangxi); Central (Inner Mongolia, Shaanxi, Shanxi, and Ningxia); Northwest (Xinjiang, Gansu, and Qinghai); Southwest (Sichuan, Chongqing, Yunan, Guizhou, and Tibet); Southeast Coastal Region (Fujian, Guangxi, Guangdong, and Hainan).

Source: CNPC, quoted by China OGP (2002)

Table 14 - Gas Demand in China: by Region in 2000
(Unit: billion cubic metres per year)

Region	Province	Actual Gas Demand
Northeast China	Heilongjiang	2.0
	Jilin	0.5
	Laioning	1.2
	Sub-Total	3.7
Bohai Rim	Beijing	1.5
	Tianjin	0.6
	Hebei	2.1
	Shandong	1.4
	Sub-Total	5.6
Yangtze River Delta	Shanghai	0.3
	Jaingsu	0.0
	Zhejiang	0.0
	Sub-Total	0.3
Mid-South China	Hubei	0.0
	Hunan	0.0
	Anhui	0.4
	Henan	1.1
	Jiangxi	0.0
	Sub-Total	1.5
Central China	Inner Mongolia	0.0
	Shaanxi	0.5
	Shanxi	0.0
	Ningxia	0.6
	Sub-Total	1.1
Northwest China	Xinjiang	2.9
	Gansu	0.2
	Qinghai	0.5
	Sub-Total	3.6
Southwest China	Sichuan	5.5
	Chongqing	3.1
	Yunan	0.5
	Guizhou	0.5
	Tibet	0.0
	Sub-Total	9.6
Southeast Coastal Region	Fujian	0.0
	Guangxi	0.0
	Guangdong	0.0
	Hainan	0.3
	Sub-Total	0.3
China Total		25.7

Source: CNPC quoted by China OGP

Beijing an agriculture country, China uses the majority of gas production in the production of fertilizer. In 2000, as shown in Table ?, almost three quarters of the production was consumed by industrial users, of which fertilizer plants make up roughly 40%. The share of gas for power represents a mere 4%.

Table 15 - China's Natural Gas Demand: by sector in 2000
(Unit: billion cubic metres)

	Gas for Power	Chemical feedstock	Industrial fuel	City gas
Northeast China	0.25	1.51	1.55	0.39
Bohai Rim	0.06	1.03	2.22	2.36
Yangtze River Delta	0.00	0.00	0.00	0.30
Mid-South China	0.00	0.43	0.50	0.57
Central China	0.06	0.55	0.24	0.30
Northwest China	0.54	0.86	1.98	0.24
Southwest China	0.12	5.56	1.70	2.15
Southeast Coastal Region	0.00	0.30	0.03	0.00
Total	1.03	10.24	8.22	6.21

Source: CNPC quoted by China OGP

According to National Statistics Bureau's data, the primary industry including farming, forestry, animal husbandry, fishery and water conservancy in China consumed almost no natural gas in 1999. Natural gas remains primarily a fuel of the industrial sector. The high percentage devoted to the industrial sector reflects the government's historical priorities for energy allocation, and its current share roughly parallels the industrial share of other energy forms.

As discussed later in the long term energy supply and demand project, Chinese energy planners are optimistic about the natural gas market expansion, and projects that the expansion will be mainly driven by the power generation and city gas sector. The price burden will be a major obstacle of gas for power market development. City gas sector seems to be less sensitive than the gas for power sector.

City gas consumption is highly concentrated in the eastern coastal provinces which are the target markets for a number of natural gas supply projects. In particular, Shanghai and Jiangsu provinces alone will consume a total of 5.5 bcm of city gas in residential uses at the end of planned west-east pipeline, while other major city gas consuming areas include Beijing (0.6 bcm), Liaoning province (0.8 bcm), and Sichuan (1.0 bcm). The priorities of local and national market development, including the pricing policy, will determine the extent and speed of China's gas market development. This price factor will be decisive in gas for power market expansion, as discussed later.

It is worth mentioning the role of LPG and coal gas in line with China's gas market expansion. Currently both LPG and coal gas are two major residential fuels in the majority of cities in China. By 2000, the total length of coal gas pipeline reached 48,384 km and that of LPG pipeline recorded 7,419 km. The urban population consuming coal gas, LPG and natural gas reached 176 million, of which 23% by coal gas, 63% by LPG and the rest 13% by natural gas.

LPG consumption in China has seen an annual growth rate of 18% during the 1990-2000 period thanks to open market and the participation of private investments. The household sector is the largest LPG consumer which consumed over 10 mt of LPG in 2000.

Table 16 - Gas consumption in Urban areas: 1995-2001

	Coal Gas		Natural Gas		LPG	
	Total Supply (bcm)	For residential use (bcm)	Total Supply (bcm)	For residential use (bcm)	Total Supply (mt)	For residential use (mt)
1995	12.7	4.6	6.7	1.6	4.99	3.7
1996	13.5	4.7	6.4	1.4	5.8	3.7
1997	12.7	4.7	6.4	1.8	5.8	4.7
1998	16.8	4.8	6.9	2.0	7.9	5.5
1999	13.2	4.9	8.0	2.1	7.6	5.0
2000	15.2	6.3	8.2	2.5	10.5	5.3
2001	13.7	4.9	10.6	3.0	9.8	5.5

Source: National Statistics Bureau, quoted by China OGP

However, coal gas supply will gradually decrease as natural gas use in the cities are growing continuously. It is projected by 2005 coal gas supply will decline by 10-20% from current volume. The role of coal gas in China's city gas sector will continue to be significant, but its diminished role will be inevitable as more cities will switch from coal gas to natural gas. Considering that the total urban population in China in 2010 is projected to be 630 million and the annual growth rate of gasification during 1996-2000 was 3.5%, around 100 million more of the urban population will be using natural gas, LPG and coal gas.

1.1.7. Pipeline and Storage Development

Due to the limited proven gas reserves and uneven distribution of those reserves, China has not established a comprehensive natural gas transmission line until the end of the 1990s. However, Chinese energy planners took the initiative by pursuing the 4,000 long distance pipeline connecting the remote Tarim basin with the coastal provinces. (The details of this trunk pipeline will be discussed later)

As shown in Table 3, CNPC already prepared a blue-print for a total of 20,700 km nation-wide pipeline network, of which trunk pipeline is 16,500 km and branch pipeline network is 4,200 km. The total gas transportation and distribution capacity will be 150 bcm/y.

Currently China has 47 gas pipelines with diameter at least 426 mm, with a total distance of 8,036 km. The figure of pipelines with diameter less than 426 mm is 3,764 km. Of the 47 pipelines, only 14 pipelines were constructed since the 1990s but the combined distance is representing over 58%. The 853 km Shaanxi-Beijing pipeline is regarded as the first trans-regional pipeline in China and heralds a new era of long distance pipeline development in China. Once the West-East pipeline, the second Shaanxi-Beijing pipeline and Sino-Russian gas pipeline development is completed, it will make a significant contribution to developing a nation-wide trunk pipeline network.

Table 17 - China's Six Regional Pipeline Networks

Region	Total Distance (km)	Diameter (mm)
Xinjiang, Qinghai and Gansu provinces	6,300	700-1,400
Shaanxi, Ningxia, Inner Mongolia and Hebei provinces	3,300	300-1,400
Sichuan, Chongqing, Hubei, Hunan and Jiangxi provinces	3,100	300-1,400
Shanghai, Jiangsu, Zhejiang and Anhui provinces	2,900	300-1,400
Heilongjiang, Jilin and Liaoning provinces	2,600	600-1,200
Bohai Bay area, including Beijing and Tianjin, and Shandong and Hebei provinces	2,500	300-1,400
Total	20,700	300-1,400

Source: CNPC (1999)

There is no chance to challenge CNPC's status as the dominant player of pipeline network development, CNOOC is focusing on coastal pipeline network development. The firm aims at developing a total of 3,759 km pipeline network, of which 2,259 km for onshore section and the rest 1,500 km for offshore section by 2007 (The main coast section distance is 1,500 km), and by 2010 the total distance will be 4,189 km and it could deliver 17 bcm of gas. CNOOC is targeting a total of 2,500 km main coast trunk line by 2015, but the section above Yangtze River Delta will be heavily depending on central authority's approval on its LNG supply to Yangtze River Delta and Shandong Province. CNOOC's approach to develop a coastal trunk pipeline will help a very comprehensive and nation-wide trunk pipeline network before the end of next decade.

Table / and / tells the total distance of combine of gas pipeline network in the central region covering Sichuan-Chongqing basin and Shaanxi-Gansu-Ningxia Basin is roughly 3,630 km while that of Songliao basin and Bohai Bay basin is 958 km and 921 km respectively. The Table / also shows that the average utilization rate of the pipelines built during the planned-economy days is much lower that of the pipelines built in recent years.

Table 18 - Natural Gas Pipeline with a diameter capacity over 426 mm

	D (mm)	O (Year)	Length (km)	Capacity (bcm/y)	U (%)
Songliao Basin					
Shuangyang - Changchun	426	1990	37.5	0.105	26
Daqing - Wolitun	529	1979	47.0	0.660	23
Honggang - Wolitun	426	1976	27.0	0.410	63
Xinglongtai - Panjin	529	1973	91.0	0.100	77
Xinglongtai - Anshan	529	1972	88.0	1.000	n.a
Xinlongtai - Xinmin	426	1975	123.0	0.030	n.a
Xinlongtai - Tai'an	426	1971	61.0	0.070	15
Panjin - Sanchang	426	1970	6.4		
Panjin - Panshan	426	1974	6.5		
Ciyutuo - Shenyang	426	1985	54.0		
Ciyutao - Anshan	426	1984	293.0		

Longlian - Wangtuozi	426	1995	44.2		
Qianda - Methanol Plant	426	1966	79.0		
Sub-Total			957.6		
Bohai Bay Basin					
Yongqing - Beijing 2	529	1993	70.0	3.000	53
Dagang - Tianjin	529	1974	44.7	0.500	34
Dagang - Cangzhou	529	1976	87.0	0.500	24
Gudao - Zibo	426	1976	142.0	n.a	50
Zhongyuan -Cangzhou	426	1986	362.0	0.730	82
Pu'erlian - Pu'erhua	426	1986	5.5	n.a	6
Cangzhou - Zibo	508	2002	209.8	1.050	37
Sub-Total			921.0		
Sichuan - Chongqing Basin					
Zhongba - Deyang	720	1978	19.8	1.600	4
Lianglukou - Fuyin	720	1979	312.7	2.880	10
Fuyin - Na 3	508	1967	39.0	1.080	52
Na - 1 - Fujiaomiao	720	1978	53.2	1.080	n.a
Fujiamiao - Anfuba	426	1976	89.8	0.590	77
Fujiamiao - Caojiaba	630	1969	137.1	1.730	3
Yuexi - Chengdu	630	1966	134.4	2.160	3
Yuexi - Chengdu - Qingbaijiang	720	1976	162.9	1.460	28
Shenyakou - Jiugongmiao	426	1973	138.5	0.913	45
Quxian - Shehong - Qingbaijiang	720	1987	297.2	1.460	5
Moxi - Shehong	426	1990	81.3	0.561	73
Cheng - 13 - Quxian	426	1987	45.0	0.182	45
Dazhou - Quxian	508	1988	30.0	0.438	n.a
Weiyuan - Rongxian	529	1966	43.5		
Songjiachang - Wangjiaqiao	720	1976	18.9		
Dazhouji - Anfuba	426	1965	24.2		
Jiulongpo - Banan	426	1963	84.2		
Ruxi - Dianjiang	426	1984	102.7		
Dazhou - Lianglu	529	1998	64.3		
Sub-Total			1,968.6		
Shaanxi-Gansu-Ningxia Basin					
Jingbian - Beijing 1	660	1997	853.0	3.000	53
Jingbian - Xi'an	426	1997	488.0	0.800	50
Jingbian - Yinchuan	426	1997	320.0	0.500	78
Sub-Total			1,661.0		
Qaidam Basin					
Sebei - Ningxia - Langzhou	711	2001	953.0	2.000	20
Sub-Total			953.0		
Tarim Basin					
Shanshan - Urumqi	457	1996	301.6	0.600	n.a
Tazhong - Lunnan	426	1996	302.0	0.400	n.a
Lunnan - Korla	610	1998	193.0		

Sub-Total			796.6		
South China Sea Basin					
Yacheng 13-1 - HK	711	1995	778.0	3.000	97
Sub-Total			778.0		

Note: D means Diameter, O means operation, and U means utilization
Source: China OGP

Table 19 - Gas Pipeline under construction or to be built in the near Future

	Diameter (mm)	Length (km)	Capacity (bcm/y)	Ownership & status
Lunnan - Shanghai	1,106	3,920	12-20	PetroChina Under construction
Zhongxian - Wuhan	711	695	3.0	PetroChina Under partial construction
Chunxiao - Shanghai	914	436	2.0	CNOOC To be built by 2004
Dongfang 1-1 - Dongfang City	711	116	2.4	CNOOC To be built by 2004
Shaanxi – Beijing 2	914	897	8.0	PetroChina To be built by 2005
Shaanxi – Hohhot	n.a.	497	0.95 –1.3	Inner Mongolia Government Under construction
Lanzhou – Gantang	660	168	2.0	PetroChina To be built
Changzhou – Hangzhou	711	180	3.0	PetroChina On stream in 2005
Dingyuan – Hefei	711	90	3.0	PetroChina On Stream in 2005
Yancheng – Nantong	457	190	0.6	SINOPEC To be built
Lishui – Wenzhou	355.6	148	1.0	SINOPEC To be built
Bozhong 28-1 - Longkou	355.6	100	1.5	CNOOC To be built by 2005
Huizhou 22-1 - Zhongshan	n.a.	200	0.5	CNOOC To be built
Russia - China	n.a.	3,700	20-30	CNPC Under negotiation

Source: China OGP

In line with the above-mentioned nation-wide pipeline network development, the Chinese energy planners are also paying attention to the natural gas storage facility development. According to the storage development plan until 2015, China aims at building four gas storage in Northeast China (Daqing field 1 bcm and Laiohe field 0.8 bcm), Bohai Rim (Huabei field 1 bcm and Dagang field 0.9 bcm), Yangtze River Delta (Jiangsu field 1.3 bcm and Aqueous stratum 4.8 bcm), and Mid-south China (Jingnan field 0.3 bcm), and the combined capacity is 10.2 bcm.

In 2000, CNPC built its first underground storage facility - Dazhangtuo gas storage, located in the Dagang oil field in Tianjin - to regulate natural gas supply to both Beijing

and Tianjin. The storage's total capacity is 1.8 bcm. This storage will serve for the existing Shaanxi-Beijing pipeline and the second Shaanxi-Beijing pipeline. The Chinese energy planners fully aware that the lack of storage for Beijing-Tianjin network had worsened the performance of the Shaanxi-Beijing pipeline as maximum daily demand in winter exceeds the 3 bcm capacity of the pipeline while summer demand remains less than 1 bcm. Besides this, the second storage facility in a salt structure in Jiangsu oil field has also been approved. This storage with a capacity of 1.3 bcm will be used for the west-east pipeline.

1.2. Long Term Development Plan: Supply & Demand Projection to 2020

The Chinese Government published the Tenth Five Year Plan (2001-2005) natural gas development plan titled as "Accelerate the Development of Natural Gas Industry and vigorously improve the Energy Consumption Structure". According to this plan, China aims at discovering 1.2-1.4 tcm of proven gas reserves from the areas which has already made gas discoveries with the Tenth FYP period (the cumulative reserves would be 4 tcm), producing 50-55 bcm/y of gas by 2005, and increasing natural gas share in energy balance from 2.5% to 4-4.5%. Besides this, China plans to construct a total of over 10,000 km natural gas pipeline, including the West-East pipeline network, and onshore and offshore pipeline from the gas fields in the East China Sea and South China Sea. The implementation of this plan will lay the ground for the nation-wide gas pipeline network development in China by 2015.¹

This Tenth FYP's target figure of increasing natural gas share to 4-4.5% is somewhat lower than that of China National Petroleum Corp (CNPC)'s long term projection. As shown in Table 20, the share of natural gas in China's energy mix will be 4.8% in 2005, 7.4% in 2010 and 12.0% in 2020 respectively. Surprisingly the projection envisages almost a 20% reduction of coal share during 2000 and 2020 would be covered by the increased role of oil and gas. .

Table 20. China Energy Demand

	2000	2005	2010	2015	2020
Total (10 ⁹ tce)	1.28	1.51	1.70	1.88	2.01
Coal (%)	67.0	62.7	57.1	53.2	47.8
Oil (%)	23.6	24.9	27.5	28.9	31.3
Gas (%)	2.5	4.8	7.4	9.4	12.0
Hydro (%)	6.9	7.7	8.0	8.5	8.9

Source: Liu Hequn, "Accelerating to develop the Gas market and improve the Energy Structure in China" presented at the 7th International Conference on Northeast Asian Natural Gas Pipeline organised by Northeast Asian Gas and Pipeline Forum, Tokyo, December 3-5, 2001.

To meet this ambitious target, as shown in Table 21, CNPC sees that the natural gas demand will be 107 bcm in 2010 and 211 bcm in 2020. It is worth noting there is a big difference in the demand projection between CNPC's 2000 and 2001 version. The 2001 demand projection is significantly lower than that of 2000. However, there is no big difference between the CNPC and SDPC's projection figures (compare Table 21 & 24). It indirectly confirms CNPC's projection is fully reflected in SDPC's final plan and the role of CNPC in China's natural gas market expansion in the coming years.

It is worth noting that the Chinese planners are projecting that the driving force of China's natural gas expansion are power generation and city gas sector. Table 21 shows that almost two thirds of the demand will be covered by both power and city gas sectors. It would require a huge effort to develop the market considering that natural gas demand in both sectors is currently very low.

¹ Zhongguo Shiyou Bao, July 6th, 2001.

Table 21 - CNPC's Projection on Gas Demand in China (2001)

	2005		2010		2015		2020	
	Volume (bcm / y)	%	Volume (bcm / y)	%	Volume (bcm / y)	%	Volume (bcm / y)	%
Power Generation Sector	17.72	27.8	34.49	32.3	49.42	32.2	68.49	32.5
Chemical Sector	14.26	22.4	18.17	17.0	25.30	16.5	33.72	16.0
Industrial Sector	15.79	24.8	22.45	21.0	32.06	20.9	43.62	20.7
City Gas Sector	15.89	25.0	31.70	29.7	46.64	30.4	64.87	30.8
Total	63.66	100	106.81	100	153.42	100	210.7	100

Source: Liu Hequn, *Accelerating to develop the Gas market and improve the Energy Structure in China*.

Table 22 - CNPC's projection on China's Gas Demand Projection by Region (2000)
(Unit: billion cubic metres)

	2000	2005	2010	2015	2020
Northeast	3.7	8.1	17.1	24.8	30.9
Bohai-rim	5.6	11.8	19.0	34.2	49.2
Yangtze River	0.3	10.8	20.1	35.8	48.6
Central South	1.5	5.1	10.3	21.9	35.6
Central	1.2	3.5	5.0	9.0	13.5
West	3.6	7.6	10.5	12.2	13.2
Southwest	9.5	10.6	12.2	15.9	17.9
Southeast	0.3	6.8	17.9	31.2	42.8
Total	25.7	64.5	112.1	185.0	251.7

Note: For the following projection, CNPC conducted a gas market demand investigation in 27 domestic provinces and municipalities under the Central Government and autonomous regions and counted their market demand according to their gas consumption projects and volume.

Source: Miao Chengwu, *The Development Prediction of China's Natural Gas Market*.

Table 23 - CNPC's projection on China's gas demand projection by Sector (2000)
(Unit: billion cubic metres per year)

	2000	2005	2010	2015	2020
Power Generation	1.0	14.7	33.8	62.8	92.3
Chemical Industry	10.2	14.6	20.1	22.3	25.9
Industrial fuel	8.2	18.4	26.2	38.2	48.7
Residential & Commercial gas	6.2	16.9	32.0	61.7	84.8
Total	25.7	64.5	112.1	185.0	251.7

Source: Miao Chengwu, *The Development Prediction of China's Natural Gas Market*

Table 24 - SDPC's Projection on China's Gas Demand (2002)
(Unit: billion cubic metres)

	2005	2010	2015	2020
Northeast	7.3	15.9	21.9	28.9
Bohai Rim	8.1	19.5	28.7	40.2
Yangtze River Delta	8.4	15.0	24.2	36.4
Southeast Coast	10.1	19.1	28.5	33.8
Mid-West	3.7	5.6	7.5	10.5
Mid-South	7.8	10.6	17.1	25.4
South West	10.6	12.2	15.9	19.1
North West	7.5	8.9	12.3	16.4
Total	63.5	106.8	156.1	210.7

Note: Northeast (Heilongjiang, Jilin, and Liaoning); Bohai Rim (Beijing, Tianjin, Hebei, and Shandong); Yangtze River Delta (Shanghai, Jiangsu, and Zhejiang); Southeast Coast (Fujian, Guangdong, Guangxi, and Hainan); Mid-West (Inner Mongolia, Shanxi, and Shaanxi); Mid-South (Henan, Hubei, Hunan, Anhui, and Jiangxi); South West (Sichuan, Xizang, Yunnan, and Guizhou); North West (Xinjiang, Qinghai, and Gansu).
Source: Zhang Yuqing, "Current Situation, Outlook Policies for Natural Gas in China" presented at the Fourth US-China Oil and Gas Industry Forum jointly sponsored by State Development Planning Commission, US Dept of Commerce and US Dept of Energy, Houston, July 18-19, 2002.

As shown in Table 25, a number of western companies and institutions see the Chinese authority's projection figures are somewhat inflated. Unlike the three Chinese government energy think tank and state energy firm's projection that the natural gas demand in 2020 will be 200 bcm, the three western projections are more conservative. In particular, International Energy Agency (IEA)'s projection figures are much lower and it indicates many obstacles lying ahead for China's natural gas market expansion.

Table 25 - Projection on Natural Gas Demand in China
(Unit: billion cubic metres per year)

	2005	2010	2015	2020
CNPC	63.7	106.8	153.4	210.7
ERI/NDRC	64.5	120.0	160.0	200.0
CNOOC	61.0	100.0	150.0	200.0
BP	42.0	74.0	135.0	177.0
EI/DOE	51.0	79.0	127.0	181.0
IEA	-	61.0	-	109.0

Source: IEA, *Developing China's Natural Gas Market : The Energy Policy Challenges* (2002)

In this context, it is not so surprising to see a more conservative projection on China's gas demand is made by Energy Research Institute (ERI), as shown in Table 26. According to this revised projection, the Chinese government aims at increasing the role of natural gas up to 6.6% level by 2010 and 9.0% by 2020.

Table 26. ERI's revised projection on Natural Gas Demand

	Old projection (bcm/y)	New projection (bcm/y)	% in Energy Mix
2005	64.5	50.0	3.76
2010	120.0	100.0	6.55
2015	160.0	140.0	7.99
2020	200.0	180.0	9.00
2025		200.0	8.78
2030		200.0	7.73

Source: China OGP (Xinhua News Agency), *China Natural gas Report : A 2002 Update*, March 2003.

The ERI's revised figure of 180 bcm in 2020 is significantly lower than the initial projection figure of 255 bcm by SDPC. (See Table 27's demand figure) This drastic downscaling of the projection is a serious recognition by the Chinese authority that natural gas market expansion cannot be achieved in a day. Considering that China's domestic production target is 78 bcm in 2010 and 100 bcm in 2015 (excluding CBM) respectively, the import scale of both LNG and pipeline gas based on the ERI's revised demand projection should be 22 bcm in 2010, and 40 bcm in 2015 respectively. The possibility that a bigger role of LNG import rather than pipeline gas cannot be ruled out. It signals a considerable change of the import scale projection in both Table 25 & 26.

Table 27 - Supply, Demand and Import Balance: 2005-2020

	2005	2010	2015	2020
Demand	67.3	115.1	188.0	254.7
Domestic Gas	62.5	96.85	125.1	142.1
Imported Gas				
Pipeline Gas	0.0	20.0	45.0	60.0
LNG	4.0	13.3	17.3	21.3
Import Total	4.0	33.3	62.3	81.3
Supply Total	66.5	130.1	187.4	223.4
Balance	- 0.8	15.0	- 0.6	- 31.3

Source: Draft version of SDPC's Natural Gas Grid Plan (prepared in 2000), quoted by China OGP.

Table 28 - Projection on Russian Gas Import: 2005 -2020

	Market	2005	2010	2020
East Siberia	Northeast China	0.0	12.0	20.0
	Bohai Rim	0.0	0.0	10.0
West Siberia	Bohai Rim	0.0	0.0	9.0
	Yangtze River Delta	0.0	0.0	9.9
	Mid-South China	0.0	0.0	11.1
Total		0.0	12.0	60.0

Source: China OGP 2003

One thing very certain is that China will be the biggest natural gas user in Asia during the next decade and the scale of gas market will be much bigger than that of Japan which is the leading natural gas consumer in Asia. How far China's natural gas market

The Implications of China's Gas Expansion towards Natural Gas Market in Asia.
Chatham House Report for JBIC, February 2004

expansion can go will heavily depend on the government policy on the natural gas industry.

2. Options of Natural Gas Expansion in China

2.1. Onshore Gas Expansion

The driving force of China's onshore natural gas expansion in the coming years lies in West-East Pipeline (WEP) development. In this section will examine the background, procedure and the status of this major infrastructure development first and then touch on each major basin's development.

2.1.1. West-East Gas Pipeline Development

According to West-East Natural Gas Transportation Project Management Organization, PetroChina Company Limited, West-East Gas Pipeline Project is to transport natural gas from both Tarim and Changqing gas fields in west China to Shanghai in east China through a pipeline with the designed capacity of 12 bcm annually. China National Petroleum Corp (CNPC) initiated the planning and study of West-East Gas Pipeline Project in 1996, and the preliminary FS work was initiated in August 1998. The overall plan of the project has basically been determined in 2000.

This trunk pipeline will pass through eight provinces and a municipality, crossing large rivers like the Yangtze River and the Yellow River for six times and medium sized rivers for over 500 times, crossing highways for over 500 times and trunk railways for 46 times. The pipeline will pass through areas with seismic intensity of VI or below for about 2,500 km, of VII for about 800 km and VII for about 700 km.

The State Council has demanded the State Development Planning Commission (SDPC. Now it is National Development and Reform Commission : NDRC) to set up a working group before the end of March 2000. As shown in Table 29, many central and local authorities are included in this SDPC working group.

Table 29 - SDPC Working Group for West-East Pipeline Project

• State Development Planning Commission (SDPC) • State Economic and Trade Commission (SETC) • Ministry of Finance • Ministry of Land and Natural Resources • State Administration of Petroleum and Chemical Industries • State Power Corp (SPC) • China National Petroleum Corp (CNPC) • China Petrochemical Corp (SINOPEC) • China National Offshore Oil Corp (CNOOC) • China International Engineering Consulting Corp (CIECC)	• Xinjiang Province • Gansu Province • Ningxia Province • Shaanxi Province • Shanxi Province • Anhui Province • Jiangsu Province • Henan Province • Shanghai Municipality	• People's Bank of China • Bank of China • State Development Bank • Industrial & Commercial Bank of China • China Construction Bank
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Source: China OGP

A working conference entitled "West Gas East Transport" was organized by SDPC 24-26 March 2000. The following parties attended:

- Ministry of Construction
- Ministry of Foreign Trade and Economic Co-operation
- People's Bank of China
- National Environmental Protection Agency
- State Administration of Metallurgical Industry
- State Administration of Building Materials Industry
- State Administration of Petroleum and Chemical Industry
- State Administration of Coal Industry
- Inner Mongolia
- Hunan Province
- Hubei Province
- Fujian Province
- Beijing Municipality Government
- Agricultural Bank of China
- China United Coal-Bed Methane Co (CUCBM)

2.1.1.1. Proven Gas Reserves in Tarim

According to China's second national resource evaluation, the total reserves of four major gas regions, like Sichuan-Chongqing region, Shaanxi-Gansu-Ningxia region, Qinghai region and Xinjiang region are 22.4 trillion cubic metres (tcm), accounting for 59% of China's total gas reserves. Tarim basin in Xinjiang Uygur Autonomous Region has around 8.39 tcm, of which accumulative proven geologic reserves are 494.1 billion cubic metres (bcm).

Table 30 - Proven Natural Gas Reserves and Production Capacity in Tarim Basin

Gas field	Area Sq. km	Gas, bcm / Condensate Oil, mt	Production bcm / Export bcm
Kela-2	47.1	250.61/ -	10.0 / 10.0
Hetianhe	143.0	61.69/ -	2.0 / -
Yaha	48.9	35.78 / 28.27	1.2 / 1.2
Yingmai-li	40.4	29.57 / 4.63	1.05 / 1.045
Yangtake	17.3	24.91 / 2.17	1.0 / 0.99
Jilake	52.5	12.71 / 2.86	0.486 / 0.485
Yudong	10.2	7.33 / 1.43	0.33 / 0.329
Tazhong-6	58.0	8.53 / 0.73	0.25 / -
Jinan-4	11.0	2.58 / 1.10	0.10 / -
Tiergen	8.6	1.60 / 0.69	0.07 / -
Hongqi	3.7	0.95 / 0.35	0.03 / -
Total	441.0	436.2 / 42.22	16.5 / 14.0

Source: PetroChina's West-East Natural Gas Transportation Project Management Organization, West-East Natural gas Transportation Pipeline Project, p. 2.

PetroChina argues that there are mainly six gas fields within the basin that can supply gas for the West-East Gas Pipeline Project and the combine of the reserves stands at 361 bcm. Based on these reserves, the annual production capacity from these fields totals 14 bcm, which secures an annual capacity of 12 bcm of natural gas for the WEP project.

Kela-2, covering an area of 48.1 sq. km is regarded as the largest single gas field in China. In April 2000, the National Mineral Resources Committee approved PetroChina's reserves appraisal report, confirming that proven gas reserves in Kela-2 amounts to 250.6 bcm and recoverable reserves, 188 bcm. Besides this Tarim gas supply option, the natural gas from Changqing gas field with 338.5 bcm proven reserves can guarantee a 2 bcm/y of gas supply to Shanghai in 2003.

The limited proven gas reserves in Tarim basin was the weakest point of this 4,200 km pipeline development project. The current reserve base only secures a 13 year supply at 12 bcm/year. According to PetroChina's plan, the company will achieve a reserve base of 1 tcm in the Kuqa-north Tarim region (including both proven and probable) by 2005. The volume will be able to secure an annual production of 12 bcm for 30 years continuously. During the period of 2005-2010, PetroChina aims at boosting cumulative proven and probable reserves to 1.2 –2.0 tcm, making Tarim a solid base for annual gas production of 20 bcm which is able to last for at least 30 years.

PetroChina aims at locating a gas field with proven reserves of 150 bcm in the Dina structure, 100 km to the southeast of Kela 2 field. A wildcat well, named Dina 2, tested 2.187 mcm of gas and 131 cm of condensate daily at a depth of 4,875 metres. The Dina 2 well is 90 km away from Lunnan, the first gas pump station of the WEP. PetroChina also made major discovery in Ordos basin. The target cumulative gas reserves in Sulige district until the end of 2001 is 500 bcm, more than doubling the current 220.4 bcm. If this target is achieved, then the cumulative proven gas reserves in Ordos basin will reach 1 tcm. (For the details, see Ordos basin development)

Table 31 - Major gas production bases in the West
(Unit: billion cubic metres)

	Recoverable reserves	1999 gas output	2010 gas output projection
Changqing	203.0	1.21	10.5
Qinghai	84.4	0.36	5.45
Tarim	134.5	0.436	12.0
Xinjiang	94.3	1.5	2.5
Turpan-Hami	32.7	0.834	1.2
West Total	548.9	4.336	31.65

Source: CNPC

PetroChina would have no difficulty in achieving the production target of 22.5 bcm/y from both Tarim basin and Changqing field. Due to significant increase of the proven reserves in the major basins in the west during the last few years, the figures in Table 31 became already very conservative.

2.1.1.2. West-East Gas Pipeline Construction Plan

The West-East Gas Pipeline will be constructed and operated phase by phase. The whole project is divided into two sections: East section and West section. The East section covers from Jianbian, Shaanxi province to Shanghai, and gas from Changqing gas field will be delivered to Shanghai in the initial phase of the project. The West section covers from Tarim, Xinjiang to Jingbian of Shaanxi province.

Schedule of the project

The preliminary FS, the FS, the establishment and the design of the project were completed in 2000. The gas consuming projects will be determined under the co-ordination of State Development Planning Commission (SDPC).

In 2001 the construction of the East section project started, and in 2002 the construction of the West section project started. At the end of 2003, the East section project was completed. As a result, a 2 bcm/y of gas will flow from Changqing gas field to Shanghai and Hangzhou. In 2004, the West section project will be completed, and the whole section of the project will be constructed.

The whole project involving pipeline construction, city gas grid build-up and gas downstream projects in the Yangtze River Delta required an investment of 120 billion yuan in the first phase from 2000 to 2004. In the long run the total capital requirement is expected to be 300 billion yuan. Fixed assets investment for the pipeline construction project is pegged at 38.4 billion yuan, which will mainly go to the procurement of materials, the laying of pipeline and construction of compressor stations.

Routing: Four Sections

a. Lunnan –Wuwei Section: West Section

This section is about 1,900 km long and most part of the area along this section is located in plain, bench terrace, highland and Gobi. Since the pipeline goes along with highway and railway, it is convenient for construction of the pipeline with better traffic and transportation conditions.

b. Wuwei – Jingbian Section: West Section

This section is about 600 km long, basically located in a losses plateau area with flat relief, but there is desert near Gantang area and crossing the Yellow River is needed as well. Since much part of the pipeline in this section goes along with highway, it is also convenient for construction of the pipeline.

c. Jingbian – Zhengzhou Section: East Section

This section is about 600 km long, basically located in mountainous areas with part of highland. The pipeline in the section has to climb over Luliang Mount and Taihang Mount, and cross the Yellow River twice. Therefore conditions for construction of the pipeline in this section are tough.

d. Zhengzhou – Shanghai Section: East Section

The section is about 900 km long, located in plain areas criss-crossed with rivers, rivulets, lakes and ponds. There are many larger and medium-sized cities along the section. With frequent crossing of railways and highways, it is expected to have more construction work done in this section. Although with most part of the section going along highways, the overall construction conditions are therefore favorable, it is difficult to do construction work when crossing the wide and deep Yangtze River in this section.

Map 2 – See Annex 1

Source: IEA, *Developing China's Natural Gas Market*

The Engineering Plan

It is worth noting that Chinese steel manufacturers cannot produce the X-70 steel tube at the diameter of 1,118 mm used for the trunk line. On March 27, 2001, the Chinese government gave four guidelines with regard to home made machinery or materials:

- Give priority to domestic products that meet the project standards ;
- Use products that meet standards after technical upgrading and test ;
- Form a Sino-foreign joint bidding company ;
- Localise the maintenance in the international bidding.

Table 32 - Engineering Plan

Transportation pressure	Temporarily defined as 10 MPa
Steel Grade	It is recommended to use API X70
Line Pipe	Spiral Submerged Arc Welded (SSAW) pipes will be used for about 80% of the pipeline while Longitudinal Submerged Arc Welded (LSAW) pipes will be used for the rest of the pipelines.
Annual Capacity	The annual gas transmission volume is 12 bcm
Compressor Units	Centrifugal compressor units driven by gas turbines are preferred.
Pipe Diameter	It has been preliminarily decided to use pipe diameter of 1118 mm.
Corrosion	For corrosion protection, epoxy powder coating will be mainly used, while making epoxy-polyethylene coating subsidiary. It is planned to have 57 cathodic protection stations.
Valves	It is planned to have 194 block valves and 14 head valves.

Source: China OGP

Provision of pipeline development related materials

Unlike PetroChina's procurement scheme, according to China OGP report, CNPC's planning and engineering institute put that the entire line will consume 1.74 mt of steel, which is preliminarily decided to be X65 by PAI-5L standard. The designed pressure of the trunk line is 8.4 MPa, higher than any operating gas pipeline in China. Diameter of 1118 mm is considered the best choice for the trunk line in terms of handling the capacity.

Four domestic steel companies, like Baoshan, Wuhan, Panzhihua and Anshan, are able to produce X65. If the west-east gas pipeline has to be completed in 2004, then these four companies produce around 0.6 mt/y of pipeline steel. The four companies produced only 0.316 mt in 1998 and 0.307 mt in 1999.

Baoshan is China's largest pipeline steel producer and considered the major supplier-to-be for the project. Its output during 1998-99 was 0.409 mt. In 1999, 83.4% of its pipeline steel was X65 level. About 42% of the steel used in the 864 km Shaanxi-Beijing gas pipeline was produced by Baoshan. CNPC hope Baoshan could supply over 0.2 mt/y of pipeline steel. Wuhan Steel also supplied the Shaanxi-Beijing pipeline with X60 steel. In 1999, the output reached to 0.119 mt. CNPC has consented to 0.2 mt/y supplied by Wuhan.

The trunk pipeline requires 1.36 mt of spiral submersed arc welded (SSAW) and 0.3 mt of longitudinal submersed arc welded (LSAW) pipes. Under CNPC, six mills like Baoji, Huabei, Ziaoyng, Liaoyang, Shashi and Shengli, have the capacity to produce SSAW, and their total yield was 0.6 mt in 1999. Two of the mills, Shashi and Shengli, were handed over to Sinopec in 1998.

CNPC had to wait until 2001 before its pipe mills can produce LSAW pipeline in large scales. One of its mills in Qingxian in Hebei province was going to introduce 0.15 mt product line for LSAW pipe. The operation started in May 2001. In the case of 5,100 tonnes welding rods, they needed to import from overseas suppliers as domestic products cannot meet the qualifications.

The trunk pipeline required sixteen compressor stations along the 4167 km pipeline. Overseas business monopolised the supply of compressors worth some 7.7 billion yuan, or 20% of the total fixed assets. Centrifugal compressors and gas turbines were the first choices. Besides this, more than 200 valves and automatic control system had to be imported. The 4,200 km pipeline project calls for 49.5 bn yuan for construction, of which 45.6 bn yuan for trunk line, 1.8 bn yuan for branch, and 2.1 bn yuan for underground depot.

2.1.1.3. Western Companies Participation

In early November 1999, SDPC senior officer indicated that China was likely to lift the ban on foreign investment in town gas grid. Mr. Li Rongrong, then deputy director (vice minister) said that BOT (build, operate and transfer) which has been implemented widely in China's power sector would be practiced in the town gas sector as well.

Under the "Catalogue of the Guide to Foreign Investment" first issued in June 1995 and later revised in 1997, it is clearly stipulated that foreign investment is banned from the construction and management of urban gas, heat and power networks. Despite the Catalogue, foreign companies have managed to bypass the restriction and reached agreements with local governments for town gas and pipeline projects, notably in Shenzhen and Wuhan.

In July 2000, Zhang Guobao, deputy director (vice minister) of the SDPC said that China sets no ceiling for foreign equity shares in the west-east pipeline project. All forms of Sino-foreign co-operation are negotiable. This was the first time that China announced

that foreign partner could take majority share in gas pipeline construction. Besides this, SDPC officially announced that town gas grid is no longer off limits to foreign investors.

Besides the two policy changes, royalty reduction and exemption were also offered to the west-east gas pipeline project. Royalties would be exempted for the first year, reduced by 50% in the second and third year and reduced by 25% during the fourth to the seventh year. And related imported equipment within the total investment would enjoy tariff and VAT exemption. SDPC revised the Catalogue of the Guide to Foreign Investment, and town gas grid construction is classified into the category where foreign investment is subject to limited control.

In early March 2001, PetroChina announced that 19 companies passed the pre-launch qualification evaluation. Except Transgas from Czech, 18 companies had bought 19 data packages (each priced at US\$ 8,000), and BP bought two packages. (See Table ??)

Table 33 - The 19 Companies participated in the pre-launch qualification evaluation for the W-E pipeline project

BP Global Investments Limited	Nissho Iwai Corp
CLP Enterprises Ltd	Rao Gazprom
Energomachexport Russia	Petrolam Nasional Berhad (Petronas)
ExxonMobil China Tarim Basin Gas Ltd	Shell International Gas Ltd
Gaz de France	Sumitomo Corp
Houston Inspection International Inc.	The HK & China Gas Company Ltd
Itochu Corp	TotalFinaElf
Marubeni Corp	Transgas, s. p. Czech Republic
Mitsubishi Corp	United Technologies Corp
Mitsui & Co Ltd	

Source: China OGP

At the end of May 2001, PetroChina submitted to the State Development Planning Commission (SDPC) the appraisal report on seven investment proposals of the West-East gas pipeline project.

Table 34 - The seven investment proposals

A consortium led by BP Global Investments Ltd, including Itochu, Mitsubishi, Nissho Iwai and Petronas
A consortium composed of Exxon-Mobil China Gas Pipeline Ltd. and HK CLP Enterprises Ltd.
Shell International Gas Ltd
HK and China Gas Co Ltd
Houston Inspection International Inc
Russian Energomachexport
RAO Gazprom

Note: Both Gaz de France and TotalFinaElf dropped the bidding.

Source: China OGP

On June 5, 2001, PetroChina announced that three foreign bidders out of seven have been selected. It has invited the three bidders to enter into negotiations on the Memorandum of Understanding (MOU) for investment and Co-operation in the project.

PetroChina added that the MOU negotiations will involve the detailed investment structure, finance resources and bilateral recognition of the FS for the project and others.

In late June 2001, PetroChina announced that it invited two more foreign companies to take part in the negotiations of Memorandum of Understanding of Co-operation on the 4,000 km west-east natural gas pipeline project. Already the three top majors (Shell, ExxonMobil and BP) were selected. The two more companies are a consortium of Gazprom and Stroytransgaz, and HK & China Gas. PetroChina also appointed Deutsche Bank as the financial advisor to its foreign partner selection process. CNPC's Sichuan Designing Institute is the major designer.

On July 4th, 2002 PetroChina Co finally signed the memorandum of Understanding on JVs with three international partners for the west-east pipeline project to share project risks and to take advantage of their international experience, financial strength, technical and operational experience. The three partners are:

- Royal Dutch Shell Group + HK & China Gas Co
- ExxonMobil Corp + CLP Holdings
- Rao Gazprom + Stroytransgaz

On September 1, 2003 Financial Times reported that Shell said its negotiations with PetroChina on the west-east gas pipeline deadlocked as PetroChina could not ensure a 15% return in the upstream sector of the pipeline. In the feasibility study of the west-east gas pipeline, the economic returns of the upstream sector was pinned at 15% and that of the middle stream at 12%. PetroChina's reluctance to ensure Shell fixated economic returns caused by two factors: the one is the governmental ban on promising foreign investors with fixated economic returns in attracting foreign investment, and the other is the enhanced risks of the pipeline due to the prospect that it might have to lower the gas prices under the order of NDRC.

The most important point is that PetroChina can manage the project single handedly even if Shell withdraw from the project. In fact, PetroChina has already completed the eastern section of West-East Pipeline (WEP). Under this situation, a real question is what sort of contribution western consortium can make to the WEP project?

2.1.1.4. West-East Pipeline (WEP) Gas to Shanghai

Preparation Action for Tarim Gas

The production capacity build-up at the Kela-2 Gas Field, the backbone of WEP project is expected to finish at the end of 2004, in time for the long-distance delivery of gas from Xinjiang to China's east coast, slated to commence at the start of 2005. Until 2005, PetroChina plans to equip the gas field with a central processing plant having an annual capacity of 12 bcm, as well as lay a 170-km transmission pipeline connecting the field with Lunnan, the WEP starting-point. Total investment for the project is estimated at 6.2 billion yuan (US\$ 749 million). The gas field is designed to have an annual production capacity of 10 bcm over a period of 20 years. Apart from Kela-2, the Dina-2 Gas Field with 150 bcm of proven gas reserves is projected to become a major supply source for the WEP as well.

WEP Western Section welding completed

On November 29, the WEP finally crossed the Yellow River in western China's Ningxia Autonomous Region. As a result, the last major construction obstacle on the western section of the pipeline had been overcome. A week before this event, PetroChina announced that the western trunkline of WEP had completed welding, and the full-length pipeline will be ready for operation by the end of 2004 as previously scheduled. The western section of the WEP starts from Lunnan in the Tarim Basin, and ends in Jingbian in Shaanxi Province. The pipeline also crosses Gansu Province and the Ningxia Autonomous Region on the way, and has a length of 2,330 km.

Zhengzhou Section is completed

The Zhengzhou section had actually been completed in the morning of September 15, 2003. The section is described as the "most difficult" part of the whole project, with a length of 1,259 m at over 23 m under the riverbed. However, the pipes with a diameter of 1,016 mm will still require another one or two months to be put through the hole that has been dug under the Yellow River bed. The makeshift pipeline, currently in place beneath the riverbed, has a diameter of only 406 mm, and is believed to be capable of undertaking the transmission volume during the pipeline's testing period.

PetroChina has adopted a distinctive method for each of the five major river-crossing projects for the WEP. The two Yellow River-crossing projects, one on the border of the Shaanxi and Shanxi provinces, the other near Zhengzhou, used the tunnel-crossing and pipe pushing method respectively. The Yangtze River-crossing project near Nanjing, in Jiangsu Province adopted the shield method, and the Huai River-crossing project near Bengbu, Anhui Province, implemented the directional drilling method. As for the third Yellow River-crossing project on the pipeline's western section, the pipeline will be lifted above the river in order to cross it.

The Yellow River crossing project in Zhengzhou forms one of the three major parts of the WEP. The other two are the Yangtze River-crossing project in Nanjing and the Yellow River's Yan Shui Guan tunneling project in Yan'an city, in western Shaanxi Province.

Chongqing Gas to Shanghai through WEP

On October 1, 2003 PetroChina began to supply gas from the Changqing Gas Field in northern Shaanxi Province into the WEP. According to the Shanghai Natural Gas Grid Co. Ltd., the sole gateway gas purchaser in Shanghai, natural gas extracted from Jingbian, in Shaanxi Province, arrived at the terminal station of WEP, in the town of Baihe in suburban Shanghai on October 7. This transmission constitutes the trial operation of the 1,485-km Jingbian-Shanghai section, or the eastern section of the WEP.

As far as the supply schedule goes, WEP will begin commercial supply to Zhengzhou, the capital city of central China's Henan Province, on October 16, to the Yubei offshoot line in northern Henan Province on October 20, and to Shanghai on December 10.

WEP's First Formal Gas Supply & Purchase Agreement

On October 15, 2003 PetroChina finally signed the first formal gas supply and purchase agreement for the WEP gas, and the first group of gas users will be the 440,000 households of Zhengzhou, Henan Province. Zhengzhou Gas, the city's gas operator, signed the 20-year gas sales agreement at a purchase price of 1.16 yuan (US\$ 0.14) per cubic metres, and the contracted volume of gas will be expanded to 0.12 bcm in 2004, 0.140 bcm in 2005, 0.17 bcm in 2006 and 0.2 bcm from 2007 onwards. The city-gate price at Zhengzhou was pinned at 1.16 yuan/cm, with 0.66 yuan/cm being ex-plant price and 0.5 yuan/cm being transmission tariff.

Henan, bordering Shaanxi, is the first downstream consuming province for the WEP and is expected to draw a 0.8 bcm of gas from the trunkline annually. On October 25, 2003 a formal gas purchase agreement concerning a second offshoot to the trunkline in the northern part of the province is scheduled to be signed. The offshoot, the Yubei Pipeline, is expected to transmit 0.2 bcm per annum when steady supply is reached. Most of the gas will go to the glass-maker Ancai Group in Anyang, and the purchase price is very likely to be set at the lower end of the price band for industrial users, at 1.12 yuan (US\$ 0.135) per cubic metres.

A third offshoot pipeline to traverse the southern part of the province, named the Yunan Pipeline, is currently under construction, and expected to go into operation by the end of 2003. The pipeline will send gas to a proposed gas power plant belonging to China Huadian Group in the city of Zhumadian, as well as to local residents. The price band for power plant users of WEP gas ranges from 1.10-1.20 yuan (US\$ 0.133-0.145) per cubic metres.

Henan Province

The beginning of 2003, Henan started to lay the extension pipelines in the northern and southern part of the province. The northern line is expected to start supplying gas as early as January 2004 with a designed capacity of 0.827 bcm per year. The southern part will carry as much as 1.0 bcm per year once it is completed. The WEP Project will eventually supply at a maximum of 1.5 bcm of natural gas annually to the Henan province.

As part of the extension network development, Xinyang Hongchang Natural Gas Engineering Co. recently started construction on a 375 km long extension pipeline. On August 9, 2003 the company also started construction on the 450 million yuan (US\$ 54.4 million) project, known as "the Eastern Line of Henan", which includes two separate pipelines, one from Xinyang to Gushi and the other from Huaiyang to Huangchuan.

The Xinyang-Gushi part will extend 190 km and cost 190 million yuan (US\$ 23 million), while the Huaiyang-Huangchuan part will stretch for 185 km and cost 260 million yuan (US\$ 31.4 million). After the extension project is completed in September 2004, it will deliver a 0.99 bcm of natural gas each year from the West-East project mainly to local industrial users.

Anhui Province

In October 2003, Anhui Province began the construction of a 237 km-long pipeline. According to Anhui Natural Gas Development Co. Ltd., a state-owned company established at the end of 2002 and the sponsor of the branch pipeline project, the branch

pipeline project will be divided into five sections. The first part that links Liuxiangzi and Bengbu will be finished and come on stream at the beginning of 2004. For the remaining four parts that links Liuxiangzi and Huainan, Lixin and Buyang, Wuhu and Tongling and Hefei and Chaohu, a timetable for the construction is not ready yet. Anhui Natural Gas will invest a total of 320 million yuan (US\$ 38.7 million) into the project. The branch pipeline in Anhui is designed to have an annual delivery capacity up to 1.1 bcm of natural gas.

WEP Gas to Hangzhou

On August 26, 2003 Hangzhou Gas Group Corp began to set up a major terminal in Beimen to receive natural gas from a branch pipeline of WEP that links Huzhou to the north with Hangzhou. Construction of the terminal will finish on in early December 2003 and will start to supply natural gas to urban areas at the beginning of 2004. Apart from the gas from Huzhou, Hangzhou plans to supply WEP gas from Shanghai. Besides this, a pipeline from Ningbo was designed to fuel Hangzhou with natural gas from East China Sea. Hangzhou also plans to supply gas to the outskirts such as Xiaoshan and Linping from 2005, and to Fuyang in 2006 after the project sponsor finishes laying new pipelines to replace the old ones designed for coal gas only. This upgrading project in Hangzhou is estimated to cost 1.6 billion yuan (US\$ 193.3 million).

WEP Gas for Power in Nanjing and Shanghai

Huaneng Power International Inc. plans to set up three natural gas-fired power generator units in Nanjing, Jiangsu Province. Huaneng will invest 3.71 billion yuan (US\$ 448 million) to set up three generator units with a capacity of 390 MW each, aiming to meet one third of the city's power demand. The three units will be located 3.5 km away from the Nanjing terminal to receive natural gas from the WEP pipeline. The government has preliminarily approved the investment plan.

Huaneng also plans to set up three natural gas-fired power units with a capacity of 300 MW each in Shanghai with Shenergy Co., a local government-backed energy supplier. The 3.73 billion yuan (US\$ 449.3 million) Shanghai units will also be supplied by WEP gas.

WEP Gas for Power in Zhangjiang, Jiangsu Province

On July 30, 2003 Zhangjiagang Huaxing Power Company launched the Integrated Gasification Combined Cycle (IGCC) electricity generator project in Zhangjiang, a supporting project of the WEP (West-East Pipeline) to be fueled by gas from the WEP. With investment totaling 2.5 billion (US\$ 302 million), the project consists of two IGCC electricity generators, which will consume 0.7 bcm of piped gas per year. Each generator is designed with a production capability of 395 MW per year. As planned, the first gas turbine will be put into commercial operation by August 2005 and the second, by February 2006. It is the first one to be approved among ten gas turbine projects and will become China's largest IGCC power plant after completion.

The feasibility study on an IGCC reconstruction project, which will create the first thermo power plant in Zhejiang Province to use WEP gas, has been approved. With investment of 176 million yuan (US\$ 21.3 million), the project will be capable of 51 MW per year in electricity generation.

WEP Gas to Shanghai

On January 1, 2004 CNPC signed a final contract for selling natural gas from the WEP to Shanghai. The Shanghai Municipal Government announced that the gas reached major industrial users, including Baosteel and the Shanghai Automotive Industry Corp. (SAIC) as well as household users in suburban Shanghai. The WEP connects with Shanghai's city gas network at Baihe County, in the city's northwestern district of Qingpu.

Shanghai Mayor Han Zheng, National Development and Reform Commission deputy director Zhang Guobao and PetroChina president Chen Geng witnessed the connection of the pipelines and the signing of the gas sales contract.

No detail of the gateway gas sales contract has been given, though it is expected that the initial overall daily delivery volume will reach 0.5 mcm. Mayor Han added that Shanghai shall finish the complete conversion from coal gas to natural gas in the local grid by 2010 and will accelerate the development of multiple gas sources for the city, including the West East Pipeline, the East China Sea and imported LPG.

Gate Keeper in Shanghai

Shenergy Group has de facto control of all gas grids in Shanghai and has an indirect 60% equity in the Shanghai Natural Gas Grid Company, which is the sole gateway buyer of West East Pipeline gas coming into Shanghai. Shenergy Group, the parent company of the Shanghai-listed Shenergy Co. Ltd., will take over the three gas utilities in Shanghai from the municipal government before the end of 2003. The three utilities, namely Shanghai Dazhong Gas, North Shanghai Gas, and Pudong Gas, are currently independent companies under the administration of the Shanghai Municipal Engineering Administration Bureau. The three companies, supplying to southwest, north and east Shanghai respectively, serve an aggregate of 3.47 million household users at present. The transfer is an effort to separate government functions from business operations.

Besides this, Shenergy Co. has invested 5.14 billion yuan (US\$ 620.8 million) to supply gas from the East China Sea to 600,000 households in Pudong, an eastern district of Shanghai. The company also claims major stakes in the Waigaoqiao power plant project in Shanghai and the Qinshan Nuclear Power Station in neighboring Jiangsu Province.

According to the Shanghai Municipal Engineering Bureau, all piped gas producers, sellers and LPG suppliers in Shanghai will merge into a new gas giant, the Shanghai Gas Group. Formal inauguration of the group is set on December 26, 2003 and Shenergy Group is said to take a controlling 60% equity in the gas giant, giving it access to around 3.4 million household users in Shanghai.

WEP Gas to Zhejiang

On January 18, 2004, WEP began commercial delivery to Zhejiang Province, marking the pipeline is now accessible to all targeted downstream markets. Zhejiang Province is currently building three units of 390 MW gas-firing power plant, with a projected demand of 1.4 bcm from 2007.

Many LOIs but no formal "Take or Pay" for gas for power yet

On February 28, 2001, PetroChina signed West-East gas purchase letters of intent (LOI) with 33 enterprises from Shanghai, Jiangsu, Zhejiang, Anhui and Henan provinces.

The LOIs feature 35 projects: 20 for city gas, nine for gas for power, two for industrial fuel and four for chemical feedstock. If these are all translated into contracts, the gas demand in 2005 would be 9 bcm, 45% of the full capacity of 20 bcm/y and already the break-even point for the pipeline operation in the initial stage. In 2007 the gas demand from these projects will be 13 bcm.

It is worth noting that PetroChina signed the LOI with only one enterprise in Shanghai, the Shanghai Natural Gas Pipeline Grid Company. This company is the only gas grid company in Shanghai and has the sole responsibility for gas transmission and sales in areas under the municipality's jurisdiction. The total number of actual projects exceed ten, ranging from those for industrial fuel, those for chemical feedstock, to those for town gas.

It is also worth noting that Henan province, a relatively under-developed agricultural province, has got 10 projects involved in the LOIs, next only to Jiangsu, one of China's best developed areas. It is projected that during the initial operation of WEP project, Henan will rank next only to Shanghai in gas consumption because in Jiangsu, most gas will be used to fuel power generation projects whose start-ups will be after 2005.

Table 35 - PetroChina's LOIs with 33 Enterprises, as of 2001

Shanghai 1. Shanghai National Gas Pipeline Grid Company	Zhejiang Province 1. Zhejiang Power Development Company
Jiangsu Province 1. Jiangsu Wanfeng Fuel Gas Co. Ltd 2. Wuxi Fuel Gas General Corp. 3. Zhenjiang Natural Gas Co. Ltd 4. Suzhou Fuel Gas Group Co. Ltd 5. Nanjing Natural Gas Co. Preparatory Office 6. Changzhou Fuel Gas & Thermal Power Corp. 7. Nanjing Thermal Power Plant 8. East China Power Group Wangting Power Plant 9. Qishuyan Power Generation Co. 10. Sinopec Yizheng Chemical Fibre Co. Ltd 11. Yangzi-Basf Petro-Chemical Co. Ltd 12. Sinopec Group Yangzi PetroChemical Co Ltd. (Under Sinopec Group) 13. Sinopec Yangzi Petro-Chemical Co Ltd. (Under Sinopec Group)	Henan Province 1. Jiaozuo Fuel Gas & Thermal Power Corp. 2. Xinxiang Gas Co. 3. Henan Lotus Monosodium Glutamate Group Co. Ltd 4. Jiyuan City Natural Gas Utilization Office 5. Zhengzhou Fuel Gas Company Ltd 6. Xuchang Fuel Gas Co. 7. Henan Zhongyuan Gasification Co Ltd 8. Henan Ancai Group Co. Ltd 9. China Greatwall Aluminium Co. 10. Zhoukou Fuel Gas Company

Anhui Province 1. Huainan City West-East Gas Pipeline Project Management Office 2. Anhui Chuzhou City Coal Gas Company 3. Anhui Maanshan Fuel Gas Co. 4. Bengbu LPG Co. 5. Anhui Wuhu Fuel Gas Co 6. Hefei Coal Gas Co.	Others 1. Huaneng International Power Co Ltd 2. Beijing Sanjili Energy Co. Ltd
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Table 36 - PetroChina's LOIs with newly added 12 Enterprises

Jiangsu Province 1. Nanjing Sanjili Energy Co. Ltd 2. Huai'an City Fuel Gas Co. 3. Yangzhou City Fuel Gas Co. 4. Taizhou City Fuel Gas Co. 5. Nantong City Fuel Gas Co. 6. Jiangsu Huaneng Huaiying Power Generation Co. Ltd	Henan Province 1. Luohe City Fuel Gas Co. 2. Xinyang Welfare Construction & Development Co. Ltd 3. Hebi Fuel Gas Co. 4. Xinyang City Pipeline Fuel Gas Engineering Co.
Anhui Province 1. Chaohua Gas Co. Ltd 2. Fuyang Liye Gas Co. Ltd 3. Anhui Tongling City Fuel Gas Co.	*Huaneng International Power Co. Ltd is re-categorised as Jiangsu project. ** Beijing Sanjili Energy Co. Ltd is excluded

Table 37 shows that how each sector's demand would be covered by the west-east gas pipeline project. Under the current price system, however, the initial gas consumption from the power sector will have a real difficulty in developing the market unless the government declares clear and concrete supportive policies on gas price.

Table 37 - CNPC's projection by Sector for West-East Gas Pipeline project (Unit: billion cubic metres)

	2003	2004	2005	2006	2007
Power Generation	1.6	3.74	5.7	6.72	7.66
Chemical Production	0.6	0.74	1.19	1.19	1.19
Industrial Fuel	1.06	1.5	2.12	2.4	2.67
Town Gas	1.24	1.9	3.12	3.98	5.01
Total	4.50	7.88	12.13	14.29	16.53

Source: CNPC

PetroChina has signed draft take-or-pay contracts with 19 downstream gas users of the west-east gas pipeline at a Sept. 16-17 conference organised by the National Development and Reform Commission (NDRC) in Nanjing, with the contracted gas volume over 6 bcm. Strictly speaking, the draft contracts are not legally binding yet.

The draft contracts were reached on the basis that the average guidance price of the west-east gas had been lowered from the previously planned 1.29 *yuan/cu.m* to 1.27 *yuan/cu.m*, with the ex-plant price and transmission tariff respectively lowered to 0.48 *yuan/cu.m* and 0.79 *yuan/cu.m*.

The city-gate prices of the WEP have been respectively lowered to 1.14 *yuan/cu.m* in Henan, 1.23 *yuan/cu.m* in Anhui, 1.27 *yuan/cu.m* in Jiangsu, 1.31 *yuan/cu.m* in Zhejiang and 1.32 *yuan/cu.m* in Shanghai, 0.01-0.06 *yuan/cu.m* lower than the prices previously publicized. The prices also vary by sector. Gas prices for town gas consumption range between 1.16-1.46 *yuan/cu.m*; those for industrial purpose range between 1.12-1.3 *yuan/cu.m*; and those for gas-for-power projects range between 1.1-1.2 *yuan/cu.m*.

Because of their relatively higher affordability, the gas companies of Henan, Anhui, Jiangsu, Zhejiang and Shanghai all signed on the draft contracts, despite that gas prices for the town gas sector are the highest. Though gas prices for gas-for-power projects are the lowest, the draft contracts met boycott by gas-fired power plants, which, according to the feasibility study of the pipeline project, should digest 40% of the west-east gas.

State Energy Bureau's Intervention

According to the previous schedule, the trunkline from Changqing should have been connected to the gas grid in Shanghai on November 20, or PetroChina would risk breaking its promise to launch commercial gas delivery throughout the pipeline's eastern section on January 1, 2004. In December 2003, the director of the State Energy Bureau under the National Development and Reform Commission Bai Rongchun officially intervened the price negotiation to accelerate the WEP gas supply to Shanghai. There were two main reasons for the State Energy Bureau's intervention: One was to work out the fire safety problem with the Shanghai section of the WEP, and the other was to mediate in negotiations over the (gas supply) contract. However it is not clear yet whether the compromise on the gas for price was made by the SEB's intervention.

Apart from Shanghai, commercial gas delivery to Nanjing has not materialized due to local household users' protests about the high gas costs.

In late January 2004, PetroChina confirmed the firm had signed 20 formal "take or pay" gas sales contracts, and the contractual volume reached 7.4 bcm/y, accounting for 62% of the designed ultimate transmission capacity of 12 bcm/y. Already nine out of the 20 contracted consumers are being provided with commercial supply with an aggregate volume of over 70 mcm/y. PetroChina also confirmed that the firm is in negotiation with 15 more downstream consumers.

2.1.2. Major Onshore Basin Development in China

2.1.2.1. Tarim Basin

China's largest sedimentary basin, the remote Tarim basin, covers 560,000 sq. km nearly the size of Texas. It is located in the south-central portion of the Xinjiang Uygur Autonomous Region in northwest China. It is on the brim of the Kunlun mountain range, and borders the Aejin Mountain range in the south and the Tianshan range in the north. The Taklimakan Desert, which is the country's largest, covers 337,000 sq. km and lies in

the centre of the basin. Flowing dunes are scattered across the basin, generally extending for 9-20 km. The average height of the basin is 50-80 metre, with a possible maximum up to 100-150 metres.

The gas producing strata in the Tarim basin ranges from the Ordovician and Carboniferous periods, of the Palaeozoic era and throughout the Mesozoic era, to as late as the Cretaceous period. Hydrocarbon prospecting in Tarim was not undertaken until 1952. Initial work was very limited because the geological survey was only in recent years that many exploration teams from CNPC and MGMR (Ministry of Geology and Mineral Resource) were sent into the heart of the Tarim basin.

Chinese geologists predict that Tarim holds 8,39 tcm of geological gas reserves, but as of late 1990s only one tenth of the total reserves has been verified owing to the hostile ground conditions, the complicated distribution of hydrocarbon resources and a lack of money. Even though CNPC has amassed human and financial resources of exploration in this basin for the past decade, Tarim's exploration is still regarded as being at a very early stage, with only one wildcat well drilled on every 1,400 sq. km of basin acreage, and 0.27 km of two dimensional (2D) seismic lines shot per square kilometre. The basin's hydrocarbon resource distribution often defies conventional wisdom, as proved by past exploration. (For the detailed reserves base, see the WEP section)

2.1.2.2. Qaidam Basin

The Qaidam basin is located in the northwest of Qinghai province, with Aejin Mountains to its northwest, the Qilian Mountains to its northeast and the Kunlun Mountains to its southwest and south. A large intermontane sedimentary and structural basin, in the shape of a rhombus, the Qaidam basin covers an area of 120,000 sq km at an average elevation of about 3,000 metres. The basin dips from the northwest to the southeast, and the land form undulates in the northwest. But the basin relief is relatively gentle in the southeast. Most western parts of the basin are covered by desert.

The exploration of Qaidam began in 1954, and by 1996 the confirmed gas reserves recorded were only 67.0 bcm, 7.45% of the 900 bcm total. In mid-1990s CNPC has announced its bold decision to establish an annual gas production capacity of 5.0 bcm by 2005, and increase the cumulative proven reserves to 300 bcm.

CNPC regarded Qaidam as underexplored, with a 2D survey carried out over only 0.524 km per sq. km. The number of wildcat wells recorded per 10,000 sq. km is 15.6 and the average depth is 1,272 metre. Only 45 prospecting wells are deeper than 4,000 metres. Until 2,000 the E&P focus in Qaidam was the Lenghu –Nanbaxian area in the west basin and the Sanhu gas-prone in the east. Besides, China's self-financed E&P projects, the Qinghai oil field has carried out cooperative prospecting with two American companies, Exxon and Amoco, in an area of 326,000 sq. km.

In late May 2000, CNPC signed a PSC with AGIP China for gas development in Qaidam basin. The contract block is located in the Sebei district. The area covers 7,000 sq. km and the block is estimated to contain geological gas reserves of 250 bcm. The contract with a valid period of 30 years was expected to get approval from SETC in June 2000.

Qaidam Basin is estimated to contain 7.4 bt of geological oil and 1.4 tcm of geological gas reserves. By the end of 1999, the proven oil and gas reserves in Qaidam basin was

only 229 mt and 147 bcm respectively. The same year, only 1.9 mt of oil and 0.36 cm of gas have been produced from the basin.

Qaidam Gas Pipeline

CNPC started the construction of the 953 km pipeline from Qinghai to Gansu province on March 31, 2000. The 660 mm pipeline is designed to transport 2 bcm of gas from Sebei field to 13 cities and counties en route in Qinghai and Gansu. The total investment for the pipeline is 2.5 billion yuan expected to be recovered in a period of 8.67 years. The transportation tariff is calculated at 0.35 yuan/cm. On May 18th, 2001, PetroChina's Sebei gas field in Qaidam basin began to supply gas into the 953 km distance gas pipeline linking the field to Xining and Lanzhou. The pipeline run into full operation around Oct 2001.

PetroChina aimed at building up the production capacity of 1 bcm in Sebei at the end of 2001 and expanding it to 4 bcm/y when the market is fully developed. The major industrial users include Lanzhou Refinery, Lanzhou Chemical Industry, Lanzhou Aluminium Plant, Minhe Magnesium Plant (Qinhai), Xining Special Steel Group and Xigu Thermal Plant (Gansu).

In April 2001, PetroChina signed gas supply contracts with Qinghai Aluminium Industry Company and Qinghai Xinghuo Chromate Plant. Under the contracts, PetroChina will annually supply 60 mcm of gas to Qinghai Aluminium for five years, and guarantee a daily supply of 0.167 mcm. It will supply Qinghai Xinghuo Chromate Plant with 0.4 mcm of gas in 2001 and expand the volume to 16 mcm/y later.

According to PetroChina, the potential gas reserves in Qaidam basin exceed 2 tcm and the cumulative proven gas reserves stands at 220 bcm. Sebei field covers an area of 122 sq. km and the proven gas reserves reached 348 bcm as of 2001.

As of 1991, there are three gas pipelines moving gas within or out of Qaidam Basin :

- the first pipeline went on stream in May 1996, extending gas field to Huatugou.
- the second, 189 km from Sebei field to Golumd, started operation in August 1996.
- the third starts from Sebei gas field, passes Nanbaxian gas field and terminates at Dunhuang in Gansu province. It extends 345 km and is the first pipeline moving Qaidam gas to users outside the basin.

To accommodate the gas development in Qaidam Basin, two gas fired power plants, one in Golumd and the other in Dunhuang, have gone into operation in recent years.

- The Golmud power plant incorporates a 22 MW gas fired turbine. It started to generate electricity in 1996 when the Sebei-Golmud pipeline was completed.
- The Dunhuang power plant operates a 55 MW gas turbine and went into operation in 2000. It now sources gas from both Sebei and Nanbaxian gas fields.

Besides this, a 100,000 t/y methanol unit with the Golmud refinery, using natural gas as feed stock, has been producing since 1999.

Initially this Qinghai-Gansu pipeline was included in the west-east gas pipeline project. But it was excluded from the project as Qaidam does not have surplus gas capacity to move eastward in a period of 10 years, coupled with the requirements in Qinghai's Golmud and Dunhuang. It is projected that the gas production in Qaidam will maintain at

5.45 bcm per year from 2005 to 2010, based on a projected cumulative reserves of 279 bcm in 2005. The annual gas demand from Xining and Lanzhou will be 1.7 bcm and 2.8 bcm respectively, according to a market survey.

China's fourth largest gas field, the Sebei gas field in Qinghai Autonomous Region recorded 0.6 bcm in sale during January to July period in 2003. It is the first time that the field has reached such a high half-year sales volume. Qinghai Oilfield Natural Gas Development Company plans to produce and sell 1.1 bcm gas in 2003, up 33% compared to 2002. Sebei is the source of the Sebei-Xining-Lanzhou gas transmission pipeline.

As of 2003, the Sebei gas field is connected via four pipelines with a number of major consumer markets, including Xining, Golmud and Lanzhou, in the provinces of Gansu and Qinghai in northwest China. The four pipelines have a combined annual capacity of 3.3 bcm.

2.1.2.3. Ordos Basin

The Ordos basin, literally meaning "Green Prairie" is situated in the middle reach of the Yellow River in northern China and straddles the Shaanxi, Gansu, Ningxia Inner Mongolia, and Shanxi provinces. It covers about 370,000 sq km, the size of Japan. Its northern margin is marked by the Daiqingshan and Langshan Mountains, which belong to the western part of the Yinshan Mountains. It is bounded to the west by the Helanshan Mountains, to the south by the Qinling Mountains, and to the east by the Luliangshan Mountains.

The basin is divided into two parts by the Great Wall. The southern part is the Loess Plateau, composed of loess tablelands, ridges, gullies and hillocks formed by violent erosions and down-cutting. The highest altitude is 1,823 metres. The northern part is a desert – prairie plateau which has been planed off, with an average altitude of 1,400 metres. In this region there is the Maowushu Desert to the south, and the Kubuqi Desert to the north, and it is fringed by the Hetao basin, the Yinchuan basin and the Fenwei basin, which are well covered with Quaternary sediments. The Luipanshan basin is an uncovered Mesozoic and Cenozoic sedimentary basin, and Cretaceous and Tertiary systems are widely exposed at the surface.

The sedimentary rocks in the Ordos basin are 6,000 metres thick. China's largest onshore field, the Changqing field, is located in the central Ordos basin. It has 244 bcm of proven gas reserves in an area of 5,000 sq. km, 5.7% of the basin's total geological reserves of 4.17 tcm. Plans are under way to achieve a cumulative gas reserves of around 500 bcm by 2005 and 1 tcm by 2010.

Changqing's Sulige -6

In late January 2001, PetroChina announced a new discovery of major gas field in Ih Ju League of Inner Mongolia Autonomous Region, 700 km north of Beijing. This report from the State Oil and Gas Appraisal Office under the Ministry of Land and Mineral Resources indicated that the Sulige gas field has 220.4 bcm of proven reserves, of which 163.2 bcm is recoverable. PetroChina's Changqing Oil field company believed that it would acquire an additional 300 bcm of proven gas reserves in 2001 after drilling

more appraisal wells. The company estimated that the ultimate proven reserves in the field will exceed 700 bcm, making it China's single largest gas field.

PetroChina's announcement was made after drilling Su-6 in the Sulige area which struck a high yield gas flow at upper Palaeozoic. The peak daily gas output recorded 1.2 mcm. Seven other wells sunk later all reported either high or medium level commercial gas flows, leading to the emergence of Sulige gas field. PetroChina hopes that it can build up an annual production of 10 bcm at Sulige gas field. Unlike Kela-2 gas field which is only 48.1 sq. km, Sulige covers a gas bearing area of over 5,500 sq. km, and the area expects further expansion in 2001.

PetroChina claims that the Sulige discovery has secured a solid and reliable gas resource foundation for the west-east gas pipeline project. Cheered by this discovery, PetroChina accelerated the preparations for the dual line of Shaanxi-Beijing gas pipeline. Shell has begun to conduct joint pre-FS with Changqing team on moving the gas to be produced from its concession block Changbei to the designated markets in north China. Shell expects to put the block into operation in 2004, building up an annual production capacity of 3 bcm of gas. Before this discovery, PetroChina planned to use the Changbei gas as the backup resources for west-east gas project.

By the end of 2000, Changqing reported accumulative proven gas reserves of 750 bcm, probable reserves of 508 bcm, and possible reserves of 528 bcm. In 2000, new proven gas reserves of 409 bcm was acquired. According to PetroChina's plan, the production from Changqing will be 3 bcm in 2003, 10 bcm in 2005 and 20 bcm in 2010.

PetroChina aimed at submitting the finalized version of west-east gas project FS to the SDPC in April 2001. Reportedly the State will only grant PetroChina 4 billion yuan in loans, making up just one tenth of the total investment. So, PetroChina is determined to attract more western partners in the west-east pipeline project.

In August 2003 the PetroChina Changqing Oilfield Company (PCOC) announced that the company has newly discovered 313 bcm of extra reserves in the Sulige gas field. Now the field's total proven reserves stand at 534 bcm. PCOC put forward the newly discovered reserves at the end of July 2003, and they were officially approved by the Energy Assessment Center of the Ministry of Land and Resources.

North China's Changqing gas field, under CNPC's development, began trial gas delivery to the major cities of Hohhot, Baotou and Erdos in the Inner Mongolia Autonomous Region, after a pipeline beginning in the Field's Wushen Area finished construction at the end of September 2003. The 506-km pipeline has a designed capacity of 0.95 bcm annually. It will reach industrial, commercial and resident users in the three cities, with the volume of supply to industrial users accounting for 60% of the total. The maximum transmission volume via the pipeline could reach 1.3 bln cu m per annum. Estimated investment for the pipeline project was 839 million yuan (US\$ 101.3 million).

CNPC's other three areas for concentrated exploration and development in Changqing are Yulin, Jingbian and Sulige, which is the largest gas field in China. Both the Yulin and Jingbian areas are supply sources for PetroChina's West East Pipeline (WEP) Project. Other downstream markets for Changqing include Beijing, Xi'an, (capital of Shaanxi Province) and Yinchuan, capital of the Ningxia Autonomous Region.

Changqing Gas to Beijing

In September 1997, CNPC completed a long distance pipeline connecting Jingbian, Shaanxi Province and Beijing. The 864 km pipeline with a maximum designing capacity of 3 bcm cost 3.94 billion yuan (US\$ 475 million). The pipeline moves 1 bcm/y of gas in early stage but the volume was designed to be expanded to 3 bcm/y. In 1998, Changqing gas was to set up eight gas gathering stations and put eleven wells on stream. In 1999, the production capacity from Changqing gas field reached 1.6 bcm/y, a jump from 0.46 bcm/y in 1998. The cumulative gas production capacity from the field could reach 2.2 bcm at the end of 1999.

However, Changqing officials emphasized that its new production capacity of 1 bcm will not be built until end-user market contracts have been secured to recoup the investment at the earliest possible date. Of the 1 bcm new production base, 0.7 bcm/y capacity will be built in the Jingbian area where 28 new exploration wells will be sunk. Another 0.3 bcm capacity will be installed in the Yulin area where 14 new exploration wells are planned.

Changqing field will bring on-stream a 2 mcm/d of gas purifying capacity before the total to 8 mcm/d. When all these schemes are materialized, the field's peak daily gas moving outside of the field will hit 9-10 mcm/d. The pipeline is remotely controlled through an SCADA (Supervisor Control and Data Acquisition) system that utilizes satellite telecommunications, running from Jingbian to Beijing's Shijinshan.

On December 23, 2003 PetroChina announced that the daily peak transmission capacity through the Shaanxi-Beijing Natural Gas Pipeline had been successfully raised by over 60% to 26.3 mcm. It was estimated that more than 4 mcm of gas was being consumed every day in Beijing to generate heat, and the city's overall daily gas consumption could reach a peak of nearly 20 mcm in 2003. Consequently, PetroChina has forecast that whole-year sales via the Shaanxi-Beijing Gas Pipeline would exceed 2.7 bcm in 2003.

Beijing's natural gas consumption was projected to reach to 2.1 bcm, recording an all-time high for the whole year of 2003.² Household use, especially for heating, has

² Beijing Municipal Government has ordered that all districts switch to natural gas from coal before February 15, 1999 provided the necessary facilities for pipeline gas are ready. Beijing plans to retrofit 1,800 natural gas fuelled vehicles in 1999 which are expected to consume 30 mcm of natural gas in the latter half of 1999. Yanshan PetroChemical Group Co. Ltd as the largest industrial gas user in Beijing has promised to start natural gas from April 1999. Its annual consumption scale is likely to reach 0.3 bcm.

In July 2000, PetroChina signed a gas supply contract with Beijing Gas Group (BGG). The gas is from Changqing gas field and the contract period is six years from 2000 to 2005. BGG said that the contract does not stipulate the concrete gas volume and price.

Beijing's natural gas demand in 2000 is pegged at 1.1 bcm, of which 0.82 bcm is coming from Changqing gas field. Via the long distance pipeline. In 1999, Beijing consumed 0.75 bcm of gas, of which 0.53 bcm from Changqing and the rest from Huabei oilfield.

Most of the gas consumed in Beijing is for residential use and therefore affected by its seasonal fluctuations. Gas consumption usually peaks in winter with peak daily demand six times higher than that of the summer time. PetroChina is now building an underground gas depot in Dagang

accounted for the bulk of the increase, as the Beijing government has converted a large number of public heat-providing boilers from coal to natural gas in 2003.

To meet the rapidly growing demand in Beijing and the surrounding area, PetroChina decided to build the second gas pipeline. The proposed pipeline connecting Shaanxi Province with Beijing is scheduled to begin construction in March 2004 and officially begin to supply gas on September 30, 2005. The first Shaanxi-Beijing Gas Pipeline was completed in 1997, and had delivered a total of 7.53 bcm of commercial gas by October 20, 2003. A letter of intent on gas sales was signed in September 2002 with seven prefectures and cities in Shanxi Province. Three sub-transmission stations are to be set up in the Province. Local consumption in the first year is expected to reach 0.183 bcm, and will grow to 2.07 bcm in the fifth year.

Shaanxi Province is planning another Jingbian-Xi'an gas pipeline to boost the province's gas supply from the current 1 bcm to 4 bcm per year. The planned pipeline will measure 445km in length and 610mm in diameter. The whole project will fall into three phases, and the first phase will conclude in November, 2003.

Shell & Changbei Gas

Changbei block in Yulin area is Shell's first gas project in China. In late June 2000 PetroChina's Chongqing Petroleum Exploration Bureau started to drill gas appraisal

oil field with a storage capacity of 6 mcm. The gas depot is scheduled to start operation in Nov 2000. BGG worries about the breakdown of pipeline. It happened in 1998 when a minor technical default of the pipeline led to a two-day supply suspension. Luckily, the accident happened during the summer time when the demand was at its lowest point. So, the supply disruption was not noticed.

Since July 1, 2000, the transmission fee for Changqing gas was increased by 0.11 yuan / cm to 0.47 yuan / cm. As a result, city gate gas price has risen to 1.1 yuan / cm from the previous 0.99 yuan / cm. PetroChina, however, argued that the pipeline is still running at a loss as the transmission cost is at least 0.68 yuan / cm due to the low volume. The ownership of the pipeline is composed of a 55% stake by PetroChina and the rest 45% by Beijing Municipal government.

BGG proposed the residential gas price increase in Beijing from 1.4 yuan / cm to 1.8 yuan / cm. As of 2000, Beijing has 1.6 million residential gas users and over 100 industrial users. Among all the gas sales by BGG, industrial sector takes 10%, residential sector 20%, commercial sector 20%, and heating takes the largest share of 50%. Except the residential sector which is charging 1.4 yuan / cm, other sectors are charging 1.8 yuan / cm. In early January 2001, Beijing raised the natural gas price for residential use and service sectors. The residential sector saw the price rose from 1.4 yuan / cm to 1.7 yuan / cm. The commercial sector saw the figure dose from 1.8 yuan / cm to 2.2 yuan / cm. But the industrial price remained the same at 1.8 yuan / cm. The price for subsidised bottled LPG also went up to 36 yuan/bottle from 29.4 yuan/bottle, or from 1960 yuan/tonne to 2400 yuan/tonne, an increase of 22.4%.

During Nov 2000 to March 2001, Shaanxi-Beijing gas pipeline delivered 0.925 bcm of gas and the daily gas transportation volume averaged at 7.64 mcm. Among the total, 0.649 bcm of gas was delivered to Beijing, 0.068 bcm to Tianjin, 0.158 bcm to Yanshan PetroChemical, 0.048 bcm to Cangzhou PetroChemical. The peak daily volume recorded 10.176 mcm. Initially Beijing aimed at using 3-4 bcm of gas by 2005 and 5-6 bcm by 2010.

wells for Shell in the Changbei region. The drilling is based on a contract between the two in early June 2000. The US\$ 4 million contract which is valid for two years requires Changqing to drill two appraisal wells for Shell. The project plans to invest US\$ 27 million for the appraisal. The projected commercial production start-up is in 2004, with a production capacity of 3 bcm.

The Changebi block's proven reserves are estimated at 70 bcm, and the annual production capacity is 3 bcm. Shell is interested in constructing a long distance pipeline to move gas eastward to Hebei, Shandong, and finally Shanghai. Big cities en route include Shijiazhuang (Hebei), Weifang (Shandong) and Jinan (Shandong). Changqing is very keen on this project and plans to incorporate this project into CNPC's West East Pipeline (WEP).

In February 2001, Shell Oil Co. & PetroChina signed an agreement to build a second Shaanxi-Beijing natural gas pipeline. Current pipeline looks under-utilized, but the reality is not. The present daily supply of natural gas through this pipeline is about 1 million cubic metres during summer months. But the discrepancy of natural gas consumption in Beijing is very large. The daily supply of natural gas in the winter has been as high as 9 million cubic metres, making already impossible to add new users. The present Shaanxi-Beijing pipeline mainly supplies civil needs and the second pipeline will be used mainly by industrial customers, such as power plants. It will considerably alleviate Beijing's profound pollution problem.

SINOPEC's Initiative: Ordos gas to Shandong?

SINOPEC is working on its gas strategy in northern China, using Daniudi Gas Field in the northern part of the Erdos Basin as its supply source, and targeting east China's Shandong Province as its principle market. A pipeline connecting the two areas, around 850 km apart, is under consideration and will be submitted to the central government for approval.

The Daniudi Gas Field in the Tabamiao Block of the Erdos Basin has so far been found to contain 118.6 bcm of proven gas reserves, and the total amount of gas resources has reached 1.35 trillion cu m. SINOPEC Huabei Branch's Parent Company ambition is to ensure an annual gas supply of 1 bcm from the gas field by 2005, and further boost that amount to 3 bcm by 2020.

A pilot gas supply project from Daniudi to Hanggin Banner in the Ih Ju League of southern Inner Mongolia was put into trial operation on September 26, 2003. The pipeline, costing around 200 million yuan (US\$ 24.2 million), has a length of 138 km and is designed to transmit only 0.2 bcm of gas per annum to a glass making plant in Hanggin Banner.

2.1.2.4. Sichuan Basin

The Sichuan basin, covering an area of 180,000 sq. km is known for its long history of gas utilization. A rhombus-shaped basin, it is surrounded by the Longmen, Gonglan, Ermei, Daluo, Qiqun, Wushan and Daba Mountains. Lying in the Upper Yangtze area, the basin has marine and continental sedimentary rocks and the thickness of the strata ranges up to 6,000 – 12,000 metres. Gas traps have been found in Sinian, Ordovician, Carboniferous, Permian and Triassic, and Jurassic structures. The southern part of this

marine sedimentary basin primarily produces gas from carbonate rocks of the Late Palaeozoic era. A few small oil fields have been discovered in the northern part of the Sichuan basin.

The initial gas discovery in Sichuan was recorded 2,200 years ago, but large scale exploration and production was not initiated until 1949. Between 1758 and 1949, only about 3,200 gas wells were drilled. The gas used by salt and other industries amounted to around 3 bcm.

During 1950-51, four oil and gas investigation teams carried out a petroleum geological survey in the Longquan, Leshan, Longchang and Longmen Mountains. Until 1982 a systematic geological survey continued and since 1983 another large scale exploration has been undertaken in the basin, leading to many significant breakthroughs and important discoveries. The main finds include the Zhongba gas field in the northwest Sichuan, Permian, Triassic and Carboniferous gas bearing strata in the Liyinpu structure of northeast Sichuan, the Xujiahe formation in hexingchang of the west Sichuan depression, qinggangping and Guanyinchang gas structures in southwest Sichuan, Dongyueniao and Jialingjiang gas reservoirs in east Sichuan, the Shilongchang condensate gas field in north Sichuan, the Xiaoquan gas field in west Sichuan, the Tongnanba gas-bearing structure in east Sichuan, the Dongyuezai gas structure in northeast Sichuan and the Jia-2 reservoir of the Mitouchang slope in central Sichuan.

During the 1990s, two exploration teams were hunting for gas in Sichuan. One is Sihuan Petroleum Administration Bureau (SPAB) under the CNP and the other is the Southwest China Petroleum Bureau under the newly established China National Star Petroleum Corp.

Sichuan Gas: Supply and Demand Projection

According to a provincial survey, Sichuan's natural gas consumption will increase by 5% annually in the next two decades. The survey estimated that Sichuan's provincial natural gas consumption will reach 5.6 bcm in 2000, 9.1 bcm in 2010, and 14.9 bcm in 2020. (It is much higher than the projection figures in Table 38)

The increase will mainly come from the residential and auto fuel sectors. According to a provincial plan, by 2000 except Panshihua and three other prefectures, all the cities above the county level in the province and all the towns in the Chengdu area will have natural gas supply available for all of their residents. 1999, residents in 10 more cities and 17 counties in Sichuan are expected to cook on natural gas. In 2000 gas demand by households would reach 0.901 bcm, covering 45.9% of the provincial population.

In the auto fuel sector, the number of new vehicles fuelled by compressed natural gas (CNG) will reach 20,000 in 2000. In 2010, there will be 200 gas filling stations to serve 100,000 CNG vehicles. China's first CNGV and first CNG filling station were both put into operation in Sichuan in 1989.

Table 38 - Sichuan Province Gas Supply and Demand
(Unit: billion cubic metres)

Production		
Year	Volume	Remarks
1999	4.954	Production organizations : - CNPC Southwest Bureau - Xinxing Petroleum Corp's. Huachuan Corp - Xinchang Co. Ltd, Wanyuan Co. Ltd, and Longxing Co. Ltd
2000	7.50	
2005	8.50	
2010	10.0	
2020	11.0	
Consumption		
1999	3.957	Residential : 0.639 bcm, 1.67 million people CNG : 28 stations, 3,600 cars
2000	4.30	Residential : 0.88 bcm, 2.40 million people CNG : 100 stations, 20,000 cars (0.15 bcm)
2005	4.85	Residential : 1.17 bcm, 3.00 million people CNG : 150 stations, 50,000 cars (0.4 bcm)
2010	6.953	Residential : 1.912 bcm, 4.60 million people CNG : 200 stations, 100,000 cars (0.8 bcm)
2020	12.0	Residential : 3.051 bcm, 6.80 million people CNG : 300 stations, 140,000 cars (1.2 bcm)

Source: Lin Wenxin and Sun Yonglong (Sichuan Coal Gas Association), "Implement Gasification in all the Sichuan Province to Promote Western Development", presented at China Gas 2000 organised by China Gas Association, Chengdu, Nov. 28-29, 2000.

Sichuan Gas to Wuhan

In October 1999, China International Engineering Consulting Corp (CIECC) finished appraisal of the Sichuan-Wuhan natural gas pipe line project proposal and submitted it to the SDPC. If everything goes well, then the gas should be delivered to Hubei province in 2002. In 1999, Sichuan gas field planed to build a gas purifying plant in Zhongxian County with a daily processing capacity of 4 mcm. It also plans to add 366 km of new gas pipelines for gas collection and complete 45 sets of gas well development facilities. The direct field development investment in 1999 is planned at 1.72 billion yuan, 46.8% of the gas field's total capital outlay. The field's direct exploration investment is expected to reach 0.7 billion yuan in 1999.

CIECC's view was that there are enough gas reserves for the 738 km pipeline, but more work should be done for the downstream sector. By the end of 1998, Sichuan basin's proven reserves stand at 589.5 bcm, of which 554.6 bcm are controlled by CNPC. As of early 1999, there are over 90 gas fields in Sichuan basin with around 1,000 gas wells.

In the Chuandong (east Sichuan) area, which will be the major supply source for the 738 km pipeline have 328.2 bcm of proven gas, 55.7% of the basin's total. Around 2002, a production capacity of 10.6 bcm/y is to be built in Sichuan based on 652 bcm of proven reserves. Of this 10.6 bcm production, 2 bcm is due eastward to Wuhan and then to the Yangtze River Delta. To ensure the annual throughput of 3 bcm/y, the diameter has been revised to 711 mm from 660 mm.

Wuhan city government has asked CNPC to supply 1-1.2 bcm/y of gas eventually but the city's initial demand would be at most 0.15 bcm/y due to lack of distribution network.

In early October 1999, Wuhan Natural Gas Office signed letters of intent for gas supply with seven major potential users, like Yangluo Power Plant (coal to gas), Qingshan Thermal Power Plant (coal to gas), Dunkou Gas Turbine Power Plant (oil to gas), Wuchang Thermal Power Plant (coal to gas), Wuhan Pipeline Towngas Company, Wuhan Towngas Group Companies and Wuhan Qianneng Gas Thermal Company. The total natural gas demand from these seven companies are pegged at 2.7 bcm per year.

According to Hubei provincial government's gas utilization plan, ten cities like Yichang, Jingzhou, Jingmen, Xiangfan, Lichuan, Enshi, Zhijiang, Qianjiang, Xiantao and Yidong are expected to receive Sichuan gas around 2002. The provincial urban gas demand is projected to be 0.65 bcm in 2005, 1.5 bcm in 2010 and 2.4 bcm in 2020. City gas or Town gas is projected to take 70% of the total demand in 2005, 60% in 2010, and 55% in 2020. There would be a strong growth from the industrial sector. Wuhan plans to achieve a gasification rate of 90% by 2020 with a daily gas use of 2.36 mcm. Besides this, winter heating appliances and gas fuelled vehicles in the city will consume 10% of the total gas eventually.

Most cities in Hubei province are currently dependent on coal gas or LPG for cooking and heating. Gasification rate in urban Hubei was 77% at the end of 1998 with 0.5 million households linked to the gas grid. In Wuhan, 1.12 million people have access to coal gas with a daily consumption of 0.505 mcm. Retrofitting current grid calls for the construction of inner city gas distribution network, peak-shaving facilities and compressor stations.

Generally speaking, in inland China 1 billion yuan is needed for infrastructure development for every 100 mcm of gas consumed at households. A rough calculation by Wuhan city estimates that a total of over 22.73 billion yuan is required by 2020 to implement the gas plan. Among the total investment, 40% will go to the distribution grid which will be collected from every household in the name of initial installation fee or connection fee.

In the near term, Wuhan city government's key project is to construct a high pressure gas distribution grid within the city. The total distance is 117.5 km with a designed pressure of 2.5 MPa and a diameter of 711 mm. The cost is estimated at 1 billion yuan, of which 50% will be raised by the city government and the rest from foreign bank loan or bonds. A JV with the Chinese side holding a controlling stake will be set up to operate the pipeline grid and gas distribution.

Hubei Provincial Construction Bureau's economic analysis concluded that the city gas price should be no higher than 1.0 yuan/cm and the retail price paid by households should be no higher than 2.0 yuan/cm. CIECC specialists noted that the city gate gas price for Sichuan-Wuhan pipeline will be around 1.05-1.1 yuan/cm, just above the level of the Shaanxi-Beijing pipeline which is 0.99 yuan/cm.

Chinese pipeline economists highlight the importance that city management should take into consideration the domestic user's paying ability when charging the lump sum initial installation fee and the administrative fee. The administrative fee in the cities using natural gas currently is up to 0.4-0.5 yuan/cm, drove many potential residential users away. The initial installation fee charged on the residential users are as follows : Xian 2,868 yuan, Xianyang 3,180 yuan, Tongchuan 2,650 yuan, Changdu 4,000 yuan, Nanjing 2,300 yuan, Chongqing 5,000 yuan.

In March 2001, PetroChina started a gas gathering project in eastern Sichuan basin to back up the Zhongxian-Wuhan pipeline. PetroChina aims at building two branch lines, one 73 km and the other 19 km to link gas fields to gathering stations. It will also construct three new gas gathering stations and revamp three existing ones.

The supplying gas fields to the 738 km Zhongxian-Wuhan pipeline include six gas fields in eastern Sichuan basin with 360 bcm of proven gas reserves and 260 bcm of recoverable gas reserves. They are expected to deliver 2 bcm annually for end-users in Hubei province.

An important concern of the route designers is that in the first stage of the project Sichuan gas shall be used by local power plants as fuel when the low water season makes the Three Gorges Project unable to generate enough electricity. As the gas fired turbines are superior in peak shaving, experts believe China should reserves the local resources for the power sector. Nonetheless a possibility of linking Sichuan gas to the trunk line after 2010 still exists.

In November 2002 NDRC approved the FS of the project and in late August 2003 the formal construction of the Zhongxian-Wuhan gas pipeline was started. The US\$ 600 million Zhongxian-Wuhan Pipeline project with a total length of 1,347.3 km and 3 bcm/y of delivery capacity comprises of:

- 718.9 km-long trunk line from Zhongxian in Sichuan Province in the western part to Wuhan in central China (other source tells the distance is 738 km);
- 210 km-long branch from Jingzhou to Xiangfan, both in Hubei ;
- 340.5 km-long branch from Qianjiang in Hubei to Xiangtan in Hunan Province ;
- 77.9 km-long branch from Wuhan to Huangshi in Hubei.

The pipeline will channel natural gas to Chongqing, Wuhan, Changsha and a dozen of cities after the whole project is completed in July of 2005.

The 719-km trunkline will have to cross the Yangtze River in three places. Underground tunnel construction at one location has just been completed, and that at the other two places is still going on. On January 12, 2003 tunnel-digging at Junshan, near the terminus of Wuhan, was completed and pipes will be placed in the 1490-m tunnel later. The other two cross-Yangtze projects are located at Honghuatao near Yidu in south Hubei Province, and Chenlingji near Yueyang, which is on the border of Hubei and Hunan provinces.

According to PetroChina's timetable, the company plans to realise the operation of the trunkline and two branches — the Jingzhou-Xiangfan branch and the Wuhan-Huangshi branch – by yearend 2004, and realise the operation of the Qianjiang-Xiangtan branch by July 1, 2005. PetroChina said it had already secured sales contracts with 27 users in the region, and these users will buy 0.736 bcm/year of gas by 2004 and will buy 3 bcm/year of gas by 2008. By the year of 2008, Wuhan was expected to obtain an annual volume of 1.2 bcm of natural gas from the Sichuan Basin. PetroChina did not reveal the prices it will charge the users along Zhongxian-Wuhan pipeline. But reportedly the average price for natural gas in Wuhan was preliminarily estimated at 1.508 yuan (US\$ 0.182) per cubic metres.

Based on a proven gas reserve of 680 bcm, Sichuan-Chongqing basin is currently producing a 9 bcm/year of gas, and by 2005 the volume will rise to somewhere between 13.8-14.8 bcm/year. By 2010, the figure will reach to 16.5-18.5 bcm/year.

Burlington & Chuanzhong gas

The independent U.S. Burlington Resources Inc. (Burlington) which is now the operator of the 1.8 million acre Chuanzhong Block owning 100% working interest took over the assets from the bankrupt U.S. energy company Enron in 2001 and confirmed that the development of the Chuanzhong Block would go into full swing in 2004. A natural gas purchase and sales agreement concerning the block was signed between PetroChina and Burlington in April 2002. Three wells have been drilled in 2003, producing 0.2 mcm/d. The company is committed to invest another US\$ 50 million in the block in 2004 in order to raise the daily output to 1 mcm. Burlington hopes to achieve a maximum annual output of 0.4-0.5 bcm from Chuanzhong over the next few years and a total investment of US\$ 150-200 million will be made. The company is interested in spending US\$ 300-500 million in other parts of Sichuan so that its total output from the province will jump to 1.5 bcm per annum in future.³

Gazprom & Chongqing Storage

According to Gazprom's Beijing Office press secretary Igor Budantsev, Russia's Gazprom intends to chip in 200 million yuan (US\$ 24.2 million) on an underground gas storage (UGS) project in Chongqing Municipality, and has signed a preliminary agreement with the local government. Chongqing's current gas supply ability stands at only 0.8 mcm per day. The underground gas depot will have a storage capacity of 200 mcm, enough to supply for one month the most populous municipality in China, containing 31.1 million people.

2.1.3. Town Gas (City Gas) Expansion

To accelerate the gas market development for the west-east pipeline, central authority opened the two gas sectors to foreign and private investment in April 2002 for the first time. Even though foreign and private firms are not allowed to take the controlling stakes in gas JVs in medium and large cities, China's town-gas sector is very positive about foreign investment attraction. The leading firms in this sector are Hong Kong & China Gas Co., Xinao group based in Langfang city in Hebei province, and Panva Gas based in Shenzhen. Besides these players, big players like CNPC, SINPOEC and CNOOC are also targeting at this promising sector. In the case of CNPC, its subsidiary, Pipeline Bureau has set up a number of town-gas JVs with local and foreign gas companies.

The way major cities are responding on the city gas expansion. Instead of integrating the formerly independent gas-related enterprises the way Tianjin had done, Shanghai disbanded the coal gas sales group company and coal production group company, and established three regional sales companies and three coal-gas production enterprises. Shanghai Municipality established the Gas Distribution and Supervision Centre to co-

³ Burlington also has a 24.5% interest in developing Block 15/34 of the Panyu Offshore Project 100 miles south of Hong Kong, in which CNOOC also participates.

ordinate the operation of the sales and production companies. The existing municipal construction group has taken over the previous logistics function.

Table 39 shows how China's city coal gas grid has expanded during 1985-2000 period. The total distance of city coal gas grid is much longer than that of natural gas grid in China (See Table 40). In particular, East China has developed a major coal gas industry and consequently the total distance of region's coal gas network is roughly 20,700 km or 43% of the country total, while that of natural gas network stands at roughly 3,040 km. As the main target market of the long distance pipeline gas, cities in the Yangtze River Delta areas are upgrading their coal gas grid or developing new natural gas pipelines to accommodate the pipeline gas. On the contrary, Southwest China where Sichuan and Congqing are located has the largest natural gas network and consequently the distance of region's coal gas grid is only 1 fifth of the natural gas grid.

Table 39 - China's City Coal Gas Grid

Year	Distance (km)
1985	10,567
1990	16,312
1995	33,890
1999	45,847
2000	48,376

Source: China OGP (2002)

Table 40 - China's City Gas Grid by Province, as of 2000

Municipality / Province	Total Distance (km)	
	Coal Gas	Natural Gas
Beijing	544	4,231
Tianjin	1,270	4,268
Hebei	2,710	566
Shanxi	2,700	290
Inner Mongolia	755	-
North China Sub-Total	7,979	9,355
Heilongjiang	1,949	476
Jilin	1,889	1,017
Liaoning	4,470	2,951
Northeast China Sub-Total	8,308	4,444
Shanghai	6,606	1,742
Jiangsu	4,277	-
Zhejiang	1,084	-
Anhui	1,918	16
Fujian	567	-
Jiangxi	1,548	-
Shandong	4,676	1,279
East China Sub-Total	20,676	3,037
Henan	1,816	2,339
Hubei	2,874	-
Hunan	1,116	-
Guangdong	1,730	127

Guangxi	158	20
Hainan	-	-
Mid-South China Sub-Total	7,694	2,486
Chongqing	30	4,195
Sichuan	364	8,595
Guizhou	1,121	17
Yunnan	1,298	3
Tibet	-	-
Southwest China Sub-Total	2,813	12,810
Shaanxi	328	843
Gansu	358	36
Qinghai	17	176
Ningxia	203	81
Xinjiang	-	385
Northwest China Sub-Total	906	1,521
China National Total	48,376	33,653

Source: China OGP 2002

Table 41 - Nation-wide City Gas Demand projection by Ministry of Construction
(Unit: billion cubic metres)

	Short term : - 2005		Mid-term : 2006-2010		Long term 2011-2020
	City no.	volume	City no.	volume	volume
Sichuan	18	4.85	19	6.953	12.0
Chongqing	1	1.66	1	2.499	3.5
Hubei	11	0.646	24	1.510	2.5
Henan	12	0.696	24	1.513	3.0
Anhui	5	0.299	12	0.678	2.2
Jiangsu	5	0.321	13	3.300	8.5
Shanghai	1	1.533	1	2.133	4.1
Zhejiang	6	0.891	11	2.037	4.4
Qinghai	13	0.190	13	0.291	0.8
Gansu	3	0.170	7	0.340	2.0
Xinjiang	9	0.292	11	0.477	2.5
Ningxia	4	0.171	7	0.299	0.8
Inner Mongolia	5	0.196	5	0.216	0.8
Shaanxi	8	1.574	8	3.043	4.8
Shanxi	4	0.138	12	0.384	4.8
Beijing	1	2.024	1	3.000	6.0
Tianjin	1	0.654	1	1.056	3.6
Hebei	7	0.504	7	0.646	2.5
Shandong	8	0.530	17	1.180	4.2
Guangdong	4	0.196	9	1.980	4.5
Guangxi	6	0.307	9	0.769	2.4
Hainan	4	0.184	7	0.453	1.4
Liaoning	4	0.558	11	1.000	3.0
Heilongjiang	5	0.598	5	1.199	3.2

Jilin	3	1.060	9	1.760	3.1
Hunan	-	-	8	0.479	1.5
Guizhou	-	-	16	0.446	0.8
Fujian	-	-	5	1.578	4.0
Jiangxi	-	-	2	0.158	0.8
Total	148	20.242	270	41.377	93.70

Source: Xu Zhengkang, "Policy Research on Natural Gas Utilization in Urban Areas" presented at China Gas 2000 Conference organised by China Gas Association, Chengdu, Nov. 28-29, 2000.

2.1.3.1. Town Gas Expansion in China

There are a number of city gas companies targeting the burgeoning city gas business in China, and the companies are Towngas, Xinao Gas, Panva Gas, Wah Sang Gas, Zhengzhou Gas and Beijing Gas.

Towngas

Hong Kong and China Gas Co. Ltd. (Towngas) has conquered HK city gas sector and decided to expand its business development in China. The firm announced that as of September 2003 investments have been made in 16 city piped gas projects – including Wuhan in Hubei province, Zhongshan, Panyu and Guangzhou in Guangdong province, Yixing and Suzhou in Jiangsu province, and Jimo, Laoshan, Qingdao in Shandong province - in China with investment of HK\$ 2.4 billion (US\$ 308 million). Towngas was awarded a 3% minority equity stake in China's first LNG terminal project in Guangdong Province, and was said to have been granted a 1% interest in the West East Gas Pipeline Project, most likely from Shell.

According to the firm's report, in 2003 Towngas has established a 50:50 joint-venture gas business in Nanjing, and has entered into a framework agreement with the municipal government of Shenzhen to acquire a 30% equity stake in the Shenzhen Gas Corp., previously wholly state-owned.

According to Yichang Natural Gas Co. Ltd., Yichang, the second largest city in Hubei Province and location of the Three Gorges Dam, began the construction of a 200 million yuan (US\$ 24.2 million) urban natural gas pipeline project. The city aims to use natural gas supplied from the Sichuan Basin from the end of 2004. Towngas takes a majority 70% stake in the project, with Yichang Natural Gas holding the remaining 30%.

In August 2003, HK & China Gas Co. agreed to set up a new JV named Nanjing Ganghua Gas Ltd., and the 51% controlling stake will be given to its Chinese counterpart, the local government. Nanjing Gas Co. Ltd., which will be dissolved on September 1, 2003, currently supplies coal gas to 300,000 users, mainly domestic users, across the city. Apart from the existing coal gas business to be taken over from the Nanjing Gas Co, these projects involve a natural gas terminal to be set up in Dongyang between the cities of Nanjing and Zhenjiang. The JV also plans to spend two to three years in replacing the existing coal gas pipelines across Nanjing with new ones that are able to supply coal gas and natural gas alternatively. The partners will jointly invest 1.2 billion yuan (US\$ 145 million) in the new venture, which has a registered capital of 0.6 billion yuan (US\$ 72.5 million).

In September 2003 HK & China Gas Co. (Towngas) has entered into a contract with Weifang Gas General Co. to operate and manage piped gas projects in Weifang for as long as 50 years. Weifang has a population of 8.5 million, and the city was expected to consume 0.22 bcm/y of piped natural gas in 2015.

The same month, Towngas also signed a similar contract with Weihai and Jinan in Shandong province. First, the firm established a 50-50 joint venture with Weihai Gas Corp. to upgrade fuel pipelines in urban areas. The project will start supplying imported liquefied natural gas (LNG) to 40,000 local families after June 2004, before natural gas from the Bohai Sea begins to fuel the city in 2008. The firm also struck a deal with Jinan and secured a 60% stake in the project. In Jinan, there are 260,000 coal gas users, including families and industrial users and the city was expected to consume up to 0.268 bcm/y of gas by 2023. In Wuhan, the capital of Hubei Province, Towngas has set up a 1 billion yuan (US\$ 121 million) joint venture with Wuhan Gas and Heat Group to upgrade gas pipelines for the upcoming West-East Pipeline. Towngas took a 49% stake in the company.

Xinao Gas

Xinao Group began to invest in city gas since 1992, and Xinao Gas Holdings Ltd. (Xinao Gas) is part of the group. As of 2003 the firm claims that it is the largest non-state-owned city gas operator in Mainland China and has operations in some thirty cities. The firm advertises that it is also appointed the "State Research Base for the Utility Sector-City Gas" by the China National Situation Research Committee in 2001. All the cities targeted by Xinao Gas are cities to be reached by large-scale natural gas pipelines such as west-east gas pipeline, Zhongxian-Wuhan pipeline and Guangdong LNG project.

The number of city gas projects controlled by Xinao is 38, and the total urban population covered by the projects has hit 17.8 million. The 38 city projects are located in Guangdong, Liaoning, Jiangsu, Zhejiang Henan, and Shandong provinces as well as Beijing. The firm hopes the business expansion to 55 cities by 2005, with the project number growing by 6-7 annually.

In September 2003, Changsha Xinao Gas Co. Ltd. has received a 20-year operation license to produce, transport and distribute piped gas in Changsha in Hunan Province. The JV equity will be divided by 55:45 ratio between Xinao Gas Holdings and Changsha City Gas. The JV's registered capital is 150 million yuan (US\$ 18.12 million). Changsha became the 33rd city in China in which Xinao has obtained a business license. Currently Changsha City Gas supplies piped coal gas to 80,000 users and liquefied petroleum gas (LPG) to 12,000 users, occupying one fourth of the city's gas market. The new venture aims at doubling its market share in the city. Moreover, Xinao Gas is planning to supply natural gas from Sichuan Basin, and the gas supply to the city could start in June 2005 to gradually substitute coal gas and LPG.

Around the same period, Xinao Gas has taken position in Lianyungang city in Jiangsu province and the Wenzhou Economic Zone, Jinhua Economic Zone and Lanxi city in Zhejiang province. Xinao set up two wholly owned towngas companies for its Wenzhou and Jinhua projects.

In October 2003 the Hong Kong-listed private gas distributor, Xinao Gas Holdings Ltd. (Xinao Gas), announced that it has secured a 30-year exclusive right to operate the piped gas business in central China's Kaifeng in Henan Province, and a joint-venture with the local gas utility will be established. The joint-venture in Kaifeng is named as Kaifeng Xinao. Kaifeng, with a population of 4.6 million, is currently using natural gas from the Zhongyuan Oilfield in Henan and is connectable to the West East Pipeline through an extension line to its existing pipeline with Zhongyuan. Additionally, there are 70,000 bottled LPG users in the city as well.

Panva Gas

The Hong Kong-listed gas operator Panva Gas (Panva) solely engaged in the city gas business on the Chinese Mainland, has been tapping markets mostly in eastern, central and southwestern China. Panva Gas claimed that in 2002 it had invested 10 billion yuan (US\$ 1.21 billion) on pipeline acquisitions in 30 Chinese mainland cities. HK tycoon Lee Kai Shing's Hutchison Whampoa is a strategic partner of the gas operator.

As of the end of September 2003, Panva Gas, had 161,500 household piped gas users and 1.632 million household bottled LPG users. Hong Kong-listed Panva Gas's largest shareholder is Sinolink Worldwide Holdings (Sinolink), with 58.83% equity in Panva Gas. Currently Panva's business domain is divided into three groups, the first is LPG wholesale business, including the sale of LPG in bulk and in cylinders (58%) ; the second is Retail sales of LPG in cylinders, piped LPG and piped natural gas (25%) ; the third is gas pipeline construction (16%).

Of the seven operating subsidiaries opened by Panva in China, four are located in Sichuan Province. Besides Sichuan, the firm has one operating subsidiary in Yunnan and two in Guizhou, and has targeted Hunan and Jiangsu provinces for future expansion. The company is also developing its automobile LPG market in the major economic cities of Nanjing, Kunming and Changsha.

In September 2003, Panva Gas Holdings Ltd. announced that it has entered into two gas joint ventures with the state-owned gas operator in Jinan, Shangdong Province. The counterpart of both joint ventures is Jinan Gas Co. Ltd. Panva Gas, will invest 60 million yuan (US\$ 7.25 million) for a 70% stake in the first venture Jinan Panva LPG Co. Ltd, and will invest 51 million yuan (USD 6.16 million) for a 51% share in the second JV named the Jinan Panva Gas Co. Ltd. This second venture will jointly develop and operate a gas grid in the western districts of Jinan. Jinan Panva Gas Co. Ltd would have exclusive rights for piped gas operations in the western districts for a period of 30 years.

In November 2003, The firm announced that it signed four gas agreements in southwestern China's Sichuan Province, through which the company could gain access to over 500,000 potential piped gas-using households. The areas covered are the Yibin city, Jianyang city and Yuechi and Pingchang counties where there is an aggregate population of 15 million.

In December 2003, Panva announced that the firm signed a memorandum of understanding (MoU) with Benxi in Liaoning Province to jointly develop the local piped gas network. The MoU was signed between Panva and two local gas companies controlling altogether 271.1 km of gas pipelines and supplying over 145,500 local

households. Prior to this MOU, the firm also signed an MoU with Harbin Gas Fuel Chemical Co. (Harbin Gas) in Heilongjiang Province for the development of the local piped gas and LPG market. Harbin Gas is the exclusive piped gas operator in Harbin, having more than 1,800 km of gas pipelines in the city covering over 650,000 household users.

Wah Sang Gas

Wah Sang Gas claims to have signed exclusive contracts with over 70 cities and districts in China, covering an approximate population of 9.85 million. It has also said that turnover and net profit had reached HK\$ 504.2 million (US\$ 65 million) and HK\$ 147 million (US\$ 18.9 million). The length of pipeline networks was extended by 43% to 1,747 km by the end of September 2003 and the sales of piped gas to residential and industrial customers combined jumped 21.9%, amounting to 1.16 bln mega-joules. As of the end of June 2003, the cumulative number of connected households to the Wah Sang Gas grid reached 504,000 units.

It is interesting to note that there is a difference in the way taxation levied on the Mainland subsidiaries of Panva, Wah Sang Gas and Zhengzhou Gas : Wah Sang is exempt from the imposition of 33% VAT on its gas collection fees in Mainland China, while Panva subject to a VAT range of 15-33% and Zhengzhou Gas levied 33% VAT.

Zhengzhou Gas

Zhengzhou Gas, based in Henan Province, said that natural gas sales in the first nine months of 2003 had risen to 135.5 million yuan (US\$ 16.4 million), of which delivery to residential users in Zhengzhou accounted for over 70%. The company will connect the West East Pipeline (WEP) to Zhengzhou, the capital of Henan Province, soon.

Baijiang Gas

HK based Baijiang Gas has secured a total of 14 town gas supply projects in Jiangsu, Hunan and Yunnan provinces and the number of customer base is more than one million as of 2002. Having been in LPG business in Hunan province for years, Baijiang Gas also targeted in the province's town gas business, in particular Changsha, Zhuzhou, and Xiangtan. In 2002 Baijiang Gas was negotiating with Xiangtan local government and in 2001 secured a similar deal in Sichuan's Ziyang. Baijiang Gas pay special attention to the less developed southwest China and expects to secure about 100,000 customers in 2002.

Minglun Group

Minglun Group (Hong Kong) Co. Ltd., was an arm of the privately-owned Shenzhen-based Minlun Group, has announced that it signed a letter of intent to purchase a majority stake in the Beijing-based Changdongshun Gas Co. which is a private-owned company which supplies coal gas to Beiqijia Town and Xiaotangshan Town.

2.1.3.2. Local authority's Initiative for Town Gas Expansion

Besides the above mentioned city gas companies, some local governments are taking the steps to get the pipeline gas by upgrading their existing grid or developing a new pipeline network.

Pingdingshan, a city in Henan Province plans to lay pipelines in urban areas for the upcoming natural gas transmitted from the remote Xinjiang Uygur Autonomous Region via the West-East Pipeline (WEP) with an investment of 225 million yuan (US\$ 27.2 million). The construction was scheduled to start in October 2003 and be completed by the end of 2004 to supply gas for 90,000 local families and some industrial users. The designed capacity is 0.36 bcm/y. The project includes the installation of three gas terminals and pipelines with a combined length of 305.8 km, of which a 128.8 km for long high pressure pipe section and a 177 km-long for mid-pressure section. The urban area of Pingdingshan will increase from 50 sq km in 2000 to 72 sq km by 2005, with its population climbing from 0.6 million to 0.75 million over the period. Consumption of natural gas was expected to reach 80 mcm in 2005, nearly four times current annual demand. In Pingdingshan, the price of natural gas will be set at 1.6 yuan (US\$ 0.19) per cubic metres, almost double the current price of coal gas in the city.

Xinjiang Gas Group confirmed in August 2003 that Urumqi, Xinjiang Uygur Autonomous Region is inviting foreign investors to take part in an expansion plan in an urban gas pipeline project. The so-called "second-phase expansion" for the city's natural gas project will require a total investment of 830 million yuan (US\$ 100.3 million), including 40% set for foreign investment. The investment will be used for the construction of a couple of terminals and gas pipelines that extend 381 km. The second-phase expansion will be completed in 2005, and the project will supply 0.51 bcm/y of natural gas from Tuha Oil Field and the Junggar Basin to Urumqi. The capacity will increase to 0.76 bcm/y by 2010 and to 1.01 bcm/y by 2020. Since the end of 2002, the first-phase project started supplying natural gas to as many as 300,000 users, including industrial users and households, with a designed capacity of up to 0.2 bcm/y.

In the same month, the Shanghai Dazhong Gas Investment Company (SDGIC) with registered capital of 0.8 billion yuan (US\$ 96.65 million) has signed an agreement with Xuzhou Gas Company to set up a joint venture named the Shanghai Dazhong Xuzhou Gas Limited. A month earlier, SDGIC set up a new JV with the Nanchang Coal Gas Company in Jiangxi Province. SDGIC is an equity joint venture established by the Shanghai Municipal Asset Management and Development Co. Ltd. and the Shanghai Dazhong Science and Technology Company Limited. The firm was established by the Shanghai gas giant to specialize in JV investment. SDGIC aims to establish subsidiaries in medium- and large-sized cities. SDGIC's priority is given to Xuzhou and Nanchang.

2.1.3.3. Town Gas vs. LPG business

Liquefied Petroleum Gas (LPG) demand in China has seen an annual growth of 18% during the 1990-2000 period due to the open market competition and participation from the private investment sector. Household is the largest LPG consumer which consumed over 10 mt of LPG in 2000. Still the dominant LPG users are based in the southeast coastal provinces, in particular Guangdong province.

Table 42 - LPG Supply and Demand in China
(Unit: mt per year)

	Production	Import	Export	Consumption
1990	1.823	0.117	0.004	2.542
1995	3.623	2.314	0.071	7.409
1998	5.805	4.766	0.502	11.715
1999	6.779	5.542	0.076	12.638
2000	8.496	4.817	0.016	13.371
2001	9.110	4.850	0.020	14.000

Source: China OGP

Local LPG (liquefied petroleum gas) industry believe it is time to look for opportunities in suburban and rural markets where the urban pipelines simply cannot reach. According to Interfax China report, Yu Xiaoqiao, marketing director of SINOPEC's Refinery Department at the 2003 China LPG Market Seminar held in Chengdu said that "The state government is deliberating a policy for LNG [liquefied natural gas] to enter 16 major cities at a lower (gateway) price". Yu also predicted "But if you consider the small towns and countryside, there is a population of 0.7 billion there. So long as one-third of them use LPG, and each consumes 10 barrels a year, that will add up to 2 billion barrels of annual sales".

This remarks confirms that the LPG business in China will not disappear in a day. China's consumption of LPG reached 18.11 mt in 2002, with local households using 11-12 mt per year. Of the total civil consumption, over 50% on average goes to the urban market, while the proportion in the rural market reaches only 8%.

Considering that there are 660 cities in China now, and the West East Pipeline can be reached to a limited number of them, there is still some space of the LPG business. However, dealers based in northwest and northeast China, who are the closest to the rural market, feared that the normal charge of 40-50 yuan (US\$ 4.8-6.0) for one barrel (15 kg) of LPG is far from persuasive for local peasants to switch from burning crop stalks when they cook meals.

There are 49 major LPG producers in northeast, north, northwest and southwest China combined, compared to 11 in east and south China, and most of them need to ship their products over a long distance to reach consumers. Industry analysts said that if the rural LPG market could be tapped further, it is possible that the price will be lowered to a level acceptable to farmers, as shipment costs will be cut to almost none. It remains to be seen how the LPG business would develop a new customers where the pipeline network can not be extended.

2.1.4. Gas Expansion in Shandong

Jinan is the major Zhongyuan gas consumer in Shandong. According to an agreement signed in 1999, Zhongyuan oil field should supply Jinan a 0.2-0.3 bcm/year of gas for ten years. But it sent only 0.06 bcm of gas to the city in 2002, causing trouble to Jinan's heating system and the production of certain factories feeding on Zhongyuan natural gas.

Other cities like Zibo, Weifang and Qingdao were also suffering. Though the Zibo-

Weifang-Qingdao gas pipeline was completed in August 2002, the promised gas did not arrive.

The bulk of the Zhongyuan gas is consumed in Henan and the Cangzhou Fertilizer Plant in Hebei, with only around 0.1 bcm of gas supplied to Shandong in 2002. Zibo, which is being fuelled by 0.03 bcm/year of PetroChina natural gas via the Cangzhou-Zibo gas pipeline, did not get the gas from SINOPEC in 2002 though the company once promised the city with a 0.05 bcm/y of gas supply.

On January 18, 2003 Shandong province set up two JVs, one is a pipeline company and the other is a gas-marketing company, with SINOPEC. In early 2002, Shandong Province government formed a 70:30 gas JV with PetroChina in the wake of the operation of the firm's Cangzhou-Zibo gas pipeline.

The two newly formed JVs are part of the agreements the Shandong provincial government and SINOPEC signed in August 2002, and the agreement covers SINOPEC's building a 10 mt/y greenfield refinery, two petrochemical parks, a peak-shaving power plant, a pipeline company and gas-marketing company in Shandong.

SINOPEC has controlling shares in both companies. In the pipeline company, named Shandong Natural Gas Pipeline Co. Ltd., SINOPEC has a 65% stake and a 50% stake in the marketing company, Shandong Shihua Natural Gas Co. Ltd. The remainder shares went to Shandong Luxin Group, which was formed on the former Shandong International Trust & Investment Company and is strongly supported by the provincial government, especially the provincial development planning committee.

In mid-March 2003 SINOPEC took a preemptive action by handing in an FS of an Ordos-Shandong gas line to the National Development and Reform Commission (NDRC) for approval. The line's delivery capacity is 3 bcm/y and the distance is over 1,000 km. The target supply source is SINOPEC Star's Daniudi gasfield in the Ordos basin. SINOPEC aims to supply 1bcm/year of Ordos gas to Shandong by 2005. It could be SINOPEC's first wholly owned trans-regional gas pipeline.

If this line is constructed, SINOPEC could manage three gas sources to feed its Jinan-Zibo-Weifang-Qingdao pipeline grid that was completed in late 2002 but currently being redundant. Currently Zhongyuan is the main source and its current production capacity is quite limited. In 2002, the aging oilfield yielded 1.6 bcm of gas. SINOPEC plans to raise the volume to 1.7 bcm in 2003 and 2 bcm in 2005

Besides the 2 bcm from Zhongyuan, SINOPEC could supply a 0.6 bcm/year (or 5%) of the 12bcm/year of west-east gas to Shandong by 2005. If the 1 bcm/y of Ordos gas is added, SINOPEC can supply a total of 3.6 bcm/y of gas to the Shandong province by 2005. However, there will be a 2.4bcm/year supply shortage between SINOPEC's supplying capacity and the 6bcm/year committed supplying volume for the gas-marketing JV SINOPEC and Shandong provincial government set up in early 2003.

SINOPEC's intention is to build an LNG terminal in Qingdao to cover the supply shortage. Reportedly SINOPEC is even contacting Shell for possible LNG import from Russia's Sakhalin Islands. SINOPEC's ambition to build an LNG terminal in Qingdao is well known, and the firm is not hiding that LNG plays a key role in its gas expansion

strategy. It remains to be seen how effective the SINOPEC's initiative to contain PetroChina's dominant role in Shandong. In the long run, when gas from east Siberia arrives in Shandong, SINOPEC's pipeline grid in the province could help the Russian gas to be extended to Shandong through its network.

In early June 2003, Shandong Gas Pipeline Co. Ltd., a 65%-35% JV between Sinopec and Shandong local government, began the construction of the Zibo-Laiwu pipeline into central and southern Shandong. Sinopec plans to build two groups of pipelines in Shandong province, namely the "Northern Route" based on the existing Puyang-Jinan-Zibo-Weifang-Qingdao pipeline and the "Southern Route" from Puyang to Rizhao via Jining-Pingyi-Linyi, to realise its gas goal in the province. Both routes will have a delivery capacity of 3 bcm/y respectively. The Zibo-Laiwu pipeline, together with the planned Laiwu-Pingyi gas section, will act as the link between the two "routes". The 96-km pipeline will have a 0.9 bcm/year capacity and will start operation in June 2004.

SINOPEC is adopting CNPC's "pipeline-go-first" tactic in carrying out its gas expansion strategy in Shandong. However, NDRC is likely to veto SINOPEC's Ordos-Shandong pipeline plan as PetroChina is going to build the second Shaanxi-Beijing pipeline and routes similarly with the Ordos-Shandong line. A solution is to ask PetroChina to offer SINOPEC's Daniudi gas a "free ride" in the second Shaanxi-Beijing line, whose yearly handling capacity stands as large as 12bcm.

Unlike SINOPEC's aggressive move, CNPC's initial plan is that PetroChina's second Shaanxi-Beijing pipeline will only supply 1.3 bcm/year of gas to Shandong's Zibo and Jinan, and the volume is not the contracted one. The 850km-long Shaanxi-Beijing line will start at Yulin and stop at Hebei's Anping county. PetroChina plans to build a 238km-long branch line from Anping to Jinan if Jinan and Zibo's gas demand exceeds 0.7 bcm/year, the current capacity of the Cangzhou-Zibo gas pipeline, which was brought on stream in early 2002.

In 2003 PetroChina has entered into preliminary gas sales contracts with nine major cities in Shandong Province, and the supply should start from 2005 and both its WEP gas and the proposed second Shaanxi-Beijing Pipeline Gas will be the supply sources. It is expected that offshoots from both PetroChina's West East Gas Pipeline and the second Shaanxi-Beijing Pipeline will be extended to Jinan, the capital city of Shandong, where redistribution will be made through the local gas grid. The two offshoots will be connectable to each other as well. The two main pipelines should go into official operation on January 1 and September 30 in 2005 respectively. The cities that have entered into a gas agreement with PetroChina, previously with no share in the local gas market, are Jinan, Qingdao, Dezhou, Tai'an, Linyi, Jining, Weifang and Shouguang.

The last thing PetroChina will agree to do is to sell gas to SINOPEC at the city gate and leave SINOPEC to expand its gas market via its pipeline network. The invisible competition among the main players for the market expansion will be heavily affected by the answer of these questions :

Will SDPC allow SINOPEC to download gas from the west-east gas pipeline?
Will it allow PetroChina to duplicate a Zibo-Weifang-Qingdao pipeline in Shandong?
With CNOOC's ambition to develop a 4,000km gas pipeline grid that will stretch through Shandong can be materialized?

- WEP is not a state oil and gas company project but a part of China's western region's economic development project being promoted by the State council since 2000.
- Unlike western energy firm's view that the economics of this pipeline development is poor, the State council is using this major gas infrastructure development as a tool of accelerating economic development in the country's remote western region.
- Luckily the discovery of giant Sulige-6 field in Ordos basin in late 2000 gave a solid ground to justify the 4,000 km WEP project. PetroChina completed the eastern section of WEP and delivered the gas from the Ordos basin to Shanghai at the beginning of 2004, and the firm has virtually completed the most difficult of western section's WEP development. There is a strong possibility that the scale of proven gas reserves in western China could increase significantly in the coming years.
- PetroChina announced that around 20 take or pay contracts were signed for the WEP gas supply in January 2004. However, there is no sign that power plants have signed the contracts for WEP gas supply. It is an indirect confirmation that gas price issue will be a very heavy burden for the WEP gas market development.
- A number of medium and small size companies are targeting the city gas sector's expansion and taking positions in the cities alongside the WEP. However, due to the long delay of negotiations between PetroChina and western consortium, western majors are not taking any step in the city gas sector yet.
- Shandong province will be a battle ground for gas market development among CNPC, SINOPEC and CNOOC.

2.2. Offshore Gas Expansion

As far as offshore gas business is concerned, China National Offshore Oil Corp (CNOOC) is the driving force of the expansion. For natural gas development, building pipelines is an effective way to forestall potential market. In August 2002, CNOOC has announced its natural gas development strategy for China's coastal areas. The company planned to spend five years preparing feasibility studies for the construction of a 2,000-kilometer gas supply grid covering 10 coastal provinces, starting in Guangxi in the South and terminating in Liaoning in the Northeast. This coastal pipeline network, if it goes ahead as planned, would have an annual gas throughput of as much as 17 bcm. The ambitious plan would require CNOOC to build several LNG terminals, including facilities in Guangdong, Fujian and Shandong. These terminals would process natural gas from CNOOC's offshore fields as well as imported LNG.

More detailed action plan with serious revision on the initial plan was prepared thereafter. Including the pipelines covering the Bohai Rim, the total length of natural gas pipelines CNOOC aims at having a total of 3,759 km pipeline network until 2007 with 7.4 billion *yuan* investment. The 3,759 km pipeline network will be composed of 2,259 km onshore section and 1,500 km offshore section. In 2010, the total length will reach to 4,189 km and it could deliver 17 bcm of natural gas.

Besides the southeastern pipelines, CNOOC is also going to build four major trunklines including peri-Hainan island pipeline, Zhuhai-Zhongshan pipeline, Longkou-Yantai pipeline and Hangzhou to Huizhou & Ningbo pipeline within the next five years. To secure adequate gas supply for the long-distance pipelines, CNOOC is also studying more LNG importing opportunities with concentration on Zhejiang, Jiangsu, Shanghai and Liaoning. Besides, the company is seeking gas discoveries in the South China Sea to supplement the LNG supply.

Table 43 - CNOOC's Offshore gas pipelines

	Diameter (mm)	Length (km)	Delivery Capacity (bcm/y)	Operation Year
Jinzhou 20-2 - Jinxi Petrochemical	300	48.6	0.5	1992
Yacheng 13-1 - Hong Kong	711	778	2.9	1995
Yacheng 13-1 - Sanya	355	91	0.5	1995
Sanya - Dongfang	355	120	0.524	1996
Pinghu - Shanghai	377	385	0.5	1999
Dongfang 1-1 - Yangpu & Haikou	-	113	1.6	2003

Source: China OGP

In short, CNOOC's natural gas strategy is to establish a coastal natural gas artery to link its scattered natural gas initiatives, including gas field developments in the Bohai Bay, the East China Sea, the South China Sea and LNG terminals in Guangdong and Fujian

provinces. If the planned coastal pipeline network connecting Liaoning, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong and Guangxi Provinces plus Hainan Islands can be established, the artery will supply gas to almost all the most promising natural gas consumption centres in China. It will be CNOOC's solid base for its gas business development.

As a part of the approach, CNOOC is paying special attention to the gas for power business. CNOOC aims at building four gas-fired power plants in 2007, namely the Yangpu plant in Hainan, Zhongshan Jiaming plant and Huizhou plant in Guangdong and Putian plant in Fujian. CNOOC is scheduled to have its share of power generation to reach 2.2m kWh in 2007 and 4.3m kWh in 2015 with a total of seven gas-fired power plants. The key question CNOOC has to answer is whether the firm can secure the demand in such a scale. Considering that China is promoting cost competition among power plants, CNOOC will have to find its competitive edge over other forms of power generation. As long as CNOOC can secure a very attractive LNG supply source with a competitive price, CNOOC will have a real advantage against two other energy giants, CNPC and SINOPEC.

This section will focus on China's offshore field and the related basin development.

2.2.1. Bohai Bay Basin

Jinzhou 20-2 condensate gas field came onstream in 1992 with an initial gas production of 1.5 mcm/d. The field covering 50 sq. km is located in Liaodong Bay of the Bohai Sea (some 50 km east of Xincheng city). The recoverable gas reserves are estimated at 9.5 bcm.

The field has a gas processing plant with a capacity of 1.5 mcm/d. The plant is located in Xincheng, and is producing methane, ethane, dimethylmethane, butane and LPG. Jinxi PetroChemical Complex developed for the field's downstream business is able to produce 0.52 mt/y of ammonia and 0.32 mt/y of urea. In 1996 Jinzhou 20-2 produced 0.371 bcm of natural gas, 34,500 tonnes of liquefied petroleum gas (LPG) and 0.118 mt of condensate oil.

2.2.2. The East China Sea Basin

The East China Sea basin is China's largest offshore sedimentary basin, covering 250,000 sq.km. Located in the continental shelf of the East China Sea, the basin extends in an SW-NE direction from Taiwan in the south to the Cheju basin, off the Korean Peninsula. The basin contains predominantly deposits of Late Cretaceous-Quaternary age, to a depth of up to 10,000 metres. In the north, deposition was lacustrine, lagoonal and fluvial until the Miocene. In the south, conditions were initially shallow marine, becoming lacustrine in the Oligocene, and reverting to marine in the Miocene. Rifting ceased in the Paleocene, but subsidence continued, caused by sedimental loading. The rifting led to marine conditions from the Pliocene onwards.

Although oil and gas E&P activities of CNOOC's Donghai Corporation and foreign companies have covered 700,000 sq. km of the continental shelf of the East China Sea, no commercial discovery has occurred. As early as 1992, CNOOC offered 20 blocks in the East China Sea for foreign investment in its fourth offshore bidding round. Of the total 29 blocks covering 72,800 sq. km, four are located in the north of Shanghai, and 16

in the south off Wenzhou. CNOOC has signed sales and purchase agreements (SPAs) for 18 of the 20 blocks offered. These contracts were signed with 15 companies from even countries, but none has yet reported commercial discoveries. After 14 wildcat wells had been sunk by nine international groups and nothing had been found. The only good news came in October 1997 when Primeline Petroleum Corp located natural gas in its concession block 32/22, 159 km southeast of Wenzhou city, Zhejiang province. The wildcat well, code-named Liushi 36-1-1, tested 280 mcm/d of natural gas. It is located in with the Taibei depression in the continental basin of the East China Sea.

Chinese geologists predict that Xihu Sag will be a more gas prone area, with 60% of the total being gas and 40% oil. As of 1997, 26 wildcat wells have been drilled, and 17 wells saw industrial oil and gas flows. In addition, about 90,000 km of 2D seismic lines and 400 sq. km of 3D seismic lines have been shot. These activities are centres in the eastern slope of the Xihu Sag.

Before inauguration of CNSPC in 1997, its predecessor MGMR had registered three 'Industrial Zone Exploration' projects with the National Mineral Resources Commission. The three projects include the Pinghu Exploration Zone, the Sudi Exploration Zone and the Yuquan/Canxue Exploration Zone, covering all the major oil and gas prospects in Xihu Sag. Since 1974 MGMR has been shooting seismic lines and sinking test wells in Xihu Sag, and it has resulting in the discovery of three oil/gas fields – poetically coded Pinghu, Baoyunting and Canxue – and six oil/gas bearing structures, Yuquan, Tianwaitian, Duanquiao, Wuyunting, Kongqueting and Chunxiao, which are all named after scenic spots at Hangzhou's Xihu (West Lake). These discoveries cover Xihu Sag from north to south, with the Chunxiao produced 1.6 mcm/d of natural gas during the trial production period.

Pinghu gas field

In late March 1999, Pinghu gas field in the East China Sea went into operation. CNOOC, the operator, has successfully moved the gas from two wells through a 362 km sub-sea pipeline (with a 14 inch diameter) to Nanhui terminal in Shanghai. Pinghu field covers 240 sq km and has recoverable reserves of 10.8 bcm of natural gas, 1.77 mt of condensate, and 10.78 mt of light crude, with 15 years production period. During 1996-98, 13 production wells have been drilled.

Pinghu was planned to supply 0.3 mcm/d of gas in early stage of the development and the volume would reach to 1.2 mcm/d when the full development is made. Pinghu aimed at supplying to 1 million households in Pudong area, where a natural gas distribution network has been developed, including ten 3,500 cm pressure storage spheres.

In November 1998, Pinghu's oil pipeline put into operation. The 302 km oil pipeline connecting the field and Daishan island off Shanghai began operation and moved the oil to an oil storage in the island. The pipeline is built by Italian Saipem Company and is designed to move 0.7 mt of crude/y. Initially natural gas pipeline was targeting a simultaneous operation with the oil pipeline. But two major gas leaks had been spotted and CNOOC had to suspend production from its gas wells in the Pinghu field.

Pinghu project was jointly financed by the Shanghai Municipal government with a 40% stake, Shanghai Bureau of the China National Star Petroleum Corp (CNSPC) with a 30% stake, and CNOOC with the remaining 30%. It is China's first gas field in the East

China Sea. In 2002, Shanghai Oil and Gas Company (SOGC), JV between the trio, supplied 0.43 bcm of natural gas into Shanghai. In August 2002 SOGC decided to enhance the capacity of Pinghu, aiming to raise the capacity of the gasfield to 2mcm/day in 2005 with 1.7bn yuan.⁴

On October 16, 2003, the first-phase expansion project for the Pinghu oil and gas project in the East China Sea was completed. To celebrate the expansion of the first phase of the capacity-enhancement, shareholders of SOGC held a grand ceremony on the same day when west-east gas arrived at Zhengzhou city, the first formal gas buyer of the WEP project. Due to this expansion, Shanghai will be receiving 50% more gas from the field, and the volume will reach 1.8 mcm/d. Currently there are 650,000 household users and 4,500 institutional users of East China Sea gas in Shanghai's Pudong area. Another 100,000 households in the Puxi Area, or western Shanghai, have switched from coal gas to the East China Sea gas so far.

Shenergy having a 40% equity in the Pinghu project announced that a new offshore production platform will be built in the East China Sea soon for the second phase expansion of the supply ability to 2 mcm/d by 2006.⁵ Aggregate investment required for the two stages of development is projected at 1.7 billion yuan (US\$ 205.3 million).

According to Interfax China, a securities official with Shenergy said that "The East China Sea gas price won't see a change in the near future, although the supply volume has gone up...We believe the price, at 2.1 yuan (US\$ 0.254) per cubic metres now, is still competitive when compared with the West East Pipeline (WEP) gas." Other Shenergy official added that "We believe there won't be a collision (between the two gas sources), because demand in Shanghai is still quite robust, and the WEP gas only supplements the market gap... Besides, we as a company are just responsible for investing money and don't have the authority over consumers in which part of Shanghai to develop."

Reportedly some analysts argue that local residents in Shanghai expecting to utilize the WEP gas might have to pay the same as, if not more than, the price for the East China Sea gas, considering the length of transmission involved. The Pinghu Field is about 365 km away from the southern part of Shanghai, while the distance of delivery from Changqing to Shanghai is nearly 1,500 km. (See gas price discussion)

In October 2003, the construction of the three platforms to be used in the initial gas development area of the East China Sea gas venture was started in Zhanjiang in

⁴ Shanghai Gas Marketing (Group) Co. Ltd had a mandate to supply gas to the city centre and other areas covered by the local artificial gas pipeline network. It sells 1.7 bcm of artificial gas more than 0.1 mt of LPG/y, in addition to an eventual supply of 0.438 bcm of natural gas from offshore. Gas companies run by sub-urban counties under the Shanghai Municipality and by the Baoshan Iron and Steel Group Co, Jinshan Petro-Chemical Co and other industrial giants together sell 0.3 bcm of artificial gas and 0.15 mt of LPG annually. There are altogether 4.2 million gas users in Shanghai, of which 60% use artificial gas and 40% use LPG. Five gas factories produce the artificial gas sold by the Shanghai Gas Marketing (Group) Co. Ltd. In 1999, the companies have combined gas generation capacity of 10.12 mcm/d, of which 3.58 mcm/d as fixed supply, 3.59 mcm/d as flexible supply and 2.96 mcm/d as semi flexible supply.

⁵ Besides the 40% equity in the Pinghu project, Shenergy also has a controlling 60% stake in the sole West East Pipeline gateway gas buyer in Shanghai, the Shanghai Natural Gas Grid Co. Ltd.. Additionally, the company owns a 30% stake in one of the two WEP gas -fueled power plants in Shanghai, the 600-MW Caojing Combined Power and Heat Plant in the Shanghai Chemical Industry Park, as well as the 900-MW Shidongkou No.2 Power Plant.

Guangdong Province, and are scheduled for completion at the end of 2004. China Offshore Oil Engineering Corp will act as chief contractor for building the one central production platform and two wellhead platforms. The platforms are expected to produce oil from the Chunxiao Gas Field in the East China Sea from mid 2005.

Xihu Sag Gas

The East China Sea Basin covers an area of 250,000 sq. km. So far 200,000 km 2-D seismic survey and 2,578 sq. km 3-D seismic survey have been conducted and 48 wells drilled with four oil and gas fields and six oil and gas bearing structures found. The Xihu Sag has 150 bcm of proven and controlled natural gas reserves with 28 wells drilled. Geologists estimate the reserves in this area may reach 1-2 tcm. Besides natural gas, 40 mt of crude reserves have been proven and controlled in this area.

CNOOC planned to invest 400 million yuan in natural gas exploration in East China Sea to drill 5 wildcats in Xihu Sag and conduct 5,000 km 2-D seismic survey. The company's first wildcat in East China Sea, spud in early April 2000 in the Shaoxing 6-1 structure of the Xihu Sag, turned to be a dry hole.

Nonetheless, market proximity and short construction period make any discovery with 10 bcm reserves in this particular sea area profitable to develop and price competitive. Initially it was estimated that the price of natural gas from East China Sea will be only 1.05 yuan/cm, against about 1.2 yuan/cm for natural gas from the west. (See the discussion on the gas price issue)

CNOOC was aiming high and was promoting a new concept, that is a natural gas pipeline along the coast of South China Sea and East China Sea which moves its offshore gas to the most advanced economies in China. Wei Liucheng, president of CNOOC and chairman of CNOOC Ltd said that the coastal natural gas pipeline, if proved viable, will be built in 10-15 years from Hainan Island to Shanghai via Guangdong, Fujian and Zhejiang. Wei said the gas will come from its offshore and imported LNG, which will reach to 30 bcm/y by 2010. He also said that its offshore reserves will be expanded to 1 tcm from 0.37 tcm by 2010. In fact this remarks was the basis of CNOOC's blueprint to develop the 4,000 km gas pipeline network until 2010 (This scheme was announced in 2003)

Unlike CNOOC, CNSPC began to drill exploration wells in 1980, and so far sunk 30 wildcats in Xihu Trough and 20 of them reported oil yields of commercial value. The breakthrough is a major gas discovery in the Chunxiao structure. In January 2000, Chunxiao 3 – initially drilled by CNSPC in October 1999 - tested a 14.3 mcm/d of gas and 88 cm/d of oil at a depth of 3,750 metres. This well added 19.7 bcm of proven gas reserves to CNSPC's portfolio. By the end of 1999, CNSPC proved 64.5 bcm of gas reserves in Chunxiao. The field is the biggest oil/gas field in the East China Sea so far.

In Spring 2001, SINOPEC's Star (CNSPC) announced another gas discovery in the East China Sea. The well coded Tianwaitian 3, reported a daily gas output of 0.683 bcm and 28 cm of condensate crude. The well is located in the Tianwantian structure, 400 km south-east of Shanghai. The depth of the well reached 3,760 metres.

Star's Shanghai Bureau already drilled six wells in Chunxiao structure, of which four struck industrial oil flow. It also completed 600 sq. km of 3D seismic survey and

submitted a 37 bcm of proven reserves report for the state's appraisal. SINOPEC expected to produce 2 bcm of natural gas from Xihu in 2004 and delivers the gas to Shanghai.

On June 11, 2001, SINOPEC Corp. agreed to purchase SINOPEC Star for 6.45 billion yuan (US\$ 779 million). Natural Gas accounts for around 64% of SINOPEC Star's proven reserves and over 90% of its probable reserves, mainly based in the East China Sea.

According to SINOPEC's East China Sea development plan :

- Five wells to be drilled within 2000, and 18-20 wells before 2002. (This scheme was regarded as unrealistic).
- To increase proven gas reserves of natural gas from 54 bcm (as of early 2001) to 150-200 bcm by 2003. Meanwhile, the Chunxiao structure will be developed and supply 3 bcm of natural gas and 0.2 mt of condensate annually in the first phase of field development.
- By 2010, SINOPEC planned to drill more than 90 wells in the Xihu Sag with the aim to discover 400 – 420 bcm of natural gas with a production capacity reaching 8-10 bcm per year.

To pursue this ambitious target, in Jan 2001 SINOPEC announced that it is poised to invest 24 billion yuan to explore and develop gas resources in the East China Sea. There is no doubt that SINOPEC's initial plan laid the ground for the Xihu Sag gas development, but the firm decided to pursue the development by forming a consortium.

On August 19, 2003 SINOPEC, CNOOC, the Royal/Dutch Shell Group and the California United Petroleum Corp. (Unocal) signed an agreement to jointly tap the natural gas reserves in the East China Sea. The JVs' ownership structure is as follows : SINOPEC and CNOOC have a 30% interest each with Shell and Unocal holding 20% interest respectively.

The deal attracted the attention of China's Premier, Wen Jiabao. Premier Wen met representatives of CNOOC, SINOPEC, Shell and Unocal, saying that cooperation between the oil giants would help guarantee the supply of energy to the thriving Yangtze River Delta region, including Shanghai.

The Xihu Trough, which covers approximately 22,000 sq km area and located 450 km southeast of Shanghai. There are five blocks involved in the contract, of which Chunxiao and Baoyunting were signed for joint development and blocks 27/05, 12/21 and 20/14 were signed for venture exploration. With 65.2bcm proven natural gas reserves confirmed, the gasfields in the Chunxiao block will start up production in June 2005 and keep a production of 2.5bcm for 13 years from 2007. A 350km long sub-sea pipeline will be built to deliver the natural gas to a processing plant in Sanshan of Ningbo for Zhejiang province gas market.

CNOOC Ltd. will be the operator of all five contract areas, and claimed that until now about 100bcm proven natural gas reserves have been found in East China Sea. In the next five to ten years, there will be another 100bcm proven reserves added. The company expected that the potential reserves in this region could afford an annual natural gas production of 4-5 bcm.

The leadership role of the Xihu Trough development is performed by a joint management committee, in which three members come from SINOPEC, three from CNOOC and two from Shell and Unocal respectively. The two Chinese companies will hold the committee's chairman position in rotation. SINOPEC will take up the chairmanship for the first two years. But the investors stakes structure determines that the committee operates more like a platform for the shareholders to make discussions, and the chairman works like a meeting convener.

As the main potential customers of Xihu Trough natural gas are the subsidiaries of SINOPEC, SINOPEC assumes the task of setting up the marketing department under the Sino-foreign joint venture. The marketing department will be on behalf of the four investors to strike sales terms with the downstream consumers. To ensure the natural gas sales, SINOPEC is considering of choosing some oil-fired power plants in Zhejiang province to switch to burn natural gas.

The Xihu Trough development consortium has chosen the alternative by extending its onshore pipeline via Hangzhou Bay to reach Shanghai, rather than a direct pipeline to Shanghai as sketched in the former blueprint. The timing of WEP gas entry to Shanghai market is affecting this pipeline routing. As Chunxiao gasfields won't begin production until mid 2005, the natural gas from the East China Sea will fall behind WEP to reach the market north of Qiantang River. On the other hand, the eastern section of WEP will go into operation in early 2004 and the western section will follow in early 2005.

According to China OGP, as for the offshore gas price, Zhou Shouwei, president of CNOOC Ltd. said, "the price should have a competitive edge over that of WEP natural gas, but it cannot be so low to hurt the latter's sales." Now the government has granted 1.25 yuan/cm as the guidance price for the natural gas reaching Ningbo of Zhejiang province. (See gas price discussion)

2.2.3. South China Sea Basin

The South China Sea in this report refers to the petroliferous region of the Yinggehai-Qiongdongnan basin, located in the northern part of the continental shelf in the South China Sea. Yinggehai lies in a NNW-SSE direction and Qiongdongnan NE-SW. The basin is formed by extension forces and by the sinking of the pre-Cenozoic basement. The main faults in the Yinggehai are oriented N-S, E-W and NE-SW direction, are widespread in the eastern Depression. Faulting was much reduced during the Neocene, and the basin was undergoing quiet regional subsidence by the Pliocene.

Since 1970 systematic geological and geophysical survey and drilling activities have been carried out. Nanhai West Oil Exploration Bureau (later Nanhai West Oil Corp) was established in 1973, and Nanhai East Oil Corp was established in 1982. Both organizations are under the CNOOC. Nanhai West is responsible for the gas development in the Yinggehai-Qiongdongnan basin.

The Yinggehai-Qiongdongnan basin has an effective exploitable acreage of 90,000 sq. km and an estimated 13 tcm of gas reserves, roughly one-third of China's total. Recoverable reserves are estimated at 3.5-4.0 tcm. The earliest significant discovery in the basin is ARCO's Yacheng 13-1, which started gas production in 1996.

After drilling 20 wildcat and six appraisals, CNOOC made a number of large gas discoveries in recent years, including Dongfang 1-1, Ledong 15-1 & 22-1 gas fields, Ledong 8-1, 20-1 and 28-1, Dongfang 29-1, Yacheng 35-1 and 21-1, Wenchang 8-3 and 9-1 gas bearing structures.

Yacheng 13-1 gas field

Ya 13-1 gas field, located southwest of Hainan Island, 100 km off Sanya city and in water depths of 100 metres, is China's largest offshore gas field. It is also the only offshore gas field under PSA terms. It went on stream on January 1, 1996. Covering 53.85 sq. km, it was discovered in July 1983, and has 107.7 bcm of in-place gas reserves, of which 85 bcm are recoverable. The field, with joint investment and development by CNOOC, ARCO and KUFPEC started in April 1992 and cost US\$ 1.13 billion. It was commissioned and started production in October 1995. The field is composed of a wellhead platform and a process platform. In 1996, Yacheng 13-1 produced 2.23 bcm of natural gas and 43,000 tonnes of condensate oil.

The field's production derives from six wells, completed in May 1995. All except one are directional wells, with the maximum horizontal reach being 2,100 metres. ARCO was the operator of the field, with a Project Management Team (PMT) formed by ARCO and CNOOC. The PMT reportedly applies the latest applicable technical specifications, standards and procedures for design, procurement, site supervision and quality control.

Yacheng 31-1's total production capacity is 3.45 bcm/y, of which 2.9 bcm is transported to fuel the 2400 MW combined cycle power plant (costing HK\$ 24 billion) under Castle Peak Power Co Ltd, jointly owned by China Light and Power and US Exxon Energy Resources Co, and 0.5 bcm is allocated to the Nanshan Power Plant and a fertilizer complex on Hainan Island. The gas is supplied to Hong Kong through a 780 km long, 28 inch (0.71 metres) sub-sea gas transmission line, and to Hainan through a 91 km, 14 inch (0.355 metres) pipeline. The Hainan power plant in Sanya city, with a capacity of 100 MW, requires 0.12 bcm/y of gas ; and the fertilizer plant in Dongfang Li Autonomous County (Basuo), with a production capacity of 0.3 mt/y of ammonia and 0.52 mt/y of urea, consumes 0.38 bcm/y of gas.

On January 1, 2004, CNOOC Ltd. said that it had taken back operator status at the Yacheng 13-1 Gas Field. BP has been the gas field's operator since the start of production on January 1, 1996 and was required to turn it back to CNOOC eight years later.

CNOOC Limited currently has a 51% interest in Yacheng 13-1, with BP possessing 34.3% and Kuwait Foreign Petroleum Exploration Company (KUFPEC) 14.7%. The Yacheng 13-1 gas field was first discovered in 1983 and was the first PSC contract ever signed by CNOOC with foreign partners.

Dongfang 1-1 gas field

Located 100 km west off Hainan Islands, Dongfang 1-1 is set to be another major gas field after Yacheng 13-1. The field was discovered in 1992, and the field development started in early 1997. On August 1, 2003 Dongfang 1-1 gasfield, the largest gas resource solely under CNOOC, completed its Phase I construction and started supplying end-users on Hainan island through a 113 km underwater pipeline. CNOOC Pipeline

and Gas Transmission Company confirmed that a 247 km onshore gas transmission line with 400 million yuan investment went into operation to deliver gas to Yangpu on August 10th and Haikou on August 11th respectively.

Besides the terminal, the first phase of development includes an eight-leg center platform, a four-leg well platform (at 50 m long, 30 m wide and 45 m high), two gas pipelines and a underwater cable. The underwater section of the pipeline has a length of around 113 km.

With investment of 3.27bn yuan (USD 395 million), the Phase I construction of Dongfang 1-1 with proven reserves of 99.7 bcm has taken three years since June 2000 to build a gas production capacity of 1.6bcm /y (or 4.38 mcm/d). In the Phase II program, the gasfield will see a production increase 1.2 bcm to boost the total capacity to 2.8bcm/y (or 6.57 mcm/d) in 2008.

The Hainan 1.4 mt/y fertilizer base located in Dongfang city will be the largest consumer of Dongfang gasfield, which requires 0.8 bcm/y of natural gas. The onshore pipeline will transmit the remaining 0.8 bcm gas produced in Dongfang 1-1 Phase I, of which 0.7 bcm to the Yangpu gas-fired power plant (360,000 Kwh) and other nearby industrial consumers, and 0.1 bcm is delivered for about 43,000 households in the city of Haikou.

The remainder will be supplied to the 0.6 mt methanol project jointly invested by CNOOC Chemical Co. Ltd. (60%) and Hong Kong-listed Kingboard Chemical (40%). The project in Dongfang as well, was granted the final governmental approval from the NDRC (National Development and Reform Commission) on September 11, 2003, ten months after the State Council allowed it to go ahead, and is expected to cost 1.47 billion yuan (US\$ 177.5 million) in total. Commission of the methanol facility is slated for 2006. The designed daily production is 2,000 tons, and around 0.89 bcm of natural gas will be consumed each year.

CNOOC invested its 2.95 billion yuan (US\$ 356.3 mln) coarse urea facility into trial operation at the end of September 2003. The "Fudao Second Phase" in Dongfang brings the company's total urea production capacity on the island to 1.52 mt per year. The facility has an ability to produce 0.8 mt/y of urea as well as 0.45 mt/y of synthetic ammonia. A steady 0.8 bcm of natural gas will be drawn annually from the Dongfang 1-1 Gas Field.

It is worth noting that in 2001 CNOOC acquired the original "Fudao" fertilizer unit in Hainan, with 0.52 mt of coarse urea and 0.3 mt of synthetic ammonia annual capacity, for 0.5 billion yuan (US\$ 60.4 mln). The acquired assets produced 0.593 mt of coarse urea in 2002, creating 170 million yuan (US\$ 20.5 million) in profits. On October 16, 2002 CNOOC began the construction on the 247-km pipeline, with an investment totaling over 400 billion yuan (US\$ 48.3 million).

Another fine urea facility with an annual capacity of 0.52 mt is under preliminary study and the final feasibility study report has yet to be submitted to the central government for approval. The projected investment for the project is around 460 million yuan (US\$ 55.6 million), and the facility will consume carbon dioxide instead of natural gas extracted from Dongfang 1-1.

2.3. LNG Import

In August 2002 Chinese authority made one of the most important decisions for China's natural gas expansion, that is, the supply source of Guangdong LNG and Fujian LNG was chosen. This is a beginning of new era for LNG expansion in China. This section will examine the both Guangdong and Fujian LNG option and will discuss about the next round of LNG import.

2.3.1. Guangdong LNG

Bidding for LNG Terminal and Trunk Pipeline

In 1993, Guangdong province started the LNG import planning and preliminary study and in 1996 CNOOC submitted a "Planning Report on LNG utilization Project in South-eastern Coastal Area" to the State Council. The Report proposed three ports in east China and south China as the sites for future LNG terminals. The Guangdong option, which features a terminal in Dapeng Bay of Shenzhen at the Pearl River Mouth, was proposed to be the pilot. The second choice is planned for the Yangtze River Delta, in either Zhoushan port or Beilun port in Ningbo, Zhejiang province. The third and optional location is Zhangzhou or Xiamen in Fujian. Besides, the city of Qingdao in Shandong province was viewed as a possible site for terminal.

In the wake of the report, the Guangdong provincial government and CNOOC carried out the pre-feasibility study and the site selection. In May 1998, they jointly submitted the "Proposal of Guangdong LNG Terminal and Trunkline Project" to the SDPC. At the end of 1998, the State Council approved the pilot LNG project in Guangdong. In April 1999, project proposal was submitted to SDPC and won approval at yearend. The international bidding for foreign investors started in August 2000.

A total of 27 foreign applicants purchased the data package, and by September 8, 2000, 23 firms in ten consortiums handed in bids. Four consortiums were shortlisted by the Chinese side for the second round bidding. The four groups are as follows :

- BP Europe Ltd.
- Exxon-Mobil led Group, composed of Exxon-Mobil China(Shenzhen) LNG Ltd, Japan Guangdong LNG Co (a 51-49 JV between Chubu Electric and Nissho Iwai) and HK CLP Enterprises Ltd.
- Shell led Group, composed of Shell China B.V., Marubeni LNG (HK) Ltd, and Osaka Gas.
- Australian Consortium, composed of Guangdong LNG Operator Ltd (Chevron's wholly owned subsidiary), Guangdong LNG Technical Service Ltd (a 51-49 JV between Woodside Australian Energy and BHP), and Korea Gas Corp.

Other major companies participated in the bidding include Enron, Iran National Petroleum, Sumitomo, Mitsubishi, Petronas, TotalFinaElf and Gaz de France, and Cheung Kong Infrastructure and Itochu.

Table 44 - Ownership breakdown of Guangdong LNG terminal project

Shareholders	%
CNOOC	33.0
BP	30.0
Shenzhen Investment Holding Corp.	14.0
Guangdong Electric Power Co.	6.0
Guangzhou Gas Co.	6.0
Dongguan Fuel Industrial General Co.	2.5
Foshan Municipal Gas General Co.	2.5
H.K Electric Holdings Ltd.	3.0
H.K & China Gas Co.	3.0
Total	100.0

Source: CNOOC

In March 2001, it was announced that BP was chosen as the foreign partner for construction of the terminal and trunk pipeline. BP will take a 30% stake and invest US\$ 180 million in the Phase 1 of the project. Besides BP, as shown in the Table 44, there are eight shareholders.

Bidding for the Guangdong Supply contract

On November 2001, the international bidding for Guangdong LNG supply started. The bidding host, the Joint Executive Office of the Guangdong LNG Terminal & Trunkline Project, invited seven bidders from Australia, Indonesia, Iran, Malaysia, Qatar, Russia and Yemen to compete for the 3 mt/y supply contract. The seven companies include Australia LNG Pty Ltd, BP Gas Marketing (Indonesia), Malaysia LNG, National Iranian Oil Company (NIOC), Ras Laffan LNG Co. Ltd (Qatar), Sakhalin Energy Investment Co Ltd (Russia), and Yemen LNG Co. Ltd. Except for NIOC that failed to show up at the pre-bid conference, all six firms purchased the information package priced at US\$ 5,000.

According to the Executive Office, the selection of LNG supply sources will be executed in two phases. First, the office will shortlist two potential suppliers. In the second phase, bilateral negotiation on LNG purchase contract will be conducted and the final winner will come out. The first phase will last for a month and bidders are required to submit bidding package before Nov 18th, 2001. Chinese officials point out that three factors are decisive in acquiring the contract, and those are competitive gas price, flexible contract terms, capability in offering up-stream or mid-stream opportunities for Chinese partners.

The Chinese authority sees that the cooperation could range from upstream equity acquisition to cooperative LNG shipping or even to LNG ship construction. In addition to selling LNG assets to CNOOC, what foreign companies can do is in the area of LNG shipping where the Chinese companies have no experience.

The project's Chinese owners say that they will guarantee the selected LNG gas field will offer the lowest price (FOB plus premium) for LNG arriving at Guangzhou. With this

premise, the Chinese owners will phase in China Ocean Shipping Company whose role in the LNG project is to carry out the shipping jointly with foreign partners.

According to the Executive Office, to guarantee the downstream market, another gas fired power plant will be added into the project. With full support from the Guangdong provincial government, the plant based in eastern Shenzhen will be scaled at 3 x 300 MW with an annual LNG demand of 0.5 mt.

The Wisdom of having Two winners

The executive office of the Guangdong project submitted the bidding result to the SDPC for approval on April 24, 2002 according to the timetable and the result was initially supposed to be announced in June 2002. After some weeks delay, the decision was made. On August 8th, 2002, the Chinese government made a historic announcement that both Australia and Indonesia won the gas supplying contracts for the two terminals in Guangdong and Fujian province respectively.

Australian LNG, the marketing arm of the Northwest Shelf Project, wins a 25 year contract to supply 3 mt/y of LNG to the Guangdong terminal. But the Tangguh project wins a consolation prize with a contract to supply 2.5 mt/y of LNG to Fujian terminal. In other words, the Fujian project is not the prize it originally targeted, but it's better than nothing at all.

In May 2003, CNOOC Limited signed the agreement to acquire 25% stake in the China LNG JV within Australian North West Shelf (NWS) project. In addition to the interest acquired in NWS gas production, the agreement also grants CNOOC Ltd. approximately 5.3% interest in certain production licenses, retention leases, an exploration permit of the NWS project and the right to participate in future exploration undertaken over and above the proven reserves. The agreement stipulates that CNOOC Ltd.'s share in the LNG JV will increase correspondingly as the LNG quantity supplied to Guangdong terminal increases.

For the interest acquisition, CNOOC Ltd has to pay US\$ 348 million. Merrill Lynch (Asia Pacific) Limited and Credit Suisse First Boston (Hong Kong) Limited performed as the financial advisors to CNOOC Ltd. regarding the acquisition.

CNOOC confirmed the acquisition price is \$1.52 per barrel of oil equivalent. Including expected development costs of \$1 per BOE, the acquisition price is 37% lower than CNOOC's historical finding and development costs and 48% lower than the implied price paid by Australia's Woodside Petroleum Ltd., which is operator of the Northwest Shelf. It confirms the co-owners of the Northwest Shelf LNG project made a significant compromise to secure the Chinese market.

The Guangdong LNG Import and Development scheme is divided into two phases : The phase one incorporates a 3.7 mt/y LNG receiving terminal, a trunk gas grid extending 215.4 km with a capacity of 4 bcm/y and covering both industrial and residential users in Shenzhen, Dongguan, Guangzhou, Foshan and HK, and two branch gas lines, one to Huizhou power plant (32.6 km) and the other to Qianwan power plant (78.8 km).

Table 45 - Ownership Structure of Northwest Shelf's China LNG project

Shareholders	Equity %
CNOOC Limited	25.0
Shell	12.5
Woodside	12.5
BP	12.5
Japan Australia LNG	12.5
ChevronTexaco	12.5
BHP Billiton	12.5
Total	100.0

Source: CNOOC

Besides this, two new gas fired power plants in Shenzhen (Huizhou and Qianwan) will be constructed, and three oil to gas power plants in Shenzhen (Nanshan, Meishi and Yueliangwan) will be completed. The total investment (for receiving terminal and gas grid only) is 5.1 bn yuan (US\$ 600 million).

The phase two will add another 2.5 mt/y receiving capacity to the terminal. A new gas grid from Zhuhai to Foshan, extending 181.7 km, will be able to move 8.2 bcm of gas, including 1.5 bcm from CNOOC's Nanhai production, to Huizhou, Zhaoqing, Jiangmen, Zhongshan and Zhuhai. Two oil-to-gas power plants in Foshan (Desheng plant and Shakou plant) will be built. The total investment (for receiving terminal and gas grid only) is 2.1 bn yuan.

Table 46 - Consumers list for the Guangdong LNG project

Consumers	Demand : Phase I mt/y	Demand : Phase II mt/y
Huizhou Power Plant	0.554 (3 x 300 MW)	1.662 (6 x 300 MW)
Qianwan Power Plant : conversion from oil to gas	0.50 (3 x 350 MW)	0.57
Shenzhen towngas	0.323	0.432
Dongguan towngas	0.0557	0.1399
Guangzhou towngas	0.2346	0.4434
Foshan towngas	0.0485	0.1257
Foshan Industrial Users	0.1963	0.3573
HK & China Gas	0.4834	0.70
HK Electric Holdings	0.50	1.10
Huizhou towngas		0.1094
Jiangmen towngas		0.1060
Zhongshan towngas		0.0785
Zhaoqing towngas		0.0768
Zhuhai towngas		0.1236
Sub-Total	2.896	6.025

Source: Lai Yuankai, "Make Sound Preparation for the Smooth Implementation of Guangdong LNG Pilot Project" presented at China Gas 2000 conference organised by China Gas Association, Chengdu, Nov 28-29, 2000.

According to the long-term plan drawn by Guangdong Provincial Planning Commission, in the next 15 years throughout three Five-Year Plan periods, Guangdong will still derive much of the increased power supply from newly built coal-fired plants and hydropower sources (mainly the West-East Electricity project and the Three Gorges Project). LNG power supply, though will present a remarkable growth, will still serve as a supplementary energy source to Guangdong's increasing energy demand.

Table 47 - Power generation growth in Guangdong, 2001-2015
(Unit: GW)

	2001-2015 Total	2001-2005	2006-2010	2010-2015
1. Increased installed capacity	5.363	1.980	1.692	1.700
- Hydropower & wind energy	0.178	0.073	0.048	0.047
- Pumped storage	0.480	0	0.240	0.240
- Coal-fired power	1.910	0.538	0.833	0.548
- Oil-fired power	0	0	0	0
- Gas-fired power	0.901	0.201	0.245	0.455
- Nuclear power	0.600	0.200	0.200	0.200
- West-east Electricity project	1.004	0.668	0.126	0.210
- Three Gorges project	0.300	0.300		
2. Obsolete thermal power	0.674	0.300	0.260	0.114
3. Net increased installed capacity	4.690	1.680	1.432	1.580

Source: Guangdong Provincial Planning Commission

The Guangdong project has virtually stagnated because of the internal wrangling among the investors of the terminal, despite the expectations that its construction would start before the end of 2002. Take-or-pay contracts wait to be signed; FS remains to be submitted for SDPC approval; and the startup seems far away. Many factors like fixing the route of the trunk line, related cost in compensating local governments, and the absence of favorable terms for gas-fired power generation could affect the process of the project. Of importance, gas lacks price competitiveness as compared with coal and heavy oil in power generation.

On March 8, 2003 a milestone contract involving 11 signatories was signed in Beijing to form a joint venture for the Guangdong The power grid was split from the State Power Co., owner of the natural gas power plants, and put under the South China Power Grid Co., as the result of China's reform in its power industry in late 2002. The power purchase agreement (PPA) between the plants and the grid remained unsigned and represents the last link to complete all the major contracts.

LNG receiving terminal, two years after BP was chosen as the foreign investor in 2001. The terminal's FS report, submitted to the State Development Planning Commission on March 7th, 2003, and The China International Engineering Consulting Corp. (CIECC), entrusted by the Chinese government to make evaluations for the project's feasibility study, finished their appraisals and handed a report back to the authorities in July 2003. When approval is received, the investors will set up the JV and start terminal construction. On September 22, 2003 Guangdong LNG terminal started the preliminary construction with land-leveling work in order to meet the operation startup deadline in June 1st, 2006, even though project's FS report is still waiting to be approved by the National Development and Reform Commission.

The designed annual receiving capacity of the LNG terminal became 3.5m tonnes. If the Pearl River power plant approved in late 2002 is included, the annual LNG import in the Phase I will rise to 3.7 mt/y. Phase II's design capacity of (plus that of Phase I) also increased to 6.2 mt/y. The Guangdong LNG's recent market study had updated the annual LNG import in Phase II to 6.7 mt/y.

The total investment for the first phase construction (includes terminal, trunkline, gas depots and wharves) has increased from the previously announced 5.1bn *yuan* to 7.3bn *yuan*. There is no change of the 330 km trunkline length, but the added capital expenditure is mostly the results of the changes in the routing. But the newly approved Pearl River Power plant will demand the building of another 30 km long pipeline on top of the 330 km trunkline.

The Phase I terminal with its associated infrastructure is capable of handling a supply capacity of up to 9 mt/y of LNG. To meet this capacity ceiling, 4 x 160,000 cubic meters of gas depots are required. The current 3.5 mt/y capacity in the first phase only necessitates two such depots. The JEO plans to expand its capacity in Shenzhen LNG terminal in line with the demand expansion from the Pearl River Delta. The JEO also prefers to extend pipelines rather than construct another terminal to feed the gas demand on the other side of the Pearl River. When the gas demand in the Pearl River Delta exceeded the ceiling capacity of 9 mt/y of the Shenzhen terminal, there will be the need to launch Phase II terminal in Zhuhai.

Besides this, the agreement memo for LNG transportation was signed among COSCO, China Merchants Group, ALNG, Shenzhen Marine Co., Guangdong T&T Project JEO, and Energy Transportation Group Inc. Two joint ventures, one is the fleet owner and the other is managing the operation, will be established with the Chinese side holding the majority stake.

The Guangdong project will select the LNG carrier with the flat-roofed gas tanks instead of the popular ball-shaped ones. Each of the carrier will be built with a capacity of 145,000 cubic meters and the carrier cost US\$ 200 million. Guangdong LNG projects requires 2-3 tankers and it is very likely for the Guangdong LNG and Fujian LNG to share the extra tanker's capacity between them.

2.3.2. Fujian LNG

The decision that Chinese authority decided to give the green light for the Fujian LNG project in line with Guangdong project was very unexpected considering the following weak points of the Fujian project:

- The consumer's buying power in Fujian is far behind that in Guangdong
- A great portion of the LNG will be used for power generation. As a province rich in hydro-electricity and slated as one of the targeted markets of the west-east electricity, Fujian seems unable to absorb more LNG generated power.
- As the bridgehead of the possible Taiwan Strait's war, Fujian's economy may disrupt if the war really breaks out.
- The process of Fujian project lags far behind the one in Guangdong. So far only a preliminary FS has been done to the project.

Despite these problems, the central government decided to approve the Fujian LNG project. Since the Chinese government's announcement on August 8, 2002 that BP won the 2.5m tonne/ year gas supply contract of the Fujian LNG terminal, the project seems to have entered a fast track. On August 22, 2002 representatives from CNOOC and the Fujian provincial government held a meeting in Beijing, at which the two sides reached a raft of framework agreements on how future cooperation should be carried out. Later on, the joint executive office was formed and the FS formally began.

CNOOC aims at developing two gas-fired power stations in Nanpu and Songyu, and pipeline distribution networks in five cities, Fuzhou, Putian, Quanzhou, Xiamen and Zhangzhou. CNOOC will hold the 60% equity of the LNG terminal and trunkline project, and its partner Fujian Investment & Development Co. Ltd. (FIDC) under the Fujian government will have the remained 40% equity. Not yet ready to disclose the actual gas demand, CNOOC sources nevertheless argue that's not a problem since the pre-FS, done in May 2002, shows that downstream demand far outpaces supply.

On September 27, 2002, CNOOC announced that it had signed a Heads of Agreements (HOA) on acquiring a 12.5% stake in the Indonesian Tangguh LNG project by payment of US\$275million from BP, which holds 49.66% of the project's stake. It is worth noting that CNOOC's acquisition price for the Tangguh project is around \$0.89 per barrel of oil equivalent, well below CNOOC's average historical funding and- development costs of around \$4/BOE. The Tangguh price is also lower than the company's earlier acquisition of a 5% stake in Australia's North West Shelf Gas Project reserves, which cost CNOOC \$320 million and translates to about \$1.52 per BOE.⁶ The HOA signed in Jakarta confirmed a 25- year, \$8.5bn Sales and Purchase Agreement on supplying 2.6m tonne/year of LNG to Fujian LNG project.

⁶ CNOOC had acquired the Tangguh gas reserves at US 15 cents / 1,000 cubic feet on a proven reserves and at US 9 cents / 1,000 cubic feet on a proved, probable and possible basis. FT International Gas Report, October 11, 2002, p. 26.

Table 48 - Ownership Structure of Tangguh LNG project

Shareholders	Equity %
BP	37.2
Mitsubishi	16.3
CNOOC	12.5
Nippon Oil	12.2
British Gas	10.7
Kanematsu Corp	10.0
Nissho Iwai	1.1
Total	100.0

Source: CNOOC

The stakes of the Fujian terminal will be split only between CNOOC and the local government-backed FIDC at a ratio of 60%: 40%, which shuts potential foreign investors and local gas companies out of the door, and it is quite different from the Guangdong project. The executive office argued that they learned a lesson from the Guangdong project that too many voices in decision-making might be distracting.

A noticeable fact with the Heads of Agreements (HOA) is that the 12.5% stake is larger than the 5% stake CNOOC got in the Northwestern Shelf through leveraging a 3m tonne/year gas contract for the Guangdong LNG terminal. Another noteworthy fact is that the gas-supply volume is raised from the earlier reported 2.5m tonne/year to 2.6m tonne/year. CNOOC says it will reveal detailed information in the near future. Currently, the FS of the Fujian project is under way, and CNOOC is waiting for governmental approval to formally kick off the project.

As shown in Table 49, the total GDP volume of Fujian accounts for only 40% that of Guangdong in 2000 and the total installed power capacity in Fujian accounts for 30% that of Guangdong. This simple comparison is raising a serious question as to the market maturity for the Fujian LNG.

Table 49 - GDP volume and installed capacity in Guangdong and Fujian in 2000

	Guangdong	Fujian
GDP (bn yuan)	966.22	392.01
Population (million)	85.2	34.1
Disposable Income* (yuan)	10,415	8,313
Installed Capacity and hydropower percentage	3.189 GW / 22%	1.0415 GW / 50.9%
Power generation and hydropower percentage	133.46 bn kwh / 11.5%	40.15 bn kwh / 48.2%

Note: *As of 2001, China's average disposable income is 6,859 yuan. The figure in Beijing and Shanghai is 11,578 yuan and 12,883 yuan respectively.

Source: *Chin's Statistical Yearbook*

Despite all the negative speculation about the Fujian terminal, BP could not afford to lose it. Without the Fujian market, there is no chance for BP to initiate its investment in the green field of Tangguh. The deal helps the company to take a foothold in China's

booming natural gas market. In July 2002, the company's long-standing rival, ExxonMobil and Shell, respectively got a 15% stake in the 4,000km west-east pipeline. Failure of winning the Fujian project would have been a real embarrassment considering that it withdrew from the west-east project last September 2001 with a speculation that it would win the LNG project in Guangdong. BP did not lose out totally in the Guangdong project. After all, it holds a one-sixth stake in ALNG's Northwest Shelf project.

It is the case the Fujian LNG is facing a tighter schedule than that of Guangdong. Though the time for supplier selection is saved and the approval from the SDPC is made. The Fujian project is still in the initial feasibility study stage, which is scheduled to end in May 2003 and will be submitted in June 2003 to the State Development Planning Commission for approval. Construction of the project is expected to start in 2004, and its operation, somewhere between yearend 2006 and the beginning of 2007.

Regardless of the difficult timetable, China Merchants Transportation Holding Co. (CMTHC)⁷ has already shown its interest in securing a contract to ship liquefied natural gas from Indonesia to Fujian province. The Hong Kong-based company has approached CNOOC and FIDC to explore the possibility of getting the contract. In August 2002, CMTHC was awarded a contract by CNOOC to ship 3 mt/y of LNG to Guangdong province from Australia, starting in 2005. CMTHC will jointly manage this contract with China Ocean Shipping Co., or COSCO. The Australia-Guangdong route will require three LNG tankers to be built by Shanghai Hudong Shipyard at a cost of \$150 million each.

In early 2003, the overall project proposal of Fujian LNG terminal has been approved by the State Council. According to the project's Joint Executive office (JEO), the pre-FS report has been completed in May 2002. The FS report was expected to conclude in June 2003 and hoped to be approved by the National Development and Reform Commission (the former State Development Planning Commission) within two months after the submission of the FS. The government invited industry experts from across the country to evaluate the study reports, and the one-week appraisal, gave a green light. But the reports are still waiting for the final approval from the provincial government.

On August 23, 2003 Fujian LNG construction started with land-reclamation from the sea work in preparation for the terminal building in Putian of Fujian province, although the FS report is not yet submitted to the National Development and Reform Commission. The land reclamation work will not be completed until May 2004, and it will cause a delay of the original plan's timetable. The construction of the terminal station can begin only after the land reclamation and the ground cleaning work. The project joint executive office indicated the FS report will be submitted by the end of September 2003. But the office argued that the construction of the power plants would have to start in October 2003.

The Chinese second LNG terminal project is scheduled to complete the construction work by 2006 and start operation by April of 2007. In its Phase I stage, the terminal will receive 2.6m tonnes of liquefied natural gas from Indonesian Tannguh gasfields. The Phase II will see the total capacity increasing to 5m tonnes. The total investment for the

⁷ China Merchants Transportation Holding Co. owns and operates a fleet of seven 300,000-ton tankers, one tanker of 150,000 tons and eight 100,000-ton tankers. The company is a unit of China Merchants Group, which has operations in shipping, property development and infrastructure construction.

project is around 25 billion *yuan*, of which 6 billion *yuan* for terminal and trunkline, 15 billion *yuan* for power plants, and 4 billion *yuan* for towngas grids.⁸ Three gas-fired power plants, which will consume about 1.7-1.8 mt of LNG, are designed with a total capacity of 3,600 MW, of which 1,800 MW for Putian plant, 1,080 MW for Jinjiang plant, and 720 MW for Xiamen plant. CNOOC is having 55% stakes of Putian power plant. Now it is a difficult task to acquire stakes in the other power plants. Beside electricity generation, a 0.7-0.8 mt/y of LNG will be supplied the towngas grids in Fuzhou, Putian, Quanzhou, Xiamen and Zhangzhou. In the second phase of the project, which is originally due in 2008, another two gas-fired power plants will be built. At that time, power generation and towngas consumption will split the project's LNG storage at a rate of 50:50.

Overall Verdict

The supply bidding proved to be a complex of economic and political interests. The announcement of the final winner was postponed for several times and finally made on August 8, 2002. The Guangdong LNG bidding concluded, however, with a dramatic ending to the surprise of energy observers that the Australian Northwest Shelf proposal finally beat the other two contestants.

The Chinese then awarded the consolation prize to BP and Indonesia. CNOOC said that without tendering it was in negotiations with BP to supply LNG to a new terminal in Fujian province from Indonesia's Tangguh field. The Fujian supply contract for 2.5 million metric tons of gas a year by 2006 will be awarded on condition BP sticks by the terms it offered when bidding for the Guangdong LNG project. In a three-horse race, Exxon Mobil Corp.'s bid based on the Ras Laffan Liquefied Natural Gas Co. in Qatar appears to have been the only loser.

The biggest winner in the two LNG terminals is surely CNOOC. In the agreements it reached with ALNG and BP, the company will get up to 25% of the stakes in the Northwest Shelf project and Tangguh project, greatly boosting its oil/gas reserve portfolio.

The basic verdict on the selection of both projects was very positive. According to China Energy Report (CER), Gordon Kwan, an energy analyst with Hong Kong-based HSBC Securities (Asia) Ltd said "I think it's the perfect solution that makes everyone happy except Exxon Mobil". Kwan added that settling the Fujian supply contract at the same time as announcing the Guangdong deal also avoids accusations that BP is being punished for its decision to pull out of China's West-East gas pipeline project.

However, there was some concerns on the discount the supplier had to offer to secure the contract. CER also reported that Merrill Lynch oil and gas analyst Mario Traviati is wary that the news that Australia has secured the contract will later be tempered by the discounts offered to China to close the deal. He said that "CNOOC and the Chinese have held all the cards and it's been a stacked game because they are the only game in town... I suspect that the Chinese have strung this out to get a price that is so low that Australian LNG won't want it announced."

⁸ The total investment for the Phase I construction is 11.98 billion *yuan*, which breaks down to 4.33 billion *yuan* for terminal and trunkline, 5.6 billion *yuan* for two gas-fired power plants and 2.05 billion *yuan* for the building the towngas networks in five cities. Some 1 billion *yuan* (USD120.8 million) in investment will go to the projects in Xiamen, but the figures on other places are not available.

It is worth noting both price competitiveness and the supply security were regarded as equally important factors for the both LNG supply contracts by the Chinese government. To some extent, however, ALNG's beating BP-Pertamina alliance to supply gas to Guangdong should be attributed to China's growing concern over oil/gas supply security. Since BP's Tangguh project is a greenfield one, the company can play the low-price card to the most without worrying whether that might anger others. Despite the price competitive edge, the project has a huge shortcoming that makes Chinese officials frown. That's the geographic location of the Tangguh project.

Though BP and the Indonesian government aim to spur the area's economy through the Tangguh project, the Chinese government might have seen potential supply insecurity in it. The Tangguh project is located in Indonesia's Papua Province, where the backward economy feeds a growing separatist mood. In contrast, the Australian gas, though more expensive as compared with that of Tangguh, is fortunately located in a country which is bestowed with much more stable economic and political environment. After all, China has given the priority to the option with both price competitiveness and supply security, and became the biggest winner.

2.3.3. LNG Supply to Shanghai, Shandong, and Bohai Rim areas

LNG Supply to Shanghai

For the time being at least, CNOOC has scrapped plans to build a liquefied natural gas terminal in Shanghai. The central government is determination to foster economic development in western China, and to complete the WEP project is the priority. CNPC is the driving force in China's natural gas development though most of CNPC's reserves are a long distance away from the booming natural gas markets. On one hand, central government intends to accelerate west China's economic development via developing its natural resources. On the other hand, the current policy is giving priority to domestic gas resources to satisfy increasing market demand.

CNOOC is in an inferior position to PetroChina in terms of natural gas reserves. China has 38 tcm of natural gas resources, with 8.4 tcm located offshore, accounting for 22% of the total. Up to now, CNOOC has 377.9bcm of proven reserves, only 24% of CNPC's total and 75% of Sinopec's total.

Nonetheless, CNOOC has a blueprint of a natural gas pipeline network winding through China's most developed coastal provinces and cities, which also represent the main market of China's rapidly developing natural gas industry. Though the coastal natural gas artery design is acquiesced by the central government and welcomed by local ones, CNOOC seems to play the role of the pioneer rather than the leader in China's natural gas market, with its key handicap being insufficient natural gas reserves.

As CNOOC's gas reserves are too limited to supply its coastal pipeline network, imported LNG thus becomes a significant means for CNOOC to expand its gas market shares. Apart from the Guangdong and Fujian LNG project, LNG terminals are proposed in Shandong, Shanghai and Zhejiang.

CNOOC submitted a feasibility study and proposal for the Shanghai terminal to the State

Development Planning Commission in mid-2000, only to be rejected in the face of competition from PetroChina's WEP project. The Central government suspended the LNG project in order to make full use of the gas from the West. Despite this setback, the option of LNG supply to Shanghai will be reviewed by the government in 2005. CNOOC knows too well that the central government first wants to ensure the success of the WEP project, then it will reconsider the LNG plan as China will need to diversify LNG supply sources for energy security.

CNOOC sees eastern China's gas demand will grow to 10 bcm a year by 2005 from a small consumption base now, and further to 20.5 bcm/year by 2010. About 50% of that demand will stem from power generators, while gas for chemical production will fall from 24% in 2005 to 13% by 2010. Household consumption of gas will increase by 31% between now and 2005, and by 37% by 2010. Despite this strong demand, PetroChina will be in a position to supply only about 3.6 bcm of gas a year to Shanghai through its pipeline by 2004, with volume possibly increasing to 10 bcm/year after 2005. CNOOC's offshore gas fields in the East China Sea will be able to supply 5 bcm/year by 2010, up from just around 0.4 bcm a year now.

According to a study by the Australian Bureau of Agricultural and Resource Economics and China's Energy Research Institute, an energy think tank of NDRC having examined prospects for natural gas demand in eastern China and the role of LNG, by 2015 gas demand in Shanghai and the provinces of Jiangsu, Zhejiang and Fujian would reach 37 bcm, of which 17.2 bn cm or 12.6 mm tons would be met by LNG imports. (The projection is based on the study's reference case)

CNOOC sees that eastern China could have a gas supply deficit of about 6 bcm a year by 2010 and expects that PetroChina's pipeline would be able to supply enough gas only for two Shanghai gas-based power plants by 2005. In its feasibility study, CNOOC proposed three alternative locations for a Shanghai terminal. Of the three, CNOOC prefers Shanghai's Zhongmentang island to the other two - in Zhejiang and Jiangsu provinces respectively - in part because the Shanghai location is closest to the markets. Should the project win State Development Planning Commission approval after 2005, however, CNOOC is very likely to reject Zhongmentang in favor of Lidiaoshan island in Zhejiang province. This is due to operational safety considerations, given that the Shanghai government plans to develop shipping lanes at Zhongmentang in order to build the island into a major sea transportation hub.

It is worth noting PetroChina is also working on the LNG terminal development in Shanghai areas. In early September 2002, PetroChina started the pre-FS of building an LNG terminal in Jiangsu's Rudong Island or Shanghai's Zhongmentang to solve the peak-shaving problem of the west-east gas pipeline. PetroChina's approach is based on the two letters of intent (LOI) it signed with the provincial and municipal government of Jiangsu and Shanghai at the end of 2001. PetroChina saw the two local governments choose the company as their LNG partner in consideration of PetroChina's dominant position in China's natural gas market and the firm's leading role in supplying the west-east gas into the Yangtze River Delta.

Interestingly PetroChina's initiative towards LNG is caused by some engineering problems with the Jintan gas depot it plans to build for the WEP project. According to PetroChina, the LNG terminal will mainly play the role of peak-shaving that will naturally add expense to PetroChina's west-east gas pipeline budget, if constructed.

Concerned with PetroChina's slow progress in Jintan Salt Mine, slated for peak-shaving storage for the WEP project, however, Jiangsu province which will consume roughly 50% of the WEP gas proposed to import LNG from Indonesia. PetroChina takes Jiangsu's action as a sort of intimidation. The driving forces behind Jiangsu's LNG plan is its worries about the supply security of the WEP project. Jiangsu provincial government is acquiescing a Singaporean company named Pacific Oil & Gas International Corp. to do the pre-work of building an LNG-fired power plant on the Langsha Island and related LNG-importing facilities. The capacity of the power plant is tentatively pinned at 2 x 600 MW. The chance of SDPC's rejection of this plan is very high.

Shanghai areas will be a battle ground for the market entry with multiple gas sources, and the supply from WEP and East China Sea will sustain Shanghai's demand for quite a long time. In the long term Russian natural gas entering at Xinjiang might also find a path to reach the Yangtze River Delta. Despite these domestic gas supply sources, the potential demand for LNG in the area will be very strong and SDPC will have no choice but to make an approval for another LNG terminal development in Shanghai areas after 2005.

On October 24, 2003 CNOOC Ltd. has announced that it has signed an agreement with Australia's Gorgon Joint Venture. Upon the completion of formal contracts, CNOOC Ltd. will purchase a substantial equity stake in the Gorgon Venture, and its parent company CNOOC will purchase an unspecified percentage of LNG from Gorgon. If signed, the final gas deal will be the second major LNG importing contract signed between China and Australia.⁹

According to the preliminary agreement, CNOOC is to import 100 mt of LNG over a period of 25 years from the Gorgon Venture, which currently has 12.9 tcf in proven reserves. The deal is estimated worth AU\$ 30 billion (US\$ 21 billion). The scale of this deal could be much bigger the 25-year agreement signed by the North West Shelf Venture, which is to sell more than 75 mt to South China's Guangdong Province at a value of about AUD 25 billion (USD 17.5 billion). According to China Daily, CNOOC's Hong Kong and its New York-quoted subsidiary, CNOOC Ltd., is likely to buy a 12.5% stake in the Gorgon Venture for around US\$ 275 million. After becoming a shareholder, CNOOC will also need to pay 12.5% of the project's development costs, estimated at AU\$ 11 billion (US\$ 7.69 billion).

Zhejiang Province is one of several locations identified for the expansion of LNG trade in China. The structure of ownership is that ChevronTexaco, the operator of the venture, holds a four-seventh stake, with Shell and ExxonMobil having two-sevenths and one-seventh respectively. According to information from the Ministry of Commerce, the

⁹ A new agreement with the intent of supplying LNG from Gorgon project to China was signed during President Hu Jintao's visit there. The development of Gorgon project is faced with two options, of which one is to build a stand-alone greenfield development facility, and the other is to partner with NWS project by utilizing the latter's facility. Till now, the two project's partnership is still in stalemate. If China is to join the greenfield development with the existing partners, there must be a huge and ready market demand. Though the Chinese government is considering building more LNG terminals along the coast besides the two existing projects in Guangdong and Fujian provinces, the relevant study is yet sophisticated and no guarantee could be given about the future liquefied gas demand.

Indonesian government, intends to seal another LNG contract to export up to 5 mt per year to Jiangsu Province. It confirms that Shanghai, Zhejiang and Jiangsu provinces are the target are for the LNG supply during 2006-2010 period.

LNG Supply to Shandong and Bohai Rim areas

LNG terminals are not absolutely ruled out in northern or eastern coastal provinces, for gas supply diversity is a guideline in developing China's natural gas market. Yet the prerequisite is supply-demand gaps in these markets. And what is equally important is that CNOOC should provide the LNG at a competitive price. Therefore, CNOOC is struggling to fight against the principle of "pipeline gas first and LNG second".

Shandong province is also being targeted by several gas pipelines and LNG. Only PetroChina's Shaanxi-Gansu-Ningxia basin can serve as the domestic gas base to feed the province's natural gas pipeline network. CNOOC aims at a LNG terminal at Qingdao, while CNPC is determined to have the Russian gas as the dominant import source. Reportedly, CNOOC and the Shandong government were close to completing a feasibility study on the proposed terminal, which could start construction in 2008.

If CNOOC's scheme to import LNG to the Shandong province is approved by the SDPC before 2005 despite CNPC's scheme to import East Siberian gas, it would be another major breakthrough for CNOOC as it is determined to expand its gas market. As a way of securing the gas market, CNOOC actively seeks interests in town gas grids via joint ventures with local governments. So far, CNOOC has made cooperation agreements with Shandong, Zhejiang and Fujian, not to speak of Guangdong. The aim is to have a share in local gas networks.

China's natural gas infrastructure, including trunk lines and town gas grid, is almost being built up from scratch and will call for tremendous investment. The coastal provinces have all showed enthusiasm about establishing natural gas grids. CNOOC's "first mover" policy of participating in the local network construction is welcomed by the local governments. Both Shandong and Zhejiang provinces cooperating with CNOOC in building downstream infrastructure have showed interest in importing LNG. This should be helpful for CNOOC to maintain or even expand existing cooperation.

So far CNOOC has never mentioned the LNG supply to the Bohai Rim Areas (above Shandong province), and it may be because of the perception that the area's gas demand would be covered by both Ordos basin's gas and imported gas from East Siberia. It is true that the northern provinces will be covered by the pipeline gas but there is niche market for smaller scale LNG supply.

For example, Liaoning province's gas market potential is very big and in particular, the cities in Liaodong Peninsula are very well positioned to have a 1.0 mt/y of pilot LNG supply due to a strong demand and shortage of supply. The Russian gas supply is an option many years away. Both CNPC and the local planning commission would take the LNG scheme positively as the LNG import will offer a very useful benchmarking tool for the forthcoming transnational pipeline import. Considering that the price will be one of the most critical issues for transnational pipeline introduction, a small scale LNG terminal development in the port city in Liaodong Peninsula serves no harm to the Chinese consumers.

There is a good potential of LNG supply to the northern China's gas market. Nonetheless, so far no Chinese or western energy companies has taken the initiative to explore the possibility of developing a niche LNG market in northern China. Sooner or later there will be a serious discussion on this option of LNG supply to the Bohai Rim area.

- China's decision to choose both the LNG supply from Australia and Indonesia heralded a new LNG era in China's natural gas expansion in the coming years.
- Due to the central government policy to maximise the use of domestic gas resources, however, LNG import will play a supplementary role for the China's natural gas expansion.
- As China is set to start import a relatively big volume of pipeline gas from Russia around 2010, it will significantly affect the scale of LNG expansion in China. However, the pipeline gas development will be also seriously affected by the competitive LNG supply price.
- Despite the Chinese government's preference to maximising the use of domestic gas in western part of China by pipeline and of offshore gas by pipeline, there is a very good chance of LNG supply to Shanghai areas (including Zhejiang and Jiangsu provinces), Shandong Province and Bohai Rim areas after 2005.
- LNG supply to Shanghai areas seems unlikely to be opened before 2005 as the SDPC is determined to see the successful implementation of west-east pipeline gas introduction to the Shanghai areas.
- A smaller scale LNG (1 mt/y) supply to both Shandong and Bohai Rim areas is a very likely possibility as long as the price is competitive.
- The significant price discount offered for both Guangdong and Fujian LNG supply will affect the existing and forthcoming LNG contracts in Japan, Korea and Taiwan.
- China's Guangdong and Fujian LNG supply deals have fully reflected the fact it is buyer's market not supplier's market. But the situation could change due to the strong demand on LNG, in particular from the United States.

2.4. Trans-national Pipeline Gas Import

Until the end of the Cold War, the concept of transnational pipeline network development was a mere pipe dream. When China's energy self reliance policy virtually ended in 1993, transnational pipeline concept was no longer a remote reality. However, the breakthrough was made much earlier in the LNG import while the trans-national pipeline gas project is still struggling due to the project economics and politics.

The Chinese energy planners became very serious about the transnational pipeline concept, and the concept was very well reflected by Dr. Wang Tao (then president of CNPC)'s proposal of the establishment of a Pan-Asian oil and gas pipeline grid to Russia, Japan, Korea and central Asian Republics which was made in June 1996. When the breakthrough is made, transnational pipeline development will bring a new dimension to China's energy structure in the coming decades.

The implications of this long distance pipeline development will not be small as the impact of pipeline gas introduction will not be confined to China. This section examines the six gas supply options to China and then will focus on the main factors affecting the pipeline gas introduction to China.

As shown in Table 50, in the Russian Federation there are four gas supply sources for China, and in the central Asian Republic region there are two gas supply sources.

Table 50 - Main gas supply sources for China

Region	Field (Licensed Company)	Reserves (C1+C2)
Irkutsk	Kovyktinskoye	1,932 bcm + 90 mt condensate + 2.3 bcm helium
	(Russia Petroleum)	
	Verkhnechonskoye	280 mt
Republic of Sakha*	Chayandinskoye (Sakha Republic Gov)	1240 bcm + 50 mt
	Sredne-Botuobinskoye (Sakhaneftegaz)	171 bcm
	Taas-Yuriakskoye (Sakhaneftegaz)	114 bcm
	Talakanskoye (Surgutneftegas)	124 mt + 50 bcm
	Yurubchonskoye (Yukos)	282 mt + 374 bcm + 29 mt condensate
Krasnoyarsk**	Kuyumbinskoye (Slavneft)	154 mt
	Sobinskoye (Gazprom)	159 bcm

West Siberia	Palkliahinskoye, Bolshehetskaya (Gasprom)	3,021 bcm, of which C1 751 bcm, C2 596 bcm, and C3 1,203 bcm
Kazakhstan	Karachaganak (BG-Agip-Exaco)	1,300 bcm
Turkmenistan*		9.2 tcm in-place, of which 4.6 tcm proven
	Shatlyskoye	roughly 1,000 bcm recoverable (est)
	Dayletabad	1,380 bcm recoverable

Note:

- * As of 2002, the estimated recoverable oil and gas reserves in Sakha Republic are 2.39 billion tonnes of oil, 9,420 bcm of gas, and 409 million tonnes of condensate respectively.

** The geological oil and gas reserves of Yurubchen-Tokhomskaya area composed of Yurubchen, Kuyumbinskoye, and Tersko-Kamovskoye fields stand at 1.2 billion tonnes and 1,000-1,200 bcm respectively.

- * Besides the above mentioned, the gas fields like Bagadzhin, Kirpichlin, Naipskoye, and Gugurtlinskoye record over 100 bcm gas reserves.

Source: Keun-Wook Paik (Date?)

2.4.1. Review on Six Supply Options

Irkutsk gas export to China

In 1991 the Concept of Developing Yakutian and Sakhalin Gas and Mineral Resources of Eastern Siberia and the USSR Far East, the so-called Vostok(East) Plan was announced. The key element of the plan was construction of a 3230 km gas pipeline from Sakhalin across Russian territory through North Korea to South Korea, and a 3050 km pipeline from Yakutsk to Khabarovsk. In other words, China saw a possibility of gas import from this Vostok plan, which was an inconceivable during the Cold War period.

The year of 1992 witnessed two major approaches by the China National Petroleum Corp.(CNPC) with regard to pipeline gas imports. The first approach encompassed East Siberian oil and gas development and their export to China. It was suggested in July 1992 by Prof. Zhang Yongyi, then vice president of CNPC, who proposed the development of oil in East Siberia to Russia and Japan. Prof. Zhang added that the oil pipeline could be extended to Japan via Korea, if Japan got involved in the project. The second approach was Central Asian gas import to China. This was proposed by CNPC together with Mitsubishi at the end of 1992.

During 1993-94 period, CNPC identified Kovykta gas project in Irkutsk region as the priority project for the trans-national pipeline development between Russia and China, and in November a memorandum of understanding was signed between CNPC and Mintopenergo.

In September 1993, CNPC began to negotiate with the Russian for exploration of Markovskoye and Yarakhtinskoye oil and gas fields in Irkutsk region. (These two fields are located between Kovyktinskoye and Verkhnechonskoye fields.) CNPC's Russian counterpart was a group of Irkutsk's Petroleum and Gas Geological Company and

Geophysical Research Institute, together with 14 other local companies and organizations. CNPC's two exploratory wells were drilled in the two virgin fields.

A milestone of East Siberian gas development was laid in early November 1994 when CNPC and MINTOPENERGA signed a memorandum of understanding for the construction of a long distance pipeline to promote East Siberian oil and gas resources. The 1994 agreement was the first official expression of their determination for the pipeline development. The trans-boundary pipeline, proposed by Sidanco, aims at transporting annually 20-30 bcm from the Irkutsk region in East Siberia to the coastal cities of East China, and possibly to Korea and Japan.

Another major agreement was made in late June 1997, when a Russian delegate led by Premier Viktor Chernomyrdin visited Beijing. It was the governmental framework agreement between Russia and China to export natural gas and electricity from East Siberia to China was signed. Under the natural gas deal, Russia would export 25 bcm/y of gas from Irkutsk region over 30 years. The \$1.5 electricity deal over 25 years envisage a supply of 20 billion KW/h of electricity from Irkutsk to either Shenyang, Liaoning province or to Beijing. Basically this framework agreement was a re-confirmation of the 1994 memorandum.

The most important agreements were signed in February 1999 after the fourth regular meeting between Premier Zhu Rongji and his counterpart Yevgeny Primakov. Both sides signed 11 agreements, of which three are related with oil and gas.

- The first is on a preliminary feasibility study on crude oil export from Angarsk to Daqing through a 20-30 mt/y capacity pipeline
- The second is on a feasibility study on Irkutsk region's natural gas export to northeastern China through a long distance pipeline
- The third is on a preliminary feasibility study on a western Siberia's gas export to Shanghai by a trans-national pipeline passing through Xinjiang region.

Based on this 1999 agreement, a three years FS by the parties (CNPC, Kogas and Rusia Petroleum) was undertaken in November 2000 and the result was submitted in November 2003.

It is worth noting that the ten years preparation period of the Kovykta gas project can be divided into five stages:

Table 51 - Five Stages for Kovykta Project Negotiation

1994-1996	This period is characterized as "bilateral relationship development period" between CNPC and Mintopenergo.
1996-1997	This is the first stage for the western investment, initiated by Korea's Hanbo group and then by BP's serious move.
1998	This is the negotiation period for "five country FS work" (Had it hammered out a compromised option, it would have opened the door for the genuine "multi-lateral cooperation era" in Northeast Asia). The driving force of this negotiation was Japan, but its initiative to lend a major loan for the FS work was not supported due to its failure to open their gas market for the development.
1999-2000	The focus was once again on bilateral relationship between Russia and

	China until the three party FS work agreement is signed.
2000-2003	Both Russia and China agreed to invite South Korea to the project to minimise the risk of market availability in the early stage of the project. Even though the official agreement for the feasibility study of the Irkutsk gas project was signed in November 2000, the negotiation was suspended for at least 7-8 months due to a number of unresolved issues since Autumn 2001. The negotiation resumed in Summer 2002. The result of the FS was completed in November 2003.

Source: Keun-Wook Paik (Date?)

Kovykta Gas Development¹⁰

The Kovyktinskoye gas and condensate field discovered by parametric well 281 drilled in 1986 by Vostsibneftgasgeologiya, the subdivision of former Ministry of Geology of Russian Federation and located in the Zhigalovsky region, 350 km to the north-northeast of Irkutsk.

Table 52 - The Characteristics of Kovykta Gas

Field size	7,499.5 sq km
Depth of Occurrence (along the vertical)	2,838 – 3,388 metres
Pay Thickness	Up to 78 metres
Effective Thickness	Up to 29 metres
Sandstone Porosity	10-19%
Gas Saturation	0.6 – 0.9
Formation Pressure	25.7 MPa
Reservoir Temperature	55 degree C
Condensate Content	67.0 g/cu.m
Content of CH ₄ in gas	90.3 moles / %
Reserves (as of early 2003)*	1,931.6 tcm + 90 mt of condensate + 2.3 bcm of helium

Note: On Feb 28, 2000, Federal Geological Committee confirmed that Kovykta's C₁+C₂ reserves are 1,120 bcm. If the adjacent Khandinsky and Yuzhno-Ust-Kutsky blocks' 280 bcm are included, the total will be 1,400 bcm.

* On March 15, 2002, the 1,932 bcm (of which C₁ 1,100 bcm +C₂ 754.7 bcm) reserves registered by Central Commission for Reserves of Russian Federation Ministry of Natural Resources.

Source: Russia Petroleum Investor (Date?)

When the project was initially introduced to the western world, the proven reserves of the field stand at 870 bcm, of which C₁ was only 277 bcm. However, as of 2002 the figure became 1932 bcm, of which C₁ was 1,000 bcm. The uncertainty on the proven reserves was totally cleared. The turning point of Kovykta project development was BP's acquisition of 45% of equity of Sidanco's interest in Rusia Petroleum by providing US\$

¹⁰ Some work has been done before the 1994 when memorandum for the development of East Siberian gas development between CNPC and MINTOPENERGA(the Russian Ministry of Fuel and Energy). In 1991 Baikalekogaz consortium and BP/Statoil alliance conducted a study on East Siberian oil and gas resources in East Siberia in the early 1990s, but BP/Statoil concluded that the study had no incentive for taking further steps due to the lack of immediate market for East Siberian oil and gas export. In 1992 the Baikalekogaz consortium was converted into Rusia Petroleum. The same year Canada's SNC and Lavalin under the sponsorship of Canadian Bitech Corp. carried out a pilot feasibility study on the Irkutsk region's gas supply project based on Kovyktinskoye development.

172 million of the cost of appraising the Kovykta field. BP's positioning in the project helped the acceleration of the exploration and it confirmed the real scale of the proven reserves.

The project's three years FS work was completed in November 2003. The main objective of the feasibility study was to show whether gas supply to China and Korea will be effective and commercially viable. The study has evaluated the viability of the core concept that Russia Petroleum would sell CNPC 600 bcm of gas (20 bcm/y) and Kogas 300 bcm (10 bcm/y) over 30 years. The supply would start in 2008 to reach to the level of 30 bcm/y by 2017. The study calls for up to 4 bcm/y of gas to be supplied to Irkutsk and Chita regions and Buryatia. The required total investment for the project will total US\$ 17 billion, much higher than the US\$ 12 billion price tag initially suggested in 1995.

About 400-500 wells with average depth of 3,000 meters will be needed to develop Kovykta field. This project includes the construction of nine gas treatment plants, 20 compressor stations, and 20 collection stations. Russia's projected demand for the Kovyta gas in is 4 bcm, while that of northeastern China and northern China is 12 bcm and 8 bcm respectively, and that of Korea is 10 bcm per year. The next step of this FS work is to get the approval from the governments of all parties concerned.

Table 53 - Russian Petroleum's Shareholder Structure: as of late 2003

Shareholders	Equity %
BP	33.39
TNK	29.03
Interros	25.82
Irkutsk State Property Committee	11.24

Source: Interfax Petroleum Report (Date?)

If the project is approved by all three governments, the value of this project will soar. The biggest beneficiary of the project will be BP-TNK group with a 62% of the controlling stake of the project. It is worth noting that Interros Holdings Company's 25.8% equity was put on sales soon after the FS work completion and the estimated price for the equity is around US\$ 500 million. However, the most important players that would decide the fate of project development and the gas export are Gazprom and CNPC, and they did not take any action on this equity offer.

A number of major issues like coordinator, pipeline route, gas price and market availability issues should be sorted out for the development of this project :

i) **Coordinator of the negotiation:** There was a confusion about the role of coordinator. Gazprom argues it has the mandate to co-ordinate the gas export projects from the central authority. In fact, during the key not speech at the 22nd International Gas Conference held in Tokyo in June 2003, Alexei Miller, CEO of Gazprom officially confirmed that Gazprom has been authorized by the Government to or-ordinate the establishment of a united system for gas production and transportation. However, his talk did not give any hint how the co-ordinating role would be taken care by Gazprom. It will take time to have a clear understanding what is the role of co-ordination by Gazprom in the Kovykta project.

ii) **Pipeline Route:** During the third session (July 2002) of the co-ordinating committee for managing work to draft the Kovykta project FS, the Chinese party asked the western route of the gas pipeline (Mongolian line) will not be considered from now on.

According to Xinhua news agency's China OGP, the reasons China wants to have the eastern route rather than western route are threefold:

- The main reason is China prefers to minimising the political risk and saving the transit fee by avoiding a transit country, Mongolia
- The second is the economic benefits brought by the pipeline could make the Mongolians suddenly richer than people in China's inner Mongolia, a potentially negative influence on the stability in the Autonomous region
- The third is by choosing the east route, China will be able to deliver the economic benefits of the pipelines to northeast China, a region in desperate need of economic and social benefits from the Sino-Russian oil and gas pipelines.

Strictly speaking, Mongolian line is the most economical one for all party. However, the giant discovery of Sulige-6 gave enough space for the Chinese planners to re-consider its stance towards the Mongolian route. The exclusion of the Mongolian route option is a fatal blow to South Korea as there is no chance that the price of the eastern route could be as competitive as LNG price. Considering that a report prepared by Kogas for the Parliament's Trade and Industry Committee annual inspection in October 1997 argued that the imported pipeline gas price will be 22-25% cheaper than that of LNG, Kogas will have a difficult time in justifying to import more expensive gas through the Manzhouli routes.

Table 54 - Proposed Pipeline Routes

Mongolia Route	Manzhouli Route I	Manzhouli Route II
Kovykta - Irkutsk - Ulan Bataar - Beijing - Shandong Peninsula - Yellow Sea - Pyeongtaek	Kovykta - Irkutsk - Manzhouli - Harbin - Shenyang - Shinuiju - Ilsan - Pyeongtaek	Kovykta - Irkutsk - Manzhouli - Harbin - Shenyang - Dalian - Yellow Sea - Pyeongtaek
3,819 km , of which	4,065 km , of which	4,249 km , of which
• 1,027 km in Russia • 1,017 km in Mongolia • 1,490 km in China	• 1,850 km in Russia • 1,879 km in China	• 1,850 km in Russia • 1,659 km in China

Source: Ministry of Commerce, Industry and Energy (MOCIE), Korea

At present, Korean side is only talking about the Manzhouli route I and II, and Korea's preference is the Manzhouli II route as it would be bypassing the North Korean territory and the construction and maintenance cost would be cheaper than Manzhouli route I option. However, it will be eventually the city gate price of this imported pipeline gas that would decide the fate of this Kovykta project.

iii) Gas price: This is the most difficult part. The Russian side wanted to have US\$ 100 / 1000 cm level price, but is willing to come down to US\$ 75 / 1000 cm. The Chinese side want to pay US\$ 20-25 /1000 cm as the consumers in northeastern China cannot afford to pay the much higher price. (This issue will be discussed in detail later)

V) Market availability : Without Korea's 10 bcm/y market, the 20 bcm/y of gas supply to the northeastern provinces before 2010 is too ambitious. If a significantly discounted gas price cannot be offered, even 10 bcm/y market in northern China until 2010 is a tough target to achieve.

Sakha Gas Export to China

It is not an exaggeration to say that the initiative of East Siberian gas export to Northeast Asian market was taken by Sakha Republic. It was as early as the 1960s that the possibility of Yakutian gas export to Japan was explored and promoted, and suspended in the wake of the Former Soviet Union's Afghanistan invasion in late 1979. In the late 1980s Korea's Hyundai group revived the forgotten project, and eventually in 1995 the preliminary feasibility study commissioned for the Sakha gas development, funded by Russia and South Korea for the amount of \$10 million respectively, was implemented. But the outcome was not very encouraging, and no further step has been taken.

In other words, the conclusion was that Sakha gas export to Korea would not be acceptable for the time being due to remote location, harsh environment and consequently poor development economics. However, Sakha Republic is boasting of a relatively big proven gas reserves (over 1 tcm), and is well positioned to offer enough proven reserves that could justify a long distance and trans-national pipeline development.

According to Vasilii Moiseyevich Efimov, then president of Sakhaneftegas, as of 1998 the registered C1 category reserves in Vilyuisk region (10 fields : 437.8 bcm) and Botuobinsk region (21 fields : 586.3 bcm) are 1,000 bcm. Besides this, the reserves of Chayandinskoye field in Botuobinsk region are estimated at 755 bcm (previously 208 bcm), of which 535 bcm is exploitable. Already 64 wells have been drilled in the field.

Desperate to restore as the main gas export source in the region, Sakhaneftegas has made a proposal for East-Siberian consortium based on Irkutsk region, Sakha Republic and Evenki Autonomous region of Krasnoyarsk Krai in 1998, and the proposal is being supported by Rosneft, Chita region Administration, JSC UES of Russia, Administration of Evenki Autonomous region and Russia Petroleum. Interestingly, Sakhaneftegas has signed an agreement with Russia Petroleum for joint development of Kovyktinskoye and Chayandinskoye fields, even though the priority will be given to Kovyktinskoye first.

At that time it was the only way to remove any suspicion on the reliability of the proven reserves scale. The significance of this proposal lied in a fact that the combined development of Kovyktinskoye and Chayandinskoye fields will guarantee solid proven gas reserves that could justify 4000 km long distance pipeline development for a long period. It was not surprising to see this hybrid export scheme was presented at the 4th United States-China oil and gas industry forum by Xu Ding-Ming, then counsel of department of industrial department, State Development Planning Commission.

Map 3 – See Annex 1

Source: Xu Ding-Ming, China's Natural Gas Industry in Development, presented at the Fourth US-China Oil and Gas Industry Forum.

The hybrid export scheme has two options, even though there is no difference in the pipeline section within the Chinese territory. The first is a 4,961 km pipeline, of which the Russian section distance is 1,960 km and the two pipelines from Kovykta and Chayanda field are meeting at Bodajbo adjacent to the northern tip of the Baikal lake. The second is a 5,626 km pipeline of which 2,2625 km is in the Russian territory. This second option gives the absolute priority to the Kovykta project as the Chayanda is connected as a back-up supply source.

It is true Chayandagas project is not as advanced as Kovykta in terms of development preparation. However, a significant work has been done during the last few years. First of all, On July 26, 2002 Sakhaneftegaz completed a preliminary FS for a gas pipeline that will export gas from Chayandagas to Shenyang (This work started based on the agreement signed between CNPC and Sakhaneftegaz in April 1999 soon after the Feb 1999 agreement) The initial export volume will be 12-15 bcm/y and the figure could expand to 20 bcm/y in the later stage. Secondly, Moscow's Central Commission for Reserves of Russian Federation Ministry of Natural Resources approved the revised figure of Chayandagas proven gas reserves as 1,240 bcm as of 2002. Thirdly, in October 2002, Gazprom and Sakha Republic Government signed a framework agreement on forming a joint venture to bid a tender for the development license for the Chayandinskoye field and other fields in Sakha Republic.

In particular, Gazprom's strategic alliance with Sakha Republic Government has a special implications. In early 2002, Sakha Government reported to the local legislative assembly that Yukos has secured a 47% controlling stakes of Sakhaneftegaz which used to be controlled by Sakha Republic government. In other words, Yukos initiative forced Sakha Republic Government to be minor shareholder in Sakhaneftegaz. Sakha Republic Government's choice was to have a strategic partnership with Gazprom which has initially neglected Kovykta project and wanted to be a dominant player in the solely the Russian Federation government asset.

In February 2003, Gazprom chairman Alexei Miller and Rosneft president Sergei Bogdanchikov asked president Putin to instruct the Russian Federation Ministry of Natural Resources and other relevant ministries to consider developing the Chayandinskoye, Talakanskoye, Sredne-Botuobinskoye, Kovyktinskoye and Verkhnechonskoye oil and gas fields under a single project and initiate an auction in accordance with effective legislation, and Putin accepted the proposal.

The next month, the Russian Government held its first Cabinet meeting to discuss the development of oil and gas reserves of Eastern Siberia and the Far East. During this meeting, the government adopted the draft of the Programme to Establish a Unified System of Production, Transportation and Supply of Gas in Eastern Siberia and the Far East in view of possible export of gas to markets in China and other countries of the Asia Pacific region as the basis for further work. Besides this, the government also decided to include the Gazprom developed programme in the draft Principal Provisions of the Energy Strategy of Russia for the Period until 2020.

In terms of the proven reserves, Chayandagas 1240 bcm is somewhat smaller than that of 1932 bcm of Kovykta, but each of the reserves are big enough to pursue a long distance gas pipeline development. It will be the Russian government decision which one will get the priority for the export to China.

Sakhalin Gas Export to China

Like Sakha gas, Sakhalin offshore development was discussed since the 1960s, but until the early 1990s no real development was made partly because of uneasy relations between the former Soviet Union and Japan and partly because of poor development economics. The gas reserves in Sakhalin I (Exxon 30%, Sodeco 30%, Rosneft and Sakhalinmorneftegas 20%, and ONGC Videsh Ltd 20%), and Sakhalin II (Shell 55%, Mitsui 25%, and Mitsubishi 20%) stand at 485 bcm and 460 bcm respectively. Besides this, ExxonMobil-Texaco consortium is estimating the gas reserves of Kirinskya prospect in Sakhalin Block III at 720 bcm. If the figure is proved after exploration, Sakhalin offshore could produce enough gas that can not be absorbed by Japan's gas market alone.

Around 1998 period Japex and four Japanese steel companies investigated the possibility of introducing 2,225 km pipeline connecting Sakhalin Islands and mainland Japan. The pipeline is composed of three sections : the first section with 625 km from Katangli to Prigorodnoye, the second section with, 1300 km from Prigorodnoye to Niigata through offshore, and the last section with and 300 km from Niigata to Tokyo. In fact, Japan's Ministry of International Trade and Industry(MITI) minister, Shinji Sato announced at the International Energy Agency ministerial meeting held in May 1997 in Paris that Japan is considering the Sakhalin offshore gas import pipeline. It was the first official remarks by Japan's minister on international pipeline development between Russia and Japan.

During April 1999 and Spring 2002, both Exxon Japan Pipeline Ltd and Japan Sakhalin Pipeline Co. (JSPC) have been preparing a FS for this Sakhalin gas supply to Japan. The three years FS work cost US\$ 40 million. JSPC is composed of Japex 45%, Itochu 23.1%, Marubeni-Itochu Steel Inc. 18.7%, and Marubeni Corp 13.2% and was the operator in efforts to develop the FS. The FS assumed that the pipe diameter is 26-28 inch (65-70 cm) and delivery capacity is 8 bcm/y. The distance from Sakhalin I to Tokyo and Niigata is 900 miles (1,400 km) and 700 miles (1,120 km) respectively. The FS concluded the project was technically and commercially viable.

A breakthrough was made from Sakhalin II's LNG export to Japan during the first half of 2003. Three Japanese utilities, Tokyo Gas, Tokyo Electricity and Kyushu Electricity agreed to import a total of 2.8 mt of LNG from Sakhalin II from 2007. Basically this deal wiped out the possibility of pipeline gas supply from Sakhalin I to Japan until 2012-13 period. It is not a co-incidence that Sakhalin I began to float the idea of gas supply to northeastern provinces soon after this deal. Reportedly, the idea of gas supply to China was originally promoted by Rosneft, a shareholder of Sakhalin I project. Reportedly Sakhalin I consortium plans to resume the talk with the Chinese, halted over differences on gas price in 2002.¹¹

¹¹ FT International Gas Report, August 1, 2003, p. 14.

In terms of location, northeastern provinces in China are well positioned to be the beneficiaries of Sakhalin offshore gas development. According to SDPC's long term plan, China is also considering of importing Sakhalin offshore gas to Heilongjiang province during the period of 2011-2020. In fact, China has studied the possibility of Sakhalin gas import to Heilongjiang Jilin and Liaoning provinces in late 1990s but did not take any step on this option as the priority was given to Irkutsk gas and Sakha gas.

West Siberian Gas Export to China

Another serious pipeline gas option to China is closely connected with Gazprom's Asia policy. In early March 1995, Shi Xunzhi, then the Assistant President of CNPC, stated at a Tokyo International conference, that China was considering importing gas from East and West Siberia, and RFE via a new gas pipeline connecting Irkutsk region with China via Mongolia. However, a proposal by a bilateral working group to export gas to China from West Siberia's Vostochno-Urengoi field ran into opposition from Gazprom which suggested that all of western Siberia gas should be ear-marked to travel west to Europe or reserved for domestic consumption in Russia.

Even though Gazprom was not really convinced about CNPC's intention, and was not in a position to think of Asian export option seriously at that time, no western observer had any doubt as to Gazprom's participation in this development in some point, but had any clue as to when and how Gazprom will advance towards the Asian market. Since 1997 when Gazprom's first remarks on its Asian market policy was made by Rem Vyakhirev, then CEO of Gazprom, a very systematic approach was made by Gazprom to prepare a detailed strategy. (See Table)

Table 55 - Review on Gazprom's Asian Policy Development

1997.02	Gazprom CEO Rem Vyakhirev announced Gazprom's intention to formulate a comprehensive policy for the penetration of the lucrative Asian gas market.
1997.06	Vyakhirev revealed a detailed blueprint for Gazprom's 'new' Asian initiative in a speech delivered to the World Gas Conference. Vyakhirev stated that Gazprom is supporting a number of proposals to develop East Siberian gas for domestic consumption and for exports to East Asia. • Vyakhirev's view is the short-term (immediate) Asian demand for Russian hydrocarbons can be met by LNG imports, however, after the year 2005-2007 Asia will require additional sources of natural gas reserves. To this end a new gas production will be constructed in the East Irkutsk region at some point after the year 2000. The production center would eventually be linked by trunk pipelines to China, North and South Korea, and Japan.
1997.08	Gazprom and CNPC signed an agreement on "cooperation" in the gas sector.
1997.10	Valery Remizov, the Deputy Chairman of Gazprom, confirmed the fact that Gazprom has yet to decide the exact means by which West Siberian resources will be exported to China. The options under consideration include: • The construction of a 6,000 km pipeline to Shanghai • The construction of a 'new' terminal in southern China, to facilitate increased exports of LNG.
1997.11	Russian President Boris Yeltsin attended the 'Fifth Russian-Chinese Summit' in China. During the visit, first deputy premier Boris Nemtsov, and his

	Chinese counterpart Li Lanqing signed a memorandum of mutual understanding in the principal areas of economic, scientific and technological cooperation. The memorandum gave top priority to "large-scale" energy projects as a means of creating a solid, and substantial basis for a long-term relationship between Russia and China. The "large-scale" energy projects were: • Irkutsk-China gas pipeline project • West Siberian-China gas pipeline project • Electricity exports from Irkutsk to China
1997.12	Gazprom and CNPC ratified the 'Memorandum on Negotiations between Gazprom and CNPC' on the implementation of the project for the delivery of the Russian natural gas to the eastern areas of China.
1998.02	The Second Session of the Russian-Chinese Commission on the preparation of Governmental Summit meetings on a Regular Basis was held in February 16-17, 1998. The commission, co-chaired by B. F. Nemtsov, and Lee Lanqing, entrusted the relevant departments of the parties to assist in the implementation of the project for the Construction of the gas pipeline from West Siberia to the eastern areas of China.
1998.07	Gazprom and the administration of the Tomsk region signed a five year cooperation agreement to enhance industry infrastructure. According to the agreement Gazprom will provide assistance to the Tomsk region in the following areas: • The construction of a pipeline system linking homes in the rural and urban districts of Tomsk to the main gas distribution network. • The construction of a number of gas pipelines in West Siberia. • To promote the increased use of gas engine fuel in transportation.
1998.08	Gazprom announced that results of a preliminary feasibility study on West Siberian- China exports were promising. To be specific, the Bolshekhetskaya Cavity region of West Siberia contains approximately 3 tcm of natural gas reserves, including 0.75 tcm of Category C1 reserves, 0.6 tcm of C2 reserves, and 1.2 tcm of C3 reserves. This quantity of natural gas reserves is sufficient to sustain natural gas exports to China of approximately 30 bcm/y, thereby justifying the construction of a 6,714 km pipeline to the potentially lucrative Chinese market.
1998.11	Vyakhirev disclosed the details of two promising export options to China at the Summit Conference in Kuala Lumpur: • The Altay project : envisioning the export of West Siberian gas to the Shanghai region of China via Xinjinag province. • The Baikal project : envisioning the export of West Siberian gas to the Shanghai region via a 6,467 km pipeline passing through Krasnoyarsk, Irkutsk, Mongolia, and Beijing.
1999.02	Both government agreed to undertake a FS work on Western Siberian gas export to Shanghai areas, China.
1999.10	Vostokgazprom based in Tomsk region was formed by Gazprom (49%) and Hungary-based General Banking & Trust Co Ltd (51%) which is partially owned by Gazprom through its Gazprom bank.
2001.03	PetroChina announced 19 western companies passed the pre-launch qualification evaluation, and Gazprom is included in this evaluation list.

2001.05	PetroChina submitted to the SDPC the appraisal report on the seven investment proposals of West-East gas pipeline project (out of 19 companies), and in June 2001 SDPC approved the selection.
2002.07	On July 4 th , 2002 PetroChina Co finally signed the memorandum of Understanding on JVs with three international partners for the west-east pipeline project to share project risks and to take advantage of their international experience, financial strength, technical and operational experience. The three partners are : ● Royal Dutch Shell Group + HK & China Gas Co ● ExxonMobil Corp + CLP Holdings ● Rao Gazprom + Stroytransgaz

Source: Keun-Wook Paik, "Sino-Russian Oil and Gas Relationship: Implications for Economic Development in Northeast Asia" presented at Northeast Asia Cooperation Dialogue XIII: Infrastructure and Economic Development Workshop organised by Institute for Far Eastern Affairs, Russian Academy of Sciences, and Institute of Global Conflict and Cooperation, University of California, Moscow, Oct 4th, 2002.

The main reasons that Gazprom was not so active to both Sakhalin and East Siberian gas projects during the period are :

- Gazprom was over-stretched by its priority project like Blue-stream project, Zapolyarnoye project, Shtockmanovskoye project in the Barents Sea, and a string of major gas fields development in the Yamal peninsula, and consequently had no financial capacity to invest in a new project in the East Siberia and Russian Far East.
- Gazprom gave more weight to its participation in China's West-East gas pipeline project in preparation for the situation China has to initiate its gas import from either West Siberia or Central Asian Republics
- Gazprom was fully aware of its role as the Russian side's co-ordinator in East Siberian gas export to China and other Northeast Asian countries and did not see the necessity to move fast.

In June 2003, Gazprom Chairman Alexei Miller made a key note speech at the 22nd World Gas Conference and suggested gas production from East Siberia and Sakhalin Islands would be 26 bcm in 2010, and the figure could reach to 110 bcm in 2020. His presentation also indicated two LNG plants at Vladivostok and Vanino, on top of Korsakov in Sakhalin Islands, and it confirms where Gazprom's real intention lies in.

Gazprom's programme to create a "united system of producing, transporting and supplying gas in East Siberia and Far East with account of possible gas exports to the markets of China and other Asia-Pacific countries" reported by FT's International Gas Report confirms that the figures from Alexei Miller's speech in the Tokyo conference are carefully prepared ones.

Table 56 - Gazprom's Four Stage Development Strategy for East Siberia and Far East gas Resources

1 st Stage	By 2007	To develop Kovykta gas project
2 nd Stage	By 2009	To expand the eastern gas grid and develop Chayandagas in Sakha Republic
3 rd Stage	2010-12	To develop the gas fields in Krasnoyarsk and to make the area's gas production capacity to reach to 29 bcm per year.
4 th Stage	2014-20	To concentrate gas exports to China, Korea, Japan and the USA.

Source: FT International Gas Report, April 11, 2003.

According to the report, Gazprom aims to take over exports from all the area's gas projects (which it schedules by 2014 at earliest) and banks on massive tax privileges, including exemption from production tax until 2020 and lowering the current 24% profit tax to 18%. To implement this programme, Gazprom expects the required investment should be US\$ 31 billion, of which a half should cover the gas field's development.

Table 57 - Projected Gas Production in East Siberia and Far East : 2007-2020 period
(Unit: billion cubic metres per year)

	2007	2009	2010	2011	2015	2020
East Siberia	3.0	8.2	16.1	26.3	48.4	48.3
Irkutsk	3.0	8.2	16.1	26.3	31.2	31.2
Krasnoyarsk	-	-	-	-	17.2	17.1
Far East	16.2	24.4	38.0	50.6	54.3	58.1
Sakha Republic	3.0	6.6	16.8	24.5	27.5	27.5
Sakhalin	12.6	17.2	20.6	25.5	26.2	30.0
Kamchatka	0.6	0.6	0.6	0.6	0.6	0.6
Total	19.2	32.6	54.1	76.9	102.7	106.4

Note: Krasnoyarsk production will start from 2012 and the volume is 4.3 bcm.

Source: FT International Gas Report, April 11, 2003.

Table 58 - Projection on Capital Requirements for developing Gas Supplies from East Siberia and Far East until 2020
(Unit: US\$)

	East Siberia	Far East	Total
Field Development	8.4	6.7	15.1
Gas Transportation	5.4	7.3	12.7
Gas Processing	0.8	0.4	1.2
Gas Storage	-	0.2	0.2
Helium Facilities	0.8	0.5	1.3
Total	15.5	15.1	30.6

Source: FT International Gas Report, April 11, 2003.

It remains to be seen how long it will take for Gazprom's plan to export west Siberia gas to China to be materialized. As China is giving their priority to maximising their own domestic production as far as the West East Pipeline is concerned, the export of west Siberian gas to China could take much longer time. In particular, it will be the case, if

China decides to open the door to the central Asian republic gas first rather than the west Siberian gas.

Central Asian Gas Export to China

In the wake of the FSU collapse, newly born Central Asian Republics were struggling to find export market for their gas resources without depending on the existing Russian pipeline network. The initiative of exporting Turkmenistan gas to China was taken by CNPC and Mitsubishi. As shown the table 59, the initial proposal was made at the end of 1992 and a joint study by CNPC together with Mitsubishi and Exxon was done by the end of 1996.

The projected Turkmenistan pipeline starts from gas producing areas in southeastern Turkmenistan, and passes through Bukhara and Tashkent in Uzbekistan and Shymkent, Zhambyl and Almaty in Kazakhstan along with existing Tashkent-Bishkek-Almaty line. The length of the CIS section is roughly 2000 km. (Turkmenistan gas export to Northeast Asian market is competing with the options of Turkmenistan gas export to Turkey via Iran, and to Pakistan and India through Afghanistan, and at present the option of gas export to Turkey is in the front in terms of priority.)

Table 59 - Turkmenistan Gas Export to China

Dec 1992	CNPC & Mitsubishi explained the concept of Turkmenistan gas export to China to the Turkmenistan president.
April 1993	CNPC & Mitsubishi invited Brown & Root for the pipeline construction survey. The study was finished in August 1993.
Nov 1993	CNPC began to analyse and review the Brown & Root report.
April 1994	CNPC signed a letter of intent with the Turkmenistan government with regard to the gas pipeline development business.
August 1994	CNPC finalized a report on onshore pipeline development cost.
May 1995	Exxon joined in the study.
August 1995	CNPC, Mitsubishi and Exxon agreed to promote a joint study.
June 1996	Interim report by the three parties was produced.
End of 1996	Final report was produced.
1997	No further step has been taken.

Source: Mitsubishi Corp. (Date?)

In China, the pipeline is passing through the route of WEP. The China section distance is 4,200 km. If the pipeline is extended to Japan via Korea, the total offshore distance will be 2300 km. Onshore section alone, Turkmenistan pipeline will be 6200 km. Assuming that Karachaganak gas is connected with Xinjiang province, then the distance will be around 6900 km.

In 1997 China's interest was focused on Kazakhstan where a 2.2 bt of oil and 1,800 bcm of natural gas (excluding the Caspian Sea area) reserves are located. In fact, Kazakhstan's natural gas production in 2002 stand at 14 bcm, and the figure is projected to be 70 bcm in 2015, of which 40-45 bcm will be allocated for export. As for crude oil, the production in Kazakhstan is projected to reach 60 mt in 2005, and 100 mt in 2010, and 105 mt in 2015. About 35 mln tons will be available for export. In short, there is enough space for both oil and gas export to China if a parallel oil and gas trunk pipeline is constructed.

As part of the US\$ 9.5 billion oil deal signed between the two sides, CNPC paid US\$ 325 million to acquire a 60.28% controlling stake in the oilfields of Aktobemunaigaz to be a founding partner of CNPC- Aktobemunaigaz JV¹², and promised to invest another US\$ 585 million over the following five years. Besides this, in September 1997, CNPC and Ministry of Energy and Natural Resources of Kazakhstan agreed to build a 3,200 km pipeline between Uzen & Aktyubinsk fields to Karamay field, with a capacity of 20-27 mt/y (US\$ 3.5 billion investment). CNPC conducted a feasibility study but found that the pipeline would only be feasible when the volume reaches to 20-25 mt/y. The Kazakh side insisted that CNPC had reneged on its commitment to build the pipeline, and CNPC had also only produced one fifth of the investment it had promised.

To make the pipeline viable, CNPC suggested its investment in Uzen, another large oilfield in Kazakhstan to the north, but the Kazakh side refused even though Uzen was part of the original US\$ 9.5 billion package of investments. The Kazakh government believed that the development of Uzen should only be allowed once CNPC had honored its commitments to Aktobemunaigaz.

In May 1999, the Atyrau Scientific Research Institute of Kaspiimunaigaz completed the FS of the project. In Autumn, Chinese side changed its stance towards the pipeline development by saying that they are willing to start implementing the project subject to confirmation of hydrocarbon reserves of Kazakhstan's shelf of the Caspian Sea. The original plans were targeting the extension of the pipeline to Lanzhou, Gansu Province, where it would split in two directions, running to central China's Henan Province and to southwestern China's Sichuan.

Still China's priority is given to the crude oil supply rather than natural gas supply from the central Asian Republic region. Once the crude oil pipeline is connected with the China's Xinjiang province, it will make the parallel natural gas pipeline development much easier. Already both parties are investigating the parallel oil and gas pipeline option, and this approach confirms that a similar approach pursued by a western major could have been very successful if the timing had been right. It remains to be seen what would be the verdict.

2.4.2. Factors Affecting Trans-national Pipeline Gas Introduction to China

Crude Oil Pipeline Proposal

Initially CNPC did not pay much attention to the trans-national crude oil pipeline development, even though CNPC has initiated a negotiation for both Markovskoye and Yaratinkosye oil and gas fields in Irkutsk region in 1993.

Based on the 1999 February agreement between Russia and China, the feasibility study on crude oil pipeline was implemented. Since then the project became a priority.¹³ The

¹² This JV holds licenses for hydrocarbon production at Zhanazhol oil and gas condensate field and Kenkiyak oil field, northwestern Kazakhstan. CNPC is expected to invest a total of US\$ 4 billion and the combined reserves in place of both fields are 570 million tonnes of oil, including 140 mt of recoverable reserves. The recoverable residual gas condensate reserves are 26.5 mt.

¹³ According to China OGP, in 2001 CNPC's subsidiary Daqing oil field signed an agreement with Yukos and Rosneft to inject both technology and funds for Verkhnechonskoye oil field, 1,000 km north of the Chinese

reason that this crude oil pipeline project made a very rapid progress compared with the gas projects are:

- The Chinese authority began to worry about Daqing's production decline in the coming years due to the depletion of the reserves.
- Unlike the gas project, both sides sorted out the thorny price formula after two years negotiation.
- Demand for oil in China is very strong and the scale of oil import is getting bigger. It is essential to diversify the source is for energy supply security.
- CNPC has seen the benefit of crude oil trade with Yukos through the railways transportation.¹⁴ (Yukos agreed to ship 3 mt to CNPC in 2004 and 2.5 mt to Sinopec, rising to 5 mt and 3-3.5 mt in 2005. Yukos is aiming to supply to CNPC to 10 mt, and to Sinopec to 5 mt by 2006. Yukos counting on a rational tariff policy, as shipping by rail will be unprofitable if oil prices are below USD 18 per barrel.)¹⁵

The FS work was completed in July 2002 and the result was submitted to both governments for approval in August 2002. The initial plan was to start the construction of the pipeline in July 2003 and the operation from July 2005.

Table 60 - Angarsk-Daqing Pipeline FS Result

	Russian Section	Chinese Section
Distance	1452.4 km	761.0 km
Diameter	820-1020 mm	914 mm
Pressure	6.0-6.5 MPa	6.4 MPa
Cost	US\$ 2.1 billion	US\$ 0.65 billion

Note: *The preliminary FS calculation was US\$ 0.95 billion. **35% of cost covered by PetroChina and the rest by bank loans.

Source: China OGP

China was confident that the project would be approved by the Russian government, but Moscow had a different idea. According to Russian Petroleum Investor, in early April 2002 Transneft held the first public presentation for its project to build a crude oil pipeline to Nakhodka. Soon after this Vladivostok presentation, Transneft president Semyon Vainshtok met President Putin and got a green light on the project.

Interestingly Russian Petroleum Investor reported that in April, 2002 Japan National Oil Corp (JNOC) announced it intended to invest over US\$ 1 billion in the economy of the Primorsky Territory over four years (US\$ 0.5 bn for crude oil loading port, and US\$ 0.6 bn for the pipeline itself), subject to construction of Angarsk-Nakhodka line. During 2003

border. In early September 2001, PetroChina set up a wholly owned subsidiary company named "China Petroleum International (Exploration & Development) Company (CPIEDC)" and this new company will be responsible for Daqing's Russia venture. CPIEDC argued that cooperation was still a preliminary stage and no specific investment plan had been decided as of October 2001.

¹⁴ It is worth noting that during 1999-2003 period, the tariffs to ship crude oil in the Asian direction has quadrupled to US\$ 3.8 / tonne / km, which is eight times higher than shipping oil by pipeline. It is not surprising both Yukos and CNPC wanted to have a crude oil pipeline for the shipping of the bigger volume.

¹⁵ Russian Railways Co., or RZD, strongly indicated that it would help oil major Yukos realize its plan for a massive increase in exports to China by opening a new route. By 2006 the firm can increase exports by rail up to 12 mt, from 3 mt in 2003. RZD plans to transport 6.5 mt of oil to China and 8 mt in 2005. Overall RZD's transportation of crude and fuel exports increased to 41.4 mt in 2003, up 31% from 2003.

Japanese government made a very significant package proposal to Moscow and the approach drove the Moscow authority to find a way to take care of both Chinese and Japanese proposals. Moscow's dilemma was fully reflected in the continuous excuses for the delay of its decision making on the crude oil pipeline.

Table 61 - Angarsk Daqing vs. Angarsk-Nakhodka line

Angarsk Daqing Line*		Angarsk-Nakhodka Line** (Perevoznaya Bay)
1 st Stage : 20 mt/y (first 5 years) 2 nd Stage : 30 mt/y	volume	50 mt/y
2,213 km	distance	3,885 km
820-1020 mm	diameter	1020 mm (1220 mm)
US\$ 2.75 billion	cost	US\$ 5.8 billion
2003-2005	construction	2004-2008
Yukos & CNPC	Driving force	Transneft & Japanese Government

Note: *This line is passing through the Tunkinsky National Park in Buryat.

** Angarsk – Kazachinskoye – Tynda – Khabarovsk – Perevoznaya

Map 4 – See Annex 1

Source: M. Bradshaw and K-W Paik

Moscow's Dilemma

In January 2003, Premier Koizumi officially proposed an alternative crude oil pipeline project to the President Putin, and the core of the proposal is that Japan is willing to offer a 50 mt/y market and finance the project. However, the US\$ 5.2 billion financing was a conditional offer, subject to the Russian government's guarantee. In late January 2003 Russian Energy Minister Igor Yusufov responded by saying that the option to build trunk oil and natural gas pipeline as part of a single technological corridor along the Angarsk-Nakhodka route with a diversion to Daqing via Zabaikalsk is the best interests of the state.

On March 13th, 2003 the Russian government approved the project to build the Angarsk-Nakhodka pipeline branching off to Daqing and ordered that all necessary calculations relating to the FS and the pipeline's location be completed before May 1st. In early May 2003, however, Russian authority has given the priority to the Angarsk-Daqing line as they could not confirm the availability of proven reserves that would justify the Angarsk-Nakhodka pipeline development. Premier Kasyanov confirmed that Japan's loan offer requiring Russian government guarantees is not acceptable.

In late June 2003 Japan revised its proposal significantly by making additional provision of up to US\$ 7.5 billion in the form of low-interest government loans and government insurance of private investment, on top of the initial US\$ 5.2-6.0 billion. Besides this, Japan strongly indicated the target oil field for the pipeline development is Verkhnechonskoye field. In July 2003, the Japanese government in general agreed Russian government does not need to offer government guarantees for the recovery of Japanese investment.

The Russia's refusal to attend the routine meeting of the energy sub-commission between Russia and China scheduled on August 25th, 2003 indirectly indicated that Russia would not make the decision soon. On September 2nd, 2003 Ministry of Natural Resources rejected both suggested routes due to the ecological problems the pipeline development would cause. After the September 22nd meeting with Premier WenJia-Bao, Premier Mikhail Kasyanov said the decision on the route would be delayed at least until the end of 2003. He added that the volume of Russian crude to China by rail will be increased and reach 4.5-5.5 mt/y in 2004-5. Premier Wen responded that "We have been conducting the Feasibility Study for ten years. We have laid substantial groundwork and believe the planned project is realistic and viable. Its implementation will meet both sides' interests". It was a very serious China's warning to Russia.

Russia's continuous delay of their decision on the crude oil proposals confirms that the Japanese proposal was too good for Moscow authority to ignore it, and Russia is very busy in finding an option that can satisfy both China and Japan.

Within Russia, the views on the crude oil pipeline project is divided. A Moscow-based financial advisory group UFG is supporting the Angarsk-Daqing line as it is the most cost effective, and Lukoil president Vagit Alekperov argued that Angarsk-Nakhodka line is uneconomical as the cost of transporting crude oil to Yokohama will be at least US\$ 30 / tonne, whereas transportation from the Persian Gulf region will cost only US\$ 9-10/tonne.

However, Deputy Energy Minister Vladimir Stanev's logic tells where the Russian government's priority lies in. He sees that around 45 mt/y of spare crude oil is available for the West Siberia -Nakhodka line. Stanev argues the distance from Surgut to the border between Belarus and Poland is the same as the distance from Surgut to Nakhodka. When the route to Nakhodka is compared with Druzhba-Adria route, one can find that the pipeline heading west crosses five borders. As a result, the transportation tariff from Surgut to the Croatian Port of Omishalj will be US\$ 29 / tonne of crude oil while the tariff of Surgut-Nakhodka route is US\$ 8 / tonne.(This low figure looks very unrealistic)¹⁶

Stanev even suggests that further development of crude oil production on Sakhalin Island could be connected with Angarsk-Nakhodka line. At the same time, active geological exploration could lead to a gradual reduction of the Nakhodka pipeline's dependence on W. Siberian crude, possibly eliminating it altogether by 2020.¹⁷

Rosneft argued that the Nakhodka pipeline would ensure the development of E. Siberia and Far East, provide significant additional budget revenue, utilize the capacities of the Baikal-Amur &Trans-Siberia Railways, and resolve socio-economic problems in the region. Rosneft also pointed out that under the Daqing line Russian oil would be sold at the Chinese border at contract rather than market price. Besides this, another crude oil pipeline between Kazakhstan-China will give China another leverage to dictate price.

As the feasibility study on the Angarsk-Nakhodka line will be completed in 2004, it will help Moscow re-evaluate the Chinese and Japanese proposals and make a very

¹⁶ Analysts believe during the initial ten years of the loan payback period, a tonne of crude oil will cost a minimum of US\$ 25-29 to deliver from Angarsk to Nakhodka. At a later stage, tariff are expected to go down to US\$ 14-15 per tonne.

¹⁷ In March 2003, Ministry of Energy projected US\$ 12 billion investment in East Siberia/Sakha Republic will ensure Reserves growth required to sustain a production level of 100-110 mt/y by 2020.

objective decision within the year. One thing very certain is that if Moscow's decision is favorable to the Japanese government proposal, it will affect very negatively towards the Russian gas export to China, in particular the Kovykta project could a very prominent casualty of the decision.

Beijing's Dilemma

According to Interfax Petroleum Report, Prof. Zhou Xincheng, People's University said "If Russia gives up on the Daqing pipeline, they will suffer more losses in terms of the country's trustworthiness rather than their economy as the international community will become wary of future cooperation with Russia". This interview story is underestimating the failure of Angarsk-Daqing line development.

Chinese energy planner's major concern was a projected decline scale of Daqing oil production, from 56 mt/y in 1995 to 30 mt/y in 2015. The overall decline from the three major oil fields in northeastern provinces will be very significant, from 75 mt/y in 1995 to 45 mt/y in 2015. The 30 mt/y of production shortage is exactly what CNPC aimed to secure by building the Angarsk-Daqing crude oil pipeline.

Table 62 - Oil Production Decline in Main Oil fields in Northeastern Provinces
(Unit: mt per year)

	Daqing	Jilin	Liaohe	Total
1995	56.0	3.4	15.5	74.9
2000	53.0	3.8	14.0	70.8
2005	45.0	5.5	12.2	62.7
2010	34.7	5.9	10.6	51.2
2015	30.0	6.0	9.4	45.4

Source: CNPC quoted by China OGP

It is worth noting that PetroChina is undertaking to revamp its northeastern oil pipeline grid, and it looks very certain that a 524 km, 10 mt/y pipeline will be built in parallel to the existing Daqing-Tieling line. It will enhance the total capacity of northeastern line grid to 55 mt/y. This new line will be used for Daqing oil transportation between 2005-09 period, and then switched for Russian oil transportation from 2010 onwards.

CNPC has already allocated Dalian Petrochemical, WEPEC, Jinzhou Petrochemical, and Jinxi Petrochemical plants to refine the Russian crude oil. Dalian Petrochemical is expanding the capacity from 10 mt/y in 2003 to 20 mt/y by 2005. Once this expansion work is done, before 2010, Dalian Petrochemical will take care of a 15 mt/y and WEPEC will handle a 5 mt/y. After 2010 both Jinzhou Petrochemical and Jinxi Petrochemical with a combined capacity of 11 mt/y will join to take care of additional 10 mt/y of Russian oil. Besides this, PetroChina is considering to send a 5.6 mt/y of the Russian oil to Jilin Petrochemical plant.¹⁸

Due to the delay of decision on Angarsk-Daqing line, PetroChina Dalian Petrochemical Co. Ltd is now resorting to exports by sea from various overseas oil sources. The

¹⁸ WEPEC is the sole refinery with high-sulphur content oil refining capacity, and it cost a lot of money to revamp the refineries in Dalin, Jilin, Jinzhou and Jinxi to refine the Russian oil. The revamping of Dalian Petrochemical alone cost 9.8 billion yuan , and that of Jinzhou Petrochemical & Jinxi Petrochemical cost 5.0 billion yuan.

construction of a 200 million yuan (US\$ 24.2 million) pipeline connecting the refinery with a 300,000-ton oil wharf at the Dalian New Port has been launched, and will be completed in May 2004. The Dalian refining upgrade project is the largest downstream development project planned by PetroChina to utilize the 20 mt/y of crude oil by pipeline from Russia.

Three-fourths of the Dalian Petrochemical's upgraded capacity, or 15 mt/y, was originally allocated to the treatment of Russian oil, with the technical renovations for some existing facilities already under way to cater for to the high proportion of sulfur contained in Russian oil. The 42-km pipeline now under construction at the refinery was designed to transmit 15 mt of oil, the same as the projected amount of Russian oil to be processed at the refinery before.

Table 63. Existing Crude Oil Pipeline in northeastern Provinces

	Diameter mm	Length km	Capacity mt/y	Status
Daqing – Tieling 1	720	517	45	Under-operation
Daqing – Tieling 2	720	524		
Tieling – Qinghuangdao	720	454	20	
Tieling - Dalian	720	460	20	
Tieling - Fushun	720	43.7	20	
Fushun - Anshan	426	117	5	abandoned
Anshan - Xiaosonglan	529	279	10	Never used

Source: China OGP

The delay of the decision on the pipeline alone, not to speak of the suspension or cancellation of the Angarsk-Daqing crude oil pipeline, is giving the Chinese energy planners enough headache and a serious financial burden to CNPC. At the moment the Chinese party is firmly believing Moscow would honor the agreement to build the Angarsk-Daqing line. If Moscow decides to support only the Angarsk-Nakhodka line due to the limited proven reserves, it will affect very negatively towards any future energy cooperation between Japan and China. Under this situation, it is very difficult to imagine the multilateral cooperation among the LNG buyers in Japan, Korea, Taiwan and China for a while.

Russia's strengthened energy relationship with the US

In the wake of 9.11 terror, Russia's role as non-OPEC oil producer is very seriously taken care by the US authority. During the last two years, Russia's energy relationship with the US has been very much strengthened, and Russian companies are very anxious to increase the scale of oil supply to the US very rapidly.

On 27 November 2002, Russia's top oil companies including Lukoil, Yukos and Sibneft signed a memorandum to construct a pipeline running from western Siberia to Murmansk. This pipeline would cost US\$ 3.4-4.5 billion, and would run 2,500-3,600 km, crossing the White Sea and enabling Russia to sell oil on the European and United States markets.¹⁹ The plan was to put the pipeline into use by 2007.

¹⁹ . When Lukoil floated the idea of crude oil export to the US through the Murmansk route in the Spring of 2002, the proposed export capacity was at 50 mt/y of crude oil. But it did not take a long time the figure

On April 17, 2003, the Russian government had already given the go-ahead to research into the specific problems associated with the route. The construction would be divided up into two stages. The first stage would be the construction of a large-scale oil depot in Murmansk, while the second stage would see the construction of the pipeline from central Russia to the depot.

In early July 2003, the US Department of Energy sent a delegation to Murmansk to inspect the facilities and sign another memorandum with Russia's Ministry of Energy and Transneft. Ministry of Energy, Transneft, Yukos, Lukoil, Tyumen Oil Co (TNK), Surgutneftegas, and Sibneft made a joint commitment of 140 mln tons a year in supply.

Table 64 - Crude Oil Transportation Cost Comparison

Routes	Distance	Cost
Persian Gulf - US	12,800 miles	US\$ 19.5 / tonne US\$ 2.64 / barrel
W. Siberia – Murmansk – NW Europe	-	US\$ 18-20 / tonne US\$ 2.4-2.7 / barrel
W. Siberia – Murmansk – US*	5,800 miles	US\$ 24.7 / tonne US\$ 3.34 / barrel
W. Siberia – Druzhba – Adria - US	-	US\$ 29.5 / tonne US\$ 3.99 barrel
W. Siberia – CPC – US	6,685 miles	US\$ 29.9 / tonne US\$ 4.04 / barrel
Baku – Tbilisi – Ceyhan - US	6,400 miles	US\$ 31.9 / tonne US\$ 4.31 / barrel

Note: *There are two routes from W. Siberia – Murmansk. The first is W. Siberia – Ukhta – Murmansk (3,600) and the second is W. Siberia-Usa-Murmansk (through the White Sea: the distance of 2,500 km), the pipeline tariff is US\$ 24.1 / tonnes and US\$ 19.1 / tonne respectively.

Source: Eugene Khartukov and Ellen Starostina, "Post-Soviet Oil Export : Are the Russians really Coming?", *Geopolitics of Energy*, Nov 2003.

As quoted before, during the initial ten years of the loan payback period, a tonne of crude oil will cost a minimum of US\$ 25-29 to deliver from Angarsk to Nakhodka. At a later stage, tariff are expected to go down to US\$ 14-15 per tonne. A simple comparison does not give any incentive to the Asian direction export. Clearly Murmansk route has a merit in terms of cost effectiveness. There is no doubt that the availability of spare crude oil for export from the West Siberia would affect the fate of Angarsk-Daqing or Nakhodka line development. A key question is how far Moscow is willing to go? In other words, how to balance the export volume between Murmansk and Nakhodka?

The US government has no reason to object this Asia-Pacific direction export option as long as the financial burden of the pipeline development is not on their shoulder. Moscow authority is very carefully calculating the cost and benefits of Asian direction crude oil and gas pipeline development, and at the same time Moscow's relationship with the US will play an important role in finalizing the direction of the pipeline.

Competition form the Central Asia's Supply Options

reaching to 60 mt/y, 80 mt/y and finally to 120 mt/y. The assuming is that of the volume of 80 mt/y, both Lukoil and Yukos would transport 20 mt each, Sibneft and TNK 10 mt each, and Surgutneftgaz 12 mt.

Learning a lesson from the Slavneft auction and the long delay on the Russian government approval on the Angarsk-Daqing line, CNPC came to realise the significance of the Kazak-China oil line at the end of 2002 when the company's disappointment towards Russia peaked. In other words, China seems to have realized it should not put all its eggs in the Russian basket.

According to Interfax China Report, CNPC's Kazakhstan Office said that the previous concerns that the central Asian country might not be able to meet the pipeline's proposed transmission capacity of 20 mt/y have now been allayed, as the pipeline will be connected with the Caspian Sea later. Mainly advised by CNPC, the Chinese government decided that China could hardly lose any time to diversify its oil import from Kazakhstan, and then the Caspian Sea.

In January 2002 CNPC won the tender to acquire a 30% interest in Salvan Oil with a development license of both Kyursangi and Karabagly fields with 150 mt reserves in Azeribaijan, and in Nov 2002 CNPC's equity level in the project reached to 50% by acquiring 20% of equity from Delta-Hess, the US-Saudi alliance. It was a direct confirmation that CNPC is still very anxious to establish a solid crude oil supply bases in Central Asian Republic region.

In 2003 CNPC has bought a 100% stake in Texaco North Buzachi Inc and become the new owner of the North Buzachi Oilfield with recoverable reserves of 300-500 million barrels. At present, the field's production level is 0.4 mt/y. CNPC wants to increase the production to 1 mt/y, and pipe back the oil via a proposed pipeline connecting western Kazakhstan with China's borderline in the Xinjiang Autonomous Region

SINOPEC's Shengli Oilfield has purchased an interest in three oil blocks - Morskoe, Karatal and Dauletaly – covering a total area of 630 sq km in the Caspian region of Kazakhstan, for US\$ 2.3 million, with plans to conduct joint exploration and development of the blocks in 2004. The deal is the first overseas oil exploration venture ever completed by Shengli.²⁰ Besides this, Shengli Oilfield is going through late-stage negotiations with Azerbaijan's state oil company, SOCAR, to finalize an exploration and development agreement in the Pirsagat Oilfield, 100 km south of Baku.

CNPC and SINOPEC's oil asset purchasing in Kazakhstan and Azeribaijan in recent years confirms the renewed interest of Chinese authority in expanding their own production base in Central Asia Republic region. In 2002, CNPC's Aktobemunaigaz production capacity was only 4.3 mt/y and the figure will be 5.5 mt/y in 2005.²¹ To make the pipeline economically viable, the production capacity should be at least 20 mt/y. It is not difficult to understand why the Chinese government has hurriedly authorized both CNOOC and SINOPEC to take over BG's 16.66% equity in super giant Kashagan field with at least 10 billion barrels of proven reserves.

²⁰ Of the three blocks, Shengli expects to start production at the oldest and smallest one, Morskoe, in mid 2004. Seismic exploration programs will be deployed on the other two blocks early 2004 to conduct fresh drilling. The Morskoe Block covering 75 sq km, is located 10 km south of Kazakhstan's largest producing field, the Tengiz Oilfield. The Karatal and the Dauletaly blocks each cover an area of 420 sq km and 135 sq km respectively, 300 km north of the Morskoe Block.

²¹ CNPC announced that since 1997, it has negotiated or been in contact with over 50 countries regarding the development of oil projects, and has consequently seen its output from overseas interests rising from less than 1 mt in 1997 to 25 mt/y in 2003.

The importance of central Asian Republic region's producing countries were highlighted by president Hu Jin-Tao's visit soon after president Hu's state visit to Russia. On June 2, 2003,²² President Hu Jin-Tao and President N. Nazarbaev agreed that the two sides will resume their study on building an oil pipeline from western Kazakhstan to China and a gas pipeline from Turkmenistan to China via Kazakhstan, as well as China's participation in developing related oil and gas fields in Kazakhstan. And China's E&D activities in the Caspian Shelf will be supported by the Kazakhstan government.

The next day CNPC president Ma Fu-Cai signed an agreement with KazMunaygas for the construction of Kazak-China oil pipeline and another agreement with the Kazak Finance Ministry's State Property and Privatisation Committee on increasing the company's investment in the Republic's oil and gas industry.

With the 448 km Kenkiyak-Atyrau pipeline already partially operational in March 2003,²³ the two countries aims at building the other sections to realise the once-stalled 3,200 km oil pipeline.

- The second Phase : 1,010 km (10-20 mt/y) Atasu-Alashankou section
- The third Phase : Kenkiyak-Atasu section

The two sides will conclude the FS of the pipeline at the end of 2003. The ultimate capacity of this pipeline is 50 mt/y. According to estimates, 50 mt/y will be worth 170 billion yuan (US\$ 20.5 billion) after initial processing, and 340 billion yuan (US\$ 41 billion) after deep processing, described as "very attractive figures" for both Xinjiang and Gansu. The Xinjiang government have already emphasized the importance of constructing a pipeline running from Urumqi to Lanzhou, enabling oil to reach the Lanzhou-Chengdu-Chongqing supply line.

The crude oil line is not the only one reactivated by China. In late September 2003, Kazakh Premier Danial Akhmetov told the press after China visit that Astana and Beijing are going over three possibilities for the building a gas pipeline running from Kazakhstan to western China. Of importance, the issue was discussed during the premier's meeting with Premier Wen Jian-Bao.

- The first option is to make use of the existing Tashkent-Almaty gas pipeline.
- The second option is to build a pipeline from western Kazakhstan through Kyzylorda, Chimkent and Almaty, also using existing stretches of pipeline.
- The third is to build a completely new line running 2,000 km along the Petropavlovsk-Astana-Karaganda-Balkhash from Kazakhstan's north through the country's centre to the border with China.

All these three options envision joining the border between the two countries in the are of the international railway terminal at Dostyk-Alashankou. According to Kazakh national

²² At a press conference, president Hu said that China was suffering an energy shortage, and with Kazakhstan's rich hydrocarbon resources, there was much ground for cooperation between the two countries.

²³ CNPC and Kazmunaigaz (KMG), the Kazakh national holding company, are also the founding partner of the MunaïTas North Western Pipeline Co.(a subsidiary of KazTransOil) which completed the construction of phase on of the 450 km Kenkiyak-Atyrau crude oil pipeline with 6 mt/y of delivery capacity.

oil and gas company KazMunaiGaz, the feasibility study for a project to pipe Kazakh natural gas to China will be ready by autumn 2004. It is worth noting that Kazakhstan produced more than 14 bcm of gas in 2002 and plans to bring its annual output to 70 bcm by 2015, exporting between 40-45 bcm of the total.

It is not a coincidence that China has re-activated the options of both crude oil and natural gas pipelines connecting Kazakhstan and western China in 2003. It is an indirect confirmation that Chinese authority is not willing to accept the continuous delay of Russia's decision making on the Angarsk-Daqing crude oil pipeline.

The importance of Kazakhstan oil pipeline to Xinjiang province lies in a fact that a parallel gas pipeline could easily be constructed once the crude pipeline development goes ahead as a large chunk of gas production from the western part of Kazakhstan Republic can be exportable to China. If the Turkmenistan and Kazakhstan pipelines are connected with China's main gas trunk pipeline, the gas export volume to China could easily reach to 30-40 bcm.

It is worth quoting the Interfax interview remarks by Zhao Huasheng, director of the Russia-Central Asia Division of the Shanghai Institute of International Studies, "If the Russian pipeline meets any problems, China should switch to the Kazakhstan pipeline project as a primary alternative". To the Chinese planners, an invisible competition between Russia and central Asia Republic countries for gas export will provide a useful negotiating leverage in accelerating its transnational pipeline development.

- In 2003, a three years FS on trans-national pipeline gas from East Siberia to China and Korea was completed. The study has removed the uncertainty on the proven reserves base but still a number of major issues like Gazprom's co-ordination role in the project, pipeline routing(the extension from China to Korea), and the border price, should be cleared for a real progress of the development.
- Kovykta gas project is the front runner but Chayandagas in Sakha Republic is also very well positioned to start the gas export to northern China. If Moscow decides to support the Japanese government proposal of northern line, it will be Chayandagas that will get a priority from Gazprom for the export to China.
- Sakhalin I's gas export to northeastern provinces is a possibility but it is not a real priority due to two major competing supply options, Kovykta and Chayandagas.
- West Siberia's gas export to western China is a possibility that can be easily connected with China's 4,000 km WEP project, but both Kazakhstan and Turkmenistan gas are also targeting the connection with China's WEP project. It will be a real agenda during 2011-2020 period.
- The introduction of trans-national pipeline gas will be significantly affected by the final verdict on the crude oil pipeline proposals from China and Japan. If Moscow's verdict is favorable to Japan's proposal, it will be a very strong possibility that the Kovykta gas supply to China and Korea could be the first casualty.
- China has already re-activated the option of central Asian Republic region's oil and gas supply to western China. It is a kind of indirect confirmation that the Chinese authority is not happy about the long delay of approval on Angarsk-Daqing pipeline by the Russian Government.
- Chinese authority may have to rethink of its strategy of trans-national pipeline gas introduction to northeastern China, and a couple of years delay cannot be totally ruled out.

3. Implications of China's Natural Gas Import towards Natural Gas Market in Northeast Asia: focused on Price Competitiveness

4. Natural Gas Cooperation in Northeast Asia

Since 1969 when Japan began to import LNG from Alaska as a way of reducing its dependence on Middle East oil and diversifying the energy supply sources, no one has expected the LNG industry would expand to the current level. South Korea started to import LNG from 1986, and Taiwan's first LNG import was made in 1990. As of 2002, the LNG import by Japan, Korea and Taiwan recorded 72.7 bcm, 24.1 bcm and 7.0 bcm respectively. The total of three major LNG consumer's import volume was 104 bcm (75.8 mt) or representing 69% of the global LNG trade. As the European and Atlantic LNG markets are being opened, the dominant role of northeast Asia region in the even growing LNG trading will diminish to certain extent in the coming years but its role as key LNG market will continue for a considerable period.

Based on August 2002 LNG supply agreement with Australia's North West Shelf and Indonesia's Tangguh, China is set to be a member of the Northeast Asian region's LNG buyers group from 2006. China's great bargain for the LNG supply price has already delivered a positive impact to Japan and Korea's price negotiations. In August 2003 Korea's POSCO/SK consortium became a beneficiary of the Guangdong and Fujian benchmark price, even though Japanese utilities, TEPCO, Tokyo Gas and Kyushu Electricity did not really see the full benefit of the Chinese benchmark price in their LNG supply contract with Sakhalin II project. China will pursue more LNG supply contracts during the period of 2006-2010 period and China's entry as a member of northeast Asian LNG buyers seems likely to widen the scope of cooperation among the LNG importers.

In this section will examine Korea's natural gas expansion and the necessity of swap deal as a way of handling the supply shortage issue and will study how far the scope of cooperation will be once China begins to import both LNG and pipeline gas.

Korea's gas expansion and LNG Supply Shortage issue

A western major executive described Korea's gas expansion as follows : "Kogas was established by the Korean government to handle the construction and operation of LNG terminals, importing LNG and transportation of the imported LNG domestically. Until 1992 when the LNG import scale reached 4.6 bcm/y, Kogas returns were specifically fixed at 0% to underpin the early development of the gas import and transmission infrastructure. In parallel, a rolling programme of market development in local distribution companies were undertaken, and city gas companies were financed by cheap government loans to cover up to 80% of the cost of pipeline construction". It is not an exaggeration to say that Korea's gas expansion was a result of government's preferential policy and the domestic trunk pipeline development. In fact, in late December 2002, a total of 2,442 km nationwide natural gas pipeline network was completed after 12 years construction with 2.5 trillion won (roughly US\$ 2.1 billion) of investment.

According to Korea's city gas business regulations, the Ministry of Commerce, Industry and Energy(MOCIE) should announce Korea's Long Term Gas Supply Plan every two years. The 4th Long Term Natural Gas Supply Plan (LTNGSP) was officially announced by the Ministry of Commerce, Industry and Energy (MOCIE) in March 1999, and a year

later the 5th LTNGSP was announced in March 2000. The 6th LTNGSP was announced in November 2002 and the 7th LTNGSP is expected to be announced in Spring 2004.

Table 95 - Korea's Long Term Natural Gas Demand Projection
(Unit: billion cubic metres)

	Residential	City Gas Commer- -cial	Industrial	Sub- Total	Power Generation *	Total Demand
1994	1.612 (66%)	0.536 (22%)	0.306 (12%)	2.454 (100%)	3.329	5.783
1997	3.768	0.959	1.043	5.770	5.377	11.147
2001 E	5.487	1.567	2.526	9.580	6.406	15.986
2001 A	5.720	1.831	2.749	10.300	5.287	15.587
2002	6.061	1.845	2.937	10.843	5.269	16.112
2003	6.639	2.020	3.245	11.904	6.355	18.259
2004	7.002	2.163	3.504	12.669	7.224	19.893
2005 (5)	6.893	2.073	3.132	12.098	6.202	18.300
2005 (6)	7.377	2.333	3.773	13.483	6.500	19.983
2006	7.892	2.483	4.035	14.410	6.727	21.137
2007	8.290	2.612	4.282	15.184	7.305	22.489
2008	8.666	2.747	4.542	15.955	6.228	22.183
2009	9.023	2.891	4.819	16.733	4.671	21.404
2010 (5)	7.715	2.850	4.352	14.917	6.054	20.971
2010 (6)	9.368	3.076	5.038	17.482	4.168	21.650
2015 (6)	10.902	3.857	6.484	21.343	6.997	28.240
Annual Growth Rate	4.7%	5.5%	6.3%	5.3%	2.0%	4.3%

Note: 2001 E means 5th LTNGSDP estimate, and 2001 A means actual record.

- The figures of power generation includes IPPs.
- (5) means 5th LTNGSDP estimate, and (6) means 6th LTNGSDP estimate.

Source: Ministry of Commerce, Industry and Energy, *The 6th Long Term Natural Gas Supply and Demand Plan (1999-2015)*, November 2002.

Gas demand for power generation during the 6th LTNGSP period is projected to make a modest increase with a growth rate of 2.0%, it is lower than that of 2.2% by the 5th LTNGSP. In terms of volume, gas demand for power generation during 2001-2010 is projected to be around 4.2-7.3 mt. In short, Korea's long term gas demand projection confirms that the gas expansion until 2010 will be driven not by power generation but by the city gas.

As witnessed during the 4th – 6th LTNGSDP projection, the government demand projection's figure was always lower than the actual demand. Kogas has taken care of the supply based on the seven main long-term supply contracts from Indonesia, Malaysia, Qatar, Oman, and Brunei. After 1997, Kogas did not sign any long-term contract due to the Kogas Privatisation issue that could make a new supply contract very difficult in case the gas supply business is privatized. Besides this, Kogas was trying to save the pipeline gas volume for the Kovykta gas import. However, the growing demand

caused a lot of problem²⁴ and Kogas has decided to adopt a relatively short term contract option to take care of the supply shortage. Kogas projected the supply shortage will reach to 2 mt/y in 2007, and 5.1 mt/y in 2010.

Kogas LNG supply strategy is to apply a short term supply contract to cover 3-5 years from 2004 and then to pursue a long term contract after 2007 period. As for a new long term LNG contract, the decision will be made after March 2004 when the 7th Natural Gas Supply and Demand plan is finalized. This is the reason why Kogas has signed two seven years supply contract with Australia and Malaysia during the first half of 2003.

Table 96 - Long Term Import Contracts

	Project Name	Quantity (mt)	Period	Contract Date
Indonesia	Arun III*	2.3	1986-2007	83.8
	Korea II	2.0	1994-2014	91.5
	Badak V	1.0	1998-2017	95.8
Malaysia	MLNG II	2.0	1995-2015	93.6
Qatar	Ras Laffan	4.92	1999-2024	95.10
Oman	OLNG	4.06	2000-2024	96.10
Brunei	BLNG*	0.7	1997-2013	97.10
Australia	NW Shelf*	0.5	2003-2010	03.01
Malaysia	MLNG Tiga	1.5-2.0	2003-2010	03.05

Note: Both ArunIII, BLNG and NW Shelf were based on ex-ship supply while the rest were based on FOB.

Source: Ministry of Commerce, Industry and Energy, November 2002 ; Gas Matters, May 2003.

Table 97 - Projected LNG Supply Shortage

Year	Supply Shortage Volume (mt/y)
2004	0.64
2005	0.12
2006	0.62
2007	1.99
2008	4.15
2009	3.47
2010	5.09

Source: Kogas, quoted by the Gas Industry News, August 5th, 2003.

In August 2003, Kogas decided to increase the emergency stock volume from current 3-5 days to 10-15 days after 2005. Initially Kogas planned to build 61 units of gas storage tanks in 2010, 67 units in 2012 and 74 units in 2015, but decided to complete the 72 units of storage tanks until 2012. In this case, Kogas could increase the monthly stock operation period to 10-20 days in 2008, and to 15-25 days after 2009.

²⁴ In late April 2003, Kogas had to suspend the supply of LNG for the power companies and consequently during April 25 and 30th, the six power generation companies under KEPCO had to use heavy oil or Kerosene instead of LNG. During 2002-3 winter period, the LNG supply shortage was caused by excessive demand from the power companies, but this April 2003 supply shortage was caused by Kogas failure to provide the contracted volume to the power companies. Power companies under KEPCO argued that a total of 309.5 billion won (roughly US\$ 258 million) loss was caused due to the replacement of LNG with heavy oil and Kerosene during Nov 15, 2002 and March 25, 2003 period.

Swap Deal Necessity by Kogas Supply shortage

Since 1999 when the first LNG trade was made between the buyers, a total of 24 trades were made in Asian region. It is worth noting that only one was arbitrage deal based on the market price difference and the rest were all to take care of the supply and demand imbalance. In other words, it was a kind of cooperation between the buyers, based on 'No Profit, No Loss' concept.

During 2000-2001 period, Taiwan could not absorb the contracted volume and it was taken care by swap and re-sale deal with Kogas and Japanese companies. During the 2002 winter, Kogas had to secure a number of spot cargoes to take care of the winter season demand by changing the unloading port. On Nov 18th, 2002, Kogas signed a contract to supply five spot cargoes from North West Shelf. It is worth noting that the three cargoes out of the five cargoes were originally allocated for Kansai Electricity but redirected to Kogas.

After this deal, a number of swap deals were followed. In December 2002, Kogas made a swap deal with Tohoku Electricity (TE) by exchanging TE's MLNG cargo scheduled to arrive at Japan on Dec 10th with Kogas' MLNG cargo scheduled for Dec 30th delivery to Korea. Then TE's MLNG cargo for Jan 27th delivery was swapped with Kogas' MLNG cargo for Feb 14th delivery.

Besides this Tohoku Electricity, Kogas has also made a swap deal with Tokyo Electricity by exchanging TEPOC's MLNG cargo (delivery schedule for Jan 31, 2003) with Kogas O LNG cargo (delivery schedule for March 3rd, 2003), and Chubu Electricity by exchanging Chubu's Pertamina cargo (delivery schedule for Jan 31, 2003) with Kogas' Pertamina cargo (delivery schedule for Feb 22nd, 20003)

To make sure the winter period supply security, Kogas have made a total of seven swap deals with TEPCO, Tohoku Electricity and Chubu Electricity companies during the 2002 winter. In May 2003, Kogas entered swap arrangements for 0.59 mt of LNG with Tohoku Electric Power Co and three other Japanese electric power companies during the winter to cover shortages resulting from unexpectedly high growth in domestic demand and a higher take by thermal generating subsidiaries of Korea Electric Power Corp (KEPCO)²⁵. The initiative is aimed to help prevent a recurrence of the LNG shortages Kogas experienced during the 2002 winter.

This swap deal could usher in a new era of cooperation among the LNG importers in Northeast Asian region. Normally Kogas experiences its highest LNG demand in the winter period, while the Japanese power firms see their highest demand in the summer when air conditioner use is highest. It makes sense to extend the scope of cooperation using the seasonal difference of the demand.

To increase the flexibility of this swap deal, Kogas is asking a total removal of the restrictions on the "unloading port" clause. At present LNG producers are willing to loosen the restrictions only to a limited cases and seem very unlikely to accept the complete removal of the clause.

²⁵ FT International Gas Report, 9 May 2003, p. 22 ; The Gas Industry News, Oct 16, 2003.

Nonetheless the trend is heading for more swap deals. In January 2003, BP and Spain's Repsol completed a multi-party deal involving Abu Dhabi Gas Co (Adgas) and Kogas enabling LNG to be diverted from European market delivery to meet Korean winter needs. The European gas market commitment is being back-filled with gas from the Atlantic Basin. This is the first European and Asian swap deal.

Kogas bought around 45 spot LNG cargoes during 2002 winter period, and 22 cargoes during 2001 winter period. Reportedly, in August 2003 Kogas confirmed that it has covered most of its LNG demand for the 2003-2004 winter season after securing up to 2 mt of spot LNG supplies from Qatar, Oman and Malaysia until March 2004. The Qatar contracts covers 15 cargoes during May 2003 - March 2004 period, and the MLNG contract was for 10 cargoes during October 2003 – March 2004 period. In the case of O LNG contract, nine cargoes including two option cargoes would be taken care during November 2003 – March 2004 period.²⁶

As Kogas is suffering from the chronic LNG over-supply during the summer time and supply shortage during the wintertime, an increased utilization of swap deal would help easing the fluctuation of the seasonal demand. For example, Kogas can release its surplus volume during the summer period to the Japanese and Taiwanese power companies and receive the volume during the winter period. Besides the seasonality issue, cooperation between the buyers will be very useful when a kind of emergency occurs. Recently Tokyo Electricity also experienced a temporary but indefinite closure of 14 of the company's 17 nuclear reactors and the unexpected situation has forced Japan's biggest utility firm to increase operation of its fossil-fired capacity.

Another major benefit from cooperation between the buyers lies in the price negotiation leverage based on the gas purchasing power. As shown in China's Guangdong and Fujian LNG supply deal, China became a genuine beneficiary of gas market opening power. Both Japanese and Korean buyers have been generous in paying the Asian premium to LNG, not to speak of crude oil. A formation of Asian gas consumers cartel will help Asian gas buyers exercise enough influence to get the best bargain price. To secure a competitive price is what Japanese utilities are also very interested as liberalization of natural gas and power sector is wiping out the space for the premium paid price and is driving a fierce price competition.

Gas Cooperation with CNOOC and CNPC

When it comes to a wider and comprehensive cooperation between Japan, Korea and Taiwan, and the late comer China, CNOOC is the front runner as the firm is solely responsible for both Guangdong and Fujian LNG projects. The second candidate is CNPC responsible for majority of onshore gas business and trans-national pipeline gas introduction. To some extent, both CNOOC and CNPC have a freedom to make their own business decision about the cooperation with gas buyers in the neighboring countries.

However, in a broader sense both Chinese state energy firm's cooperation will be greatly conditioned by the geopolitics of energy, in particular Moscow's final verdict on the crude oil pipeline. As China is placing such a great importance in constructing the Angarsk-

²⁶ FT international Gas Report, 15 August 2003, p. 18.

Daqing crude oil line, China's stance towards the cooperation will have a very different characteristic.

The first is an assumption of Angarsk-Daqing line being rejected. If Moscow authority decides to push only Angarsk-Nakhodka line despite the uncertainty about the proven crude oil reserves and a gigantic cost, it looks very certain that the energy relationship between Japan and China will suffer as National Development and Reform Commission is already warning about the consequence. In this case, the LNG cooperation with China is inconceivable as CNOOC will have no freedom to act alone.

The second is a kind of compromise option. Moscow would support the Angarsk-Nakhodka line, but the priority is given to the sideline from Skovorodino to Daqing through the Heilongjiang province. This approach could open a new door for cooperation between Japan and China, as China made very clear that they would accept the compromise option as long as oil supply to Daqing is implemented first. In this case, not only the LNG cooperation with CNOOC, but also pipeline gas cooperation with CNPC is possible.

However, CNPC will not see a 30% cost saving benefit from the trans-national gas pipeline along the Angarsk-Daqing route if Skovorodino-Daqing line is established. Ironically it could open a new door for the Mongolian route for the transnational pipeline gas introduction to China, Korea and even extension to southern Japan as the price from this Mongolian route will be very competitive against Guangdong and Fujian LNG price. In fact, in 1998 JNOC and Sumitomo consortium worked very hard to pursue a five country FS on Kovykta gas supply to China, Korea and possibly to Japan via Mongolia, but the 12 months negotiations had collapsed dramatically just before the end of 1998 as Japan's co-ordination role was questioned. Under this second option, cooperation with both CNOOC and CNPC will be a very realistic possibility.

The third is the case of Angarsk-Daqing line approved. Most of western analysts in Moscow see this option as the most likely possibility. In late January 2004, the Moscow Times reported that the Angarsk-Nakhodka pipeline cost could be much higher than the initial price of US\$ 5.8 billion. If not politics, Chinese authority is firmly believing that Moscow authority will eventually give the green light to the Angarsk-Daqing line.

If the green light is given to the Chinese plan in 2004, it will definitely will help giving another green light to the trans-national gas pipeline. This scenario will be good for China but not really good for Korea and Northeast Asian region as the pipeline is not based on the most optimal route that could offer the most competitive pipeline gas price the region can dream of. Under this scenario, NDRC will have no objection towards CNOOC's LNG cooperation with the region's main LNG buyers.

Natural gas cooperation in northeast Asian region will be very seriously affected by the geopolitics of energy in the region. Moscow's final decision on the crude oil pipeline proposals will decide the fate of natural gas cooperation, including LNG cooperation in the coming years.

5. Summary

China's long march for its economic development began at the beginning of the 1980s and after twenty years the country started its second stage economic development that would take care of the long neglected its vast western region. On top of this, last year Beijing authority made very clear that the revitalisation of the northeastern provinces will also be pursued. After all China is pursuing a nation-wide economics development, and consequently a massive energy, in particular oil and gas use is inevitable.

In January 2004 FT reported that China became the second biggest crude oil consumer in 2003 by passing Japan's 271.5 mt/y. The China's consumption level of 273 mt/y is much smaller than 1,000 mt/y of the US consumption. But it is more than symbolic. It was only the year of 1993 when China became the oil importer for the first time in its history, and in 2003 the crude oil import recorded 91 mt/y, an increased of 31% compared with 2002. By 2030 China's net oil imports are expected to reach 500 mt/y and meet more than 80 percent of its demand, compared with 35 percent in 2000.²⁷

Considering that in 2003 China's economic growth rate was 9.1% and twenty one out of the total 32 provinces and regions have experienced some form of power restriction, the surge of crude oil demand is not a surprising news. Hardest hit are China's fastest growing areas, especially the Yangtze river delta, including the provinces of Zhejaing and Jiangsu and Shanghai municipality, which together accounted for 23 percent of gross domestic product in 2003. The power shortage will continue in the coming years.

According to Wang Mengkui, director of the development research institute of the State Council, China's population is almost 40 percent urbanised as of 2003, but in 20 years this population will be close to 60 percent. In other words, some 300 million people will mover from the rural to urban areas. Around that time, China would cease to be the predominantly rural country it has been for millennia.

A stable energy supply is vital for China's economic development. Since the early 1990s China gas begun to recognize that it will have to import massive amounts of oil and gas in the coming decades to sustain that development, and now leaves no stone unturned to explore and secure all possible energy sources both domestically and abroad. In this context, the expansion of natural gas use is only a part of a comprehensive development plan for China's energy supply system.

In 1995 China announced its blue print for the country's long term natural gas expansion plan. Since then a systematic steps were taken for China's natural gas expansion. In March 2000, the State Council took the initiative to implement the West East Pipeline (WEP) project and the Ordos basin gas was delivered to Shanghai at the beginning of 2004. In August 2002, State Development Planning Commission (now NDRC) announced that it will approve both Gaungdong and Fujian LNG supply contract. In November 2003 the Feasibility Study on trans-national pipeline gas introduction completed. When all these schemes are realized, China's natural gas market will exercise a significant market power. The impact to Asian gas market will not be small.

²⁷ Victor Mallet, 'China is biggest oil consumer after US', Financial Times, Jan 21, 2004.

This report aims at getting some hints on the implications of China's gas expansion towards natural gas market in Asia.

Before delivering the conclusion, here is a short note on liberalization, Privatisation, demonopolisation and third party issues. The natural gas market in China is very early stage of its expansion and it is premature to talk about these issues at this stage. The three major oil companies in China are not interested in inviting a fierce competition by recommending NDRC to take steps for liberalization of China's gas market. It will be NDRC which give the direction or guidance on this matter in line with the gas market expansion. They will focusing on maximization of their market share until they witness a market situation that a fair competition is inevitable due to internal and external pressure.

It is not an exaggeration to say that CNPC together with and CNOOC are enjoying a monopoly status for their onshore and offshore gas expansion business respectively. What they are chasing is to establish a kind of value chain business by monopolising the upstream, mid-stream and downstream business. CNOOC's Dongfang 1-1 project. In the case of PetroChina's WEP project, the upstream sector is totally monopolised by PetroChina, but the central authority intended to introduce western participation in the mid-stream section. So far the negotiation is not going very well as PetroChina did not really see the necessity of western party's contribution to the pipeline development based on the gas reserves purely discovered by the biggest Chinese oil and gas firm. The only sector that western party could make a real contribution is the downstream sector where PetroChina does not have a know-how and experience. However, western energy majors are not so keen in entering the down stream market where profit margin is very low and competition is fierce. Without a significant stake in all three sectors, western firms cannot justify its participation in China's major gas infrastructure development. This is the reason why the Financial Times has reported the problems of negotiation between PetroChina and western consortium.

In this context the third party issue will be an important factor that would affect western investment attraction to China's gas market development. Third party access (TPA) is a right of a third party to access and/or make use of the transportation and related services of a pipeline company for a charge (tariff) to move gas owned by the third party, and it can be introduced to increase competition and efficiency only when a gas market has been significantly developed and reached a high degree of maturity. According to the European Commission's definition, TPA is a regime providing for an obligation, to the extent that there is capacity available, or companies operating transmission and distribution networks to offer terms for the use of their grid, in particular to individual consumers or to distribution companies, in return for payment. There are certain conditions for the application of TPA:

- There should be a sufficiently well developed gas market with access pipeline transmission capacity;
- There should be a sufficiently large number of gas producers and consumers who seek to have access to the spare capacity rather than building their own pipelines;
- Physical links exist or are feasible with the existing pipelines.

It seems unlikely that PetroChina would volunteer to open the door for the use of main trunk pipeline in the foreseeable future. For example, Kogas is still exercising its monopoly position to block the third party's access. Recently KEPCO asked Kogas to allow the trunk pipeline use for the planned LNG scheme and Kogas did not respond positively. In short, Liberalization of China's gas industry is an agenda long way off.

The main summary of this study is as follows:

- China's natural gas production base is not big enough to support a rapid expansion of its gas sector, so substantial amounts of gas imports by both LNG and pipeline gas in the coming years are inevitable. Even though China's total estimated geological gas reserves stand at 38 tcm, the remaining recoverable reserves are only 1.0-1.3 tcm. CNPC, SINOPEC and CNOOC are aiming at producing 78 bcm in 2010 and 100 bcm in 2015 (excluding coal-bed methane). Reaching to the 100 bcm production level will be possible but to maintain the production level continuously will not be easy without a string of major gas discoveries.
- Chinese energy planner's initial demand projection figures were very high but now the figures are coming down significantly. For example, the projected demand in 2002 by CNPC was initially 250 bcm but now the figure is 210 bcm. NDRC's figure is 180 bcm. This production business is one thing and the market development business is another thing. It took over 30 years for Japan to develop over 70 bcm LNG market and for Korea it took over 15 years to have over 20 bcm LNG market.
- A comprehensive transportation and distribution network development is essential for increased gas use. Both CNPC and CNOOC have an ambitious pipeline network development scheme. The backbone of CNPC scheme is WEP that would deliver the Tarim gas to Shanghai and that of CNOOC is a coastal pipeline that could deliver the imported LNG and offshore gas between Hainan and Wenzhou. Unlike WEP, there is uncertainty in CNOOC's plan. If CNOOC's plan to extend the coastal pipeline to the Bohai Bay is implemented, a connection of this network with CNPC's 20,000 km onshore trunk line will complete the nation-wide pipeline development. However, CNOOC's plan to extend the coastal pipeline to the Bohai Bay will be conditioned by the approval of LNG supply in Yangtze Delta, Shandong and Liaoning provinces.
- The great bargain price from Gaungdong and Fujian LNG supply is a big blessing to CNOOC but is a real headache to both NDRC and CNPC which have been the driving forces of WEP project. In late 2003 WEP's eastern section construction work was completed and the WEP began to deliver the Ordos gas from the beginning of 2004 to Shanghai. NDRC's intervention for CNPC's signing of 20 take or pay contracts out of the 35 potential buyers indirectly confirm the sensitivity of gas price in gas market development. This price issue will play a very important role in balancing WEP gas use structure eventually. (Korea's gas expansion was made due to its trunk pipeline development and the driving force of the expansion was the city gas sector, not the power sector. In Japan, the ratio of power and city gas demand is divided into 70 : 30, but in Korea the rate is reversed). Chinese energy planners' dilemma is that the expensive gas for power has to compete with cheap coal for power, and it is very necessary to introduce a preferential policy for the gas for power business expansion. NDRC made clear the preferential policy will be applied to both WEP gas and LNG if introduced, and in this case, WEP cannot compete with LNG. After 2005 when the WEP is completed, the Yangtze Delta will definitely offer a sizable gas market if the LNG supply with an attractive price is provided.
- In summer 2002 the Chinese authority made a very important decision on trans-national pipeline route, that is, they decided not to consider the Mongolian route for the Kovykta gas import. Basically, this decision removed the very best pipeline gas price option they can compete with LNG price. The reason was that they want to make sure the Manzhouli route should help revitalisation of three northeastern

provinces in China. Due to this decision, China's negotiation position against the trans-national pipeline development has been significantly weakened as Russia can excuse the change of crude oil pipeline route under the name of balanced economic development of Russia's far east. Unlike WEP based on China's indigenous gas resources, NDRC has only a limited freedom to select the route and price. As the trans-national pipeline involves both Russia and Korea's commitment, China's approach to give a priority to its national interest rather than offering a mutual benefit to all parties involved can be backfired.

- The pipeline extension to Korea is a very fragile link as Korea's participation was based on an assumption that the imported pipeline gas will be 20-25% cheaper than the LNG price. Due to Guangdong and Fujian's great bargain price, there is no chance for Korea to have this attractive pipeline gas price, if not the Mongolian route. Currently China is using coal price as the negotiation tool for the trans-national pipeline gas. The effectiveness is not so high. Instead the Chinese energy planners should establish a new benchmark price in north China by introducing a small scale LNG scheme to the Bohai Bay area. What north China needs is the price negotiation leverage against the trans-national pipeline gas.
- Regardless of this price issue, the trans-national pipeline gas introduction will be greatly affected by Moscow's decision on the crude oil pipeline proposal. Chinese authority is expecting the sound economics of Angarsk-Daqing line will eventually prevail. As mentioned above, however, by ruling out the Mongolian route China has already shown a good example to the Moscow authority that there can be no compromise as far as the national interest is concerned. Like China's approach, Moscow can give the priority to its frontier oil and gas development by changing the agreed route. Moscow has long dreamed of gasification of Russia's far east and it is now a part of its Energy 2020 plan approved in May 2003. Angarsk-Nakhodka line provides a strong incentive for Moscow to pursue both oil and gas export scheme. It remains to be seen what sort of verdict Moscow will finally make on the crude oil proposal. The decision will change the direction of natural gas cooperation in Northeast Asia fundamentally.
- The most ideal option for all parties involved is to pursue Angarsk-Nakhodka line and the sideline from Skovorodino-Daqing line. If a natural gas export line from Chayandagas is built in line with Skovorodino-Daqing line, it will help saving a 30 percent construction cost. At the same time it would open the door for Kovykta gas to be exported to Beijing and Shandong province through Mongolian route. This option will serve for the multilateral gas cooperation in northeast Asian region as all parties involved will be the winner of this win-win strategy.

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