Natural Gas in China

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1. Rapidly growing natural gas market in China

Until recently, China's natural gas consumption has been limited to local natural gas producing provinces. For example, Sichuan province, which is well known for its production of natural gas, has a local gas transport network. In the northwest, areas near the Daqing field in Heilongjiang province and the Liaohe oil field in Liaoning province have benefited from associated gas sent via gas pipeline. Since natural gas transportation was limited to areas near the production site, low cost gas supply was possible.

Conversely, the demand for natural gas has recently grown in large cities, where the use of coal gas has already spread with modernization. In consideration of such trends, China set out a policy to raise the share of natural gas in the country's energy mix in its Ninth 5-Year Plan (1996-2000). Encouraged by the successful discovery and development of the Ordos gas field in the 1990s, Beijing started fuel switching from coal to natural gas. They also constructed a pipeline extending a total length of 865 km from the gas field to Beijing to start gas supply in 1997. This pipeline now transports as much as 2.8 billion m^3 of natural gas per year. Backed by Beijing's environmental protection policy (e.g., designating coal use restricted areas), the amount of gas being transported is expected to reach 4.8 billion m^3 in 2010. Moreover, another 953 km of pipeline extending from the Qinghai Qaidam gas field to Lanzhou in Gansu province were completed at the end of 2001 to accelerate the fuel conversion from coal and coal gas to natural gas.

Another example is Shanghai. The city government of Shanghai launched an energy source-restructuring plan in 1999 with a top priority on expanded use of natural gas for improved energy efficiency and diversified energy sources. Specifically, the plan included prohibiting the construction of new coal-based thermal power plants, reducing the number of coal boilers and constructing natural gas power plants, as well as purchasing electric power from other cities, to meet the growing power demand. Indeed, the construction of new coal power plants in industrial parks is no longer permitted in an effort to accelerate the conversion of fuel to clean energy like natural gas and electric power. Moreover, Shanghai plans to facilitate the development of oil and gas fields in the East China Sea, and introduce LP gas intensively from foreign countries to promote the fuel conversion from coal gas to natural gas.

Meanwhile, it becomes increasingly clear that gas prices are gradually rising due to long-haul transport and higher production costs. To date, gas prices have remained above reasonable market prices to profit the natural gas companies. China is now considering a system in which both buyer and seller may discuss to determine shipment prices based on a pricing mechanism recommended by the government. This pricing system is expected to drive down the market price of natural gas in future.

As for the players on supply side, there are about 60 natural gas companies in China. Among all, the Big Three—CNPC (China National Petroleum Corporation) Group, Sinopec (China Petroleum and Chemical Corporation) Group, CNOOC (China National Offshore Oil Corporation) Group account for more than 90% of the total national production.

CNPC, in particular, accounts for almost 70%. Actually, their shares of production in 2002 were 68.9% for CNPC, 15.2% for Sinopec, and 11.4% for CNOOC.

CNPC and Sinopec own and operate mostly on shore pipelines. Conversely, CNOOC owns and operates virtually all off shore pipelines. Local delivery services are mainly provided by public companies controlled by local governments that traditionally delivered city gas (typically coal gas).

For demand side, natural gas consumption is significantly less than other fossil fuels in China. It is primarily used as a raw material for chemical fertilizer and to operate oil and gas fields. Accordingly, most natural gas is consumed for production of fertilizer. Only a little over 10% of natural gas is consumed as a fuel for such as cogeneration and residential use. As the natural gas market evolves in future, however, natural gas will primarily be used for electric power and residential use as an alternative to coal.

Consequently, the Chinese natural gas market is likely to undergo drastic change in the near future, exerting a significant impact on neighboring countries.

2. Demand for natural gas

2-1 National plan

The Energy Research Institute of China predicted[*1] in October 2002 that the primary energy demand over the next 20 years would increase at an annual rate of 3.2% (energy elasticity 0.49)—about half the economic growth rate projected by Chinese government (7%). According to this projection, income per capita will grow fourfold, and total energy demand will almost double in 20 years. Conversely, the predicted growth in demand for natural gas is an average of 12% a year, or about 1.7 times the economic growth rate (energy elasticity 1.7). Thus, the share of natural gas in the primary energy will increase from 2.5% in 2000 to 12.5% in 2020. This suggests that the use of natural gas will grow at least three times as fast as that of other fossil fuels. As such, the China's expectations for natural gas are very high. The major driving forces from demand side is environmental pressure and from supply side are improvements of social infrastructure with economic growth, in the west in particular, and stable energy supply.

Table 1-1. Natural gas production by major Chinese producers

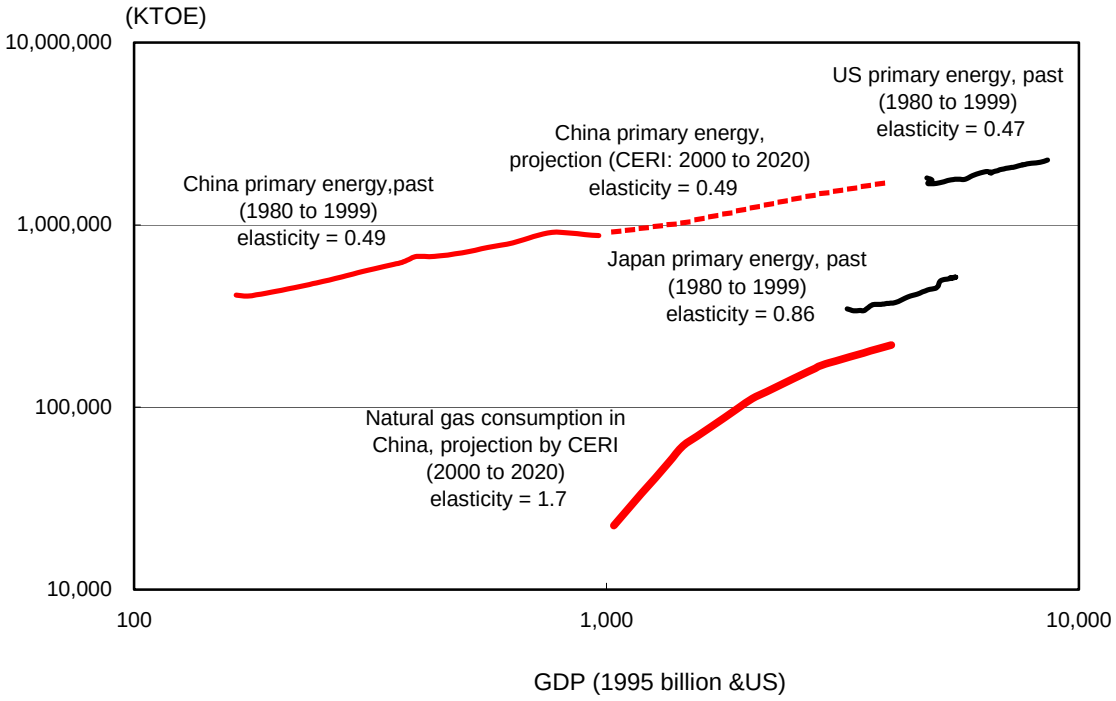
(100 million m^3)

Producer	1997	1998	1999	2000	2001	2002
CNPC*	171.80	149.83	162.60	183.10	205.81	224.75
Sinopec*		23.24	22.26	39.16	46.12	49.45
CNOOC*	40.50	38.64	43.92	39.60	38.57	37.16
Others	14.73	21.08	23.20	10.14	12.79	14.97
Total**	227.03	232.79	251.98	272.00	303.29	326.33
Growth%		2.54	8.2	7.9	11.5	7.6

Source: * China National Petroleum Corporation, China Petroleum and Chemical Industry Association
**China Statistical Yearbook 2002

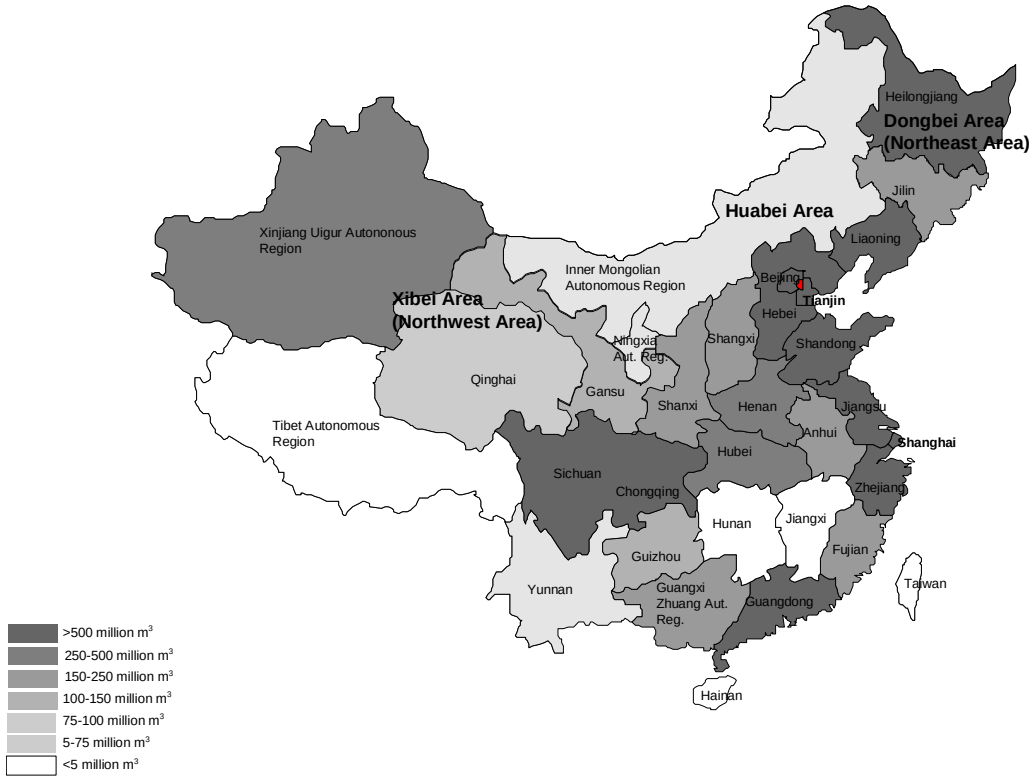
[*1] Joint research conducted between the Institute of Energy Economics (of Japan) and Energy Research Institute of China

Figure 2-1. Projected primary energy and natural gas demand in China (by Energy Research Institute, China)



Source: Past results: IEEJ; Future projection in China: ERI

Figure 2-2. Projected 2010 natural gas demand by province in China



Source: Institute of Energy Economics, Japan

2-2 Environmental challenges

Coal accounts for at least 70% of China's primary energy consumption. Raw coal is typically burned directly as it is. At least 90% of the nation's combustion facilities have no environmental protection measures, such as desulfurization and denitrification systems, and thus pose serious environmental problems. These are not only domestic problems; they represent international problems, in the form of acid rain affecting neighboring countries like Korea and Japan. From the standpoint of environmental protection, restriction of coal use and clean coal technology (CCT) should be promoted as already underway in some major cities. Specifically, coal use can be replaced by natural gas use, while technologies of desulfurization and denitrification are typical CCT to be applied to the existing coal power plants to reduce air pollutants originating from coal utilization. In the long run, the cost of such clean coal technology will be added to the price of coal, thus giving relatively clean natural gas a cost advantage over coal.

A study*2 conducted by the World Bank estimates the environmental impact of one ton of coal in China is worth at least 24 US dollars. This means that the production of one ton of coal causes as much as 24 US dollars in environmental damage, conversely China can mitigate environmental damage worth 24 US dollars by converting one ton of coal to natural gas.

Table 2-1. Social cost associated with the use of coal (environmental burden)

Sector	Environmental load associated with the use of coal		
	US$/ton	$US/ MMBtu	yuan/ 1,000kcal
Electricity	23	1.15	0.038
Consumer use	17	0.85	0.028
Heat supply	39	2.00	0.065
Industrial use	29	1.50	0.048
Total	24	1.20	0.040

Source: Based on Box 4.3, *Clear Water, Blue Skies*, World Bank

2-3 Breakdown of demand

Natural gas, which is currently regarded as feed stock of chemical fertilizer, will play a major role in sectors of large coal consumption such as electric power generation and residential use with expectation of environmental relief by replacing coal. In an estimate, the use of natural gas in electric power generation will account for 30 to 40% of the total demand for natural gas by 2020.

It's no exaggeration to say that the successful adoption of natural gas in China depends on whether fuel conversion can succeed in the electric power sector on the demand side. For example, IEA proposed the nationwide construction of 50 MW-class gas cogeneration systems*3. Meanwhile, China plans to privatize natural gas business on both supply and demand sides, thereby gradually transforming its government-controlled market into an open one. Then, the cost competitiveness of natural gas over coal, or relative price including environmental cost will determine whether the fuel for power generation will be smoothly replaced by natural gas. The key factor is China's seriousness in implementing environmental policy.

Table 2-2. Projected natural gas demand in China by sector

Demand by sector (100 million m^3/y)			
	1997 results	2010	2020
Power	21.9	350	812
Residential use	21.2	220	500
Chemical/Fertilizer	84.3	190	325
Industry & Others	68.2	200	400
Total	195.6	960	2037

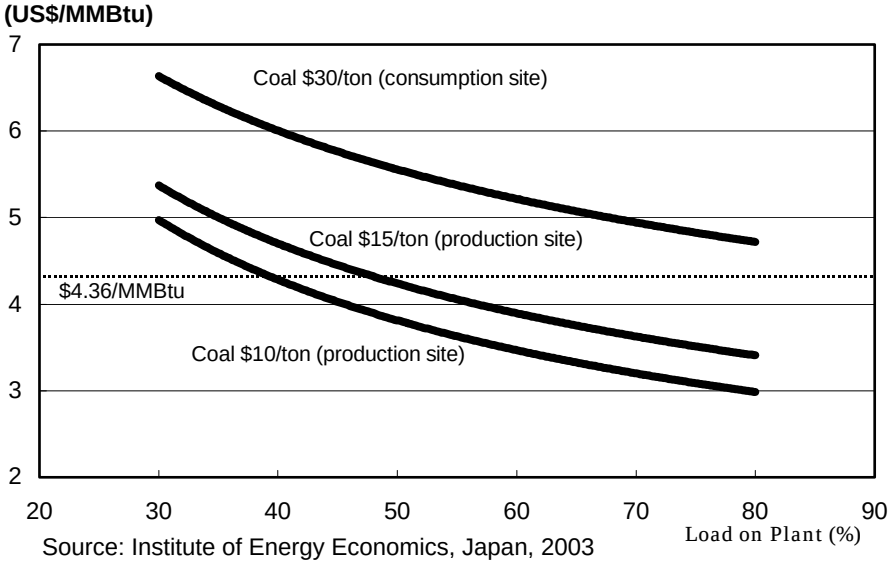
Source: IEA*3 Table 2-5 (original source: ERI)

*2 World Bank *Clear water, Blue Skies*, 1997

2-4 Price

The price of regular coal in China varies from $10 to $15/ton when shipped from the production site, but doubles in major cities, which are major consumption sites. In consideration of the cost of clean coal technology in coal utilization, the competitive price of natural gas varies from $3 to $5/MMbtu under base-load operation, and from $4 to $6/MMbtu under a 40 to 50% operation load. Assuming that the future price of natural gas for power generation in China will approach the LNG price in Japan of $4.36/MMbtu (average CIF in 2001), natural gas offers a competitive alternative to replace coal (at current production site prices) for plant operation under peak load (40% or less).

Figure 2-3 Competitive natural gas price curve by coal price and by load



Source: Institute of Energy Economics, Japan, 2003

3. Domestic Supply of Natural Gas

China's production of natural gas has rapidly increased since 1990s. Production totaled 17.947 billion m^3 in 1995, 27.726 billion m^3 in 2000, 30.344 billion m^3 in 2001, 32.633 billion m^3 in 2002, and is projected to exceed 35 billion m^3 in 2003 with 7% growth from the previous year.

China's natural gas reserves as of 1994 official estimates were: original gas in place, 38 trillion m^3 (including associated gas); proven reserves, about 2 trillion m^3; and recoverable reserves, 1 trillion m^3 (BP estimate for the end of 2002 is 1.51 trillion m^3—R/P ratio 46.3). Most reserves of natural gas exist in the middle west, where major gas fields such as Tarim, Junggar, Qaidam, Ordos, and Sichuan have been discovered. In particular, Sichuan is the traditional, largest production area in China, accounting for almost 30% of the nation's total production.

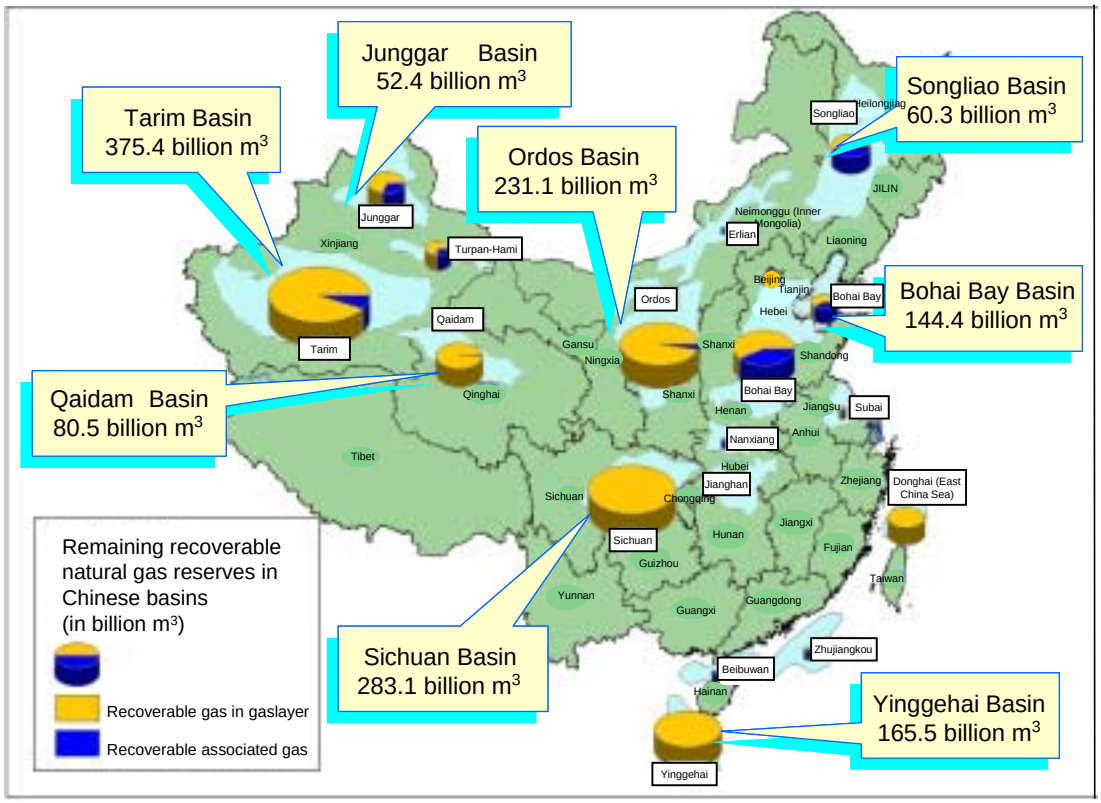
3-1 Improving infrastructure (Developing the West)

In China, socioeconomic gaps are expanding between east and west regions behind remarkable economic development, posing potential political problems. The "West Development" plan was launched as a solution. One of core projects in this plan is the West-East Pipeline Project, a project to transport natural gas produced in the west to cities in the east via a pipeline extending from the Xinjian Tarim gas field to Shanghai. Construction work is now underway to start operation in 2005. The natural gas annual transportation by this pipeline will amount to 12 billion m^3. This project is widely known because it was China's first big project open to foreign capitals. In December 2001, Petro China–the core company in the Chinese oil business–reached a framework agreement on investment with Shell Consortium on July 2002. But as of June 2003, final joint venture

*3 IEA, *Developing China's Natural Gas Market,* 2002

agreement had yet to be reached. For now, construction is proceeding by Chinese alone. Ordos expects to supply gas to Shanghai as early as October 2003. When this project is completed, gas from Tarim and Qaidam will reach many major cities. However, should the open policy of accepting foreign capital fail, the future development of the natural gas market could be undermined.

Figure 3-1. Map of China natural gas reserves



Source: Institute of Energy Economics, Japan (based on 1994 official figures)

3-2 Stable energy supply

In the past, China was able to satisfy most domestic energy demand with its own coal and oil, but it became a net importer of oil to cover shortages in 1993. Whereas the demand for oil is growing as motorization develops along with economic growth, domestic oil production is gradually decreasing. Consequently, China is forced to increase oil imports. China's oil consumption in 2002 totaled 240 million tons (while Japan's was a little more than 260 million tons), and oil accounted for about 30% of total fuel consumption. Half the oil was imported from the Middle East. Oil imports are expected to increase to 120 to 150 million tons in 2010, and growing oil imports and increased dependence on the Middle East have become serious concern.

Therefore, the national policy placing top priority on the development and exploration of domestic reserves and effective use of new gas reserves is becoming important amid concern for stable energy supply.

There are limits to the natural gas reserves, however, and sooner or later the demand for natural gas will exceed domestic production capacity. Moreover, if the Chinese yuan is appreciated in the near future, the cost advantage of domestic natural gas over imports may fall significantly.

4. Gaps in supply and demand, and imported natural gas

Given the potential magnitude of China's energy demand, many countries carefully monitor the Chinese import market including that of natural gas. With respect to geographical accessibility, imported LNG will have a cost advantage in southern provinces along the coast. In fact, provinces along the sea coast like Guangdong and Fujian plan to generate electric power using imported LNG. Guangdong province will import LNG from Australia in 2005; Fujian province will import LNG from Indonesia in 2006.

In contrast, in northern inland areas, the natural gas transported by pipeline is likely to enjoy a cost advantage. The focus of the source is on eastern and western parts of Siberia and Turkmenistan in Central Asia, and Sakhalin and Sakha in the Far East. In fact, the Kovikta gas field in Irkutsk, eastern Siberia, and the Chayanda gas field in Sakha Republic in the Far East, are attracting attention as promising natural gas suppliers for China.

The pipeline is suitable for massive transport in terms of economic efficiency. Indeed, the pipeline from the Kovikta gas field (already studied by Russia, China and South Korea) can transport up to 30 billion m^3 or more a year, which is equivalent to China's total production of natural gas in 2001. The initial plan calls for sending 20 billion m^3 to China and 10 billion m^3 to South Korea. To make such a large-capacity pipeline competitive, stable demand is required. However, the natural gas pipeline from Russia is not proceeding so well as the project of oil pipeline from Russia.

China has a policy of placing priority on the development of domestic resources and has invested heavily in fuel reserve exploration. Conversely, there are complicating factors against investment, such as politics involving Russia and South Korea and uncertainty over the future of the Chinese market. Particularly in such a big project like the construction of an international pipeline, China alone cannot provide full financing. Instead, it must involve domestic and overseas investors as well as international organizations.

4-1 Uncertainty in China's natural gas market and gap in supply and demand

The rapid growth in demand will soon pose a supply problem for China's natural gas market. Both domestic and overseas investors are paying great attention to when a gap between supply and demand exceeding 20 billion m^3 will surface, and whether a market with institutional system allowing reasonable commercial practices will be in place by the time such a supply and demand gap develops.

The progress in regulatory reform for a more open market greatly depends on China's commitment to public promises, while any evolving gap in supply and demand depends on market conditions that are still exposed to many uncertain factors. In fact, many experts point out that China's official projections are unrealistic. In contrast to 236 billion m^3 (ERI projection for natural gas consumption for 2020), the U.S. Department of Energy[*4] projects 120 to 220 billion m^3, has a scenario gap of as much as 100 billion m^3. Our projection made in 2003, ranging from 120 to 190 billion m^3, also indicates a difference of about 70 billion m^3. IEA's projections were also very low—reference case 109 billion m^3 (a little lower than DOE's and our lower limits) in its World Energy Outlook of 2002.

As we can see, while the ERI projection of 236 billion m^3 may be somewhat optimistic, the level of the half of that projection (or 120 billion m^3) is pessimistic with respect to natural gas demand in China. The main causes for such gap in projected demand scenarios are differences in views of prospects of economic development and natural gas market development. Most expert would tend to make more cautious projections, leaning toward the pessimistic side.

[*4] *International Energy Outlook 2002*

Figure 4-1 Gap in supply and demand of natural gas in China

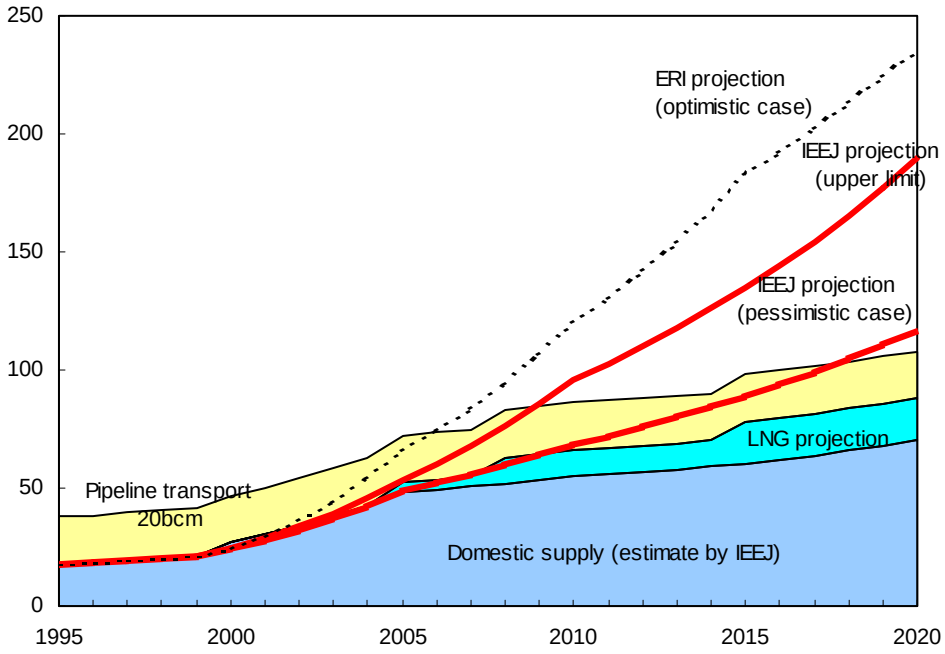
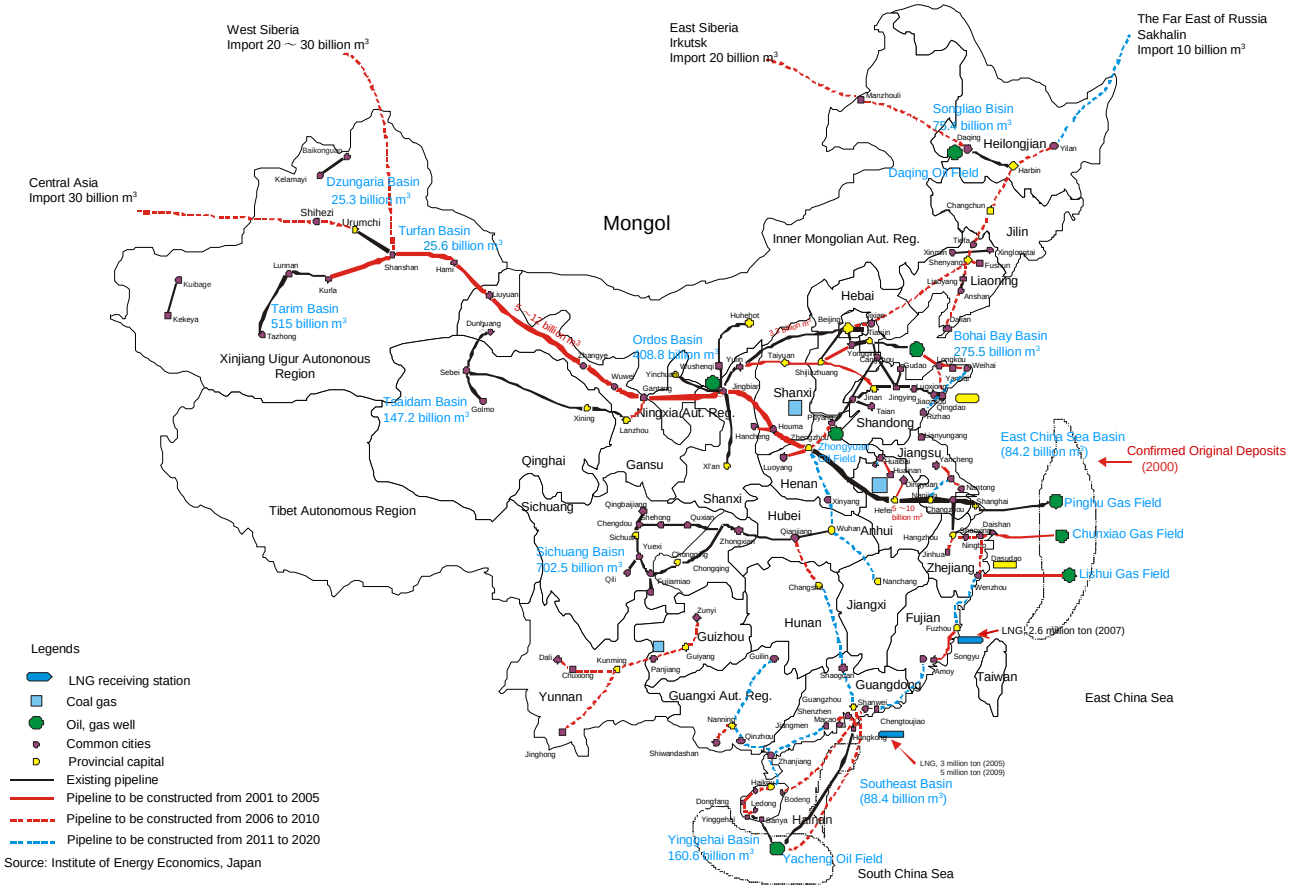


Figure 4-2. Existing and planned natural gas pipelines in China



4-2 Pipeline from Russia

When the 20-billion m^3 gap in supply and demand in China surfaces, the international pipeline from eastern Siberia will become realistic. This will happen by 2005 in the optimistic view, and by 2018 in the pessimistic view. The timing will also likely be off by several years, depending on the accuracy of projected domestic supply. However, most experts do not expect that the gap in supply and demand will be as large as China claims. Thus, it may be realistic to consider a lapse of 5 years or more (onward) in the ERI projection of the time of initiating massive imports.

Notably, the current domestic market for natural gas is still around 3 billion m^3—far smaller than the projections. The market system has yet to mature, and such an immature market is a major concern for investors. To introduce foreign capital for constructing a pipeline, it is vital to establish stable investment environments.

Moreover, international complications may affect market formation. According to the draft of the Russia-China-Korea Project now under discussion—the project of transporting natural gas of Kovikta—20 to 25 billion m^3 of a nominal capacity of 35 billion m^3 will be sent to China, with the rest going to South Korea. The concept underlying this project was constructing the shortest, lowest-cost pipeline from the south coast of Lake Baikal to Beijing via Mongolia and onward to Korea through the pan Bo-Hai area.

As a player in an international power game, Russia may claim a premium on the price of natural gas sold to China to make the gas price as high as LNG. Russia may try to pad the regular market price as an added value to China's energy security. In turn, as a Chinese domestic issue, the pipeline has political reasons to avoid Mongolia (with a route from Manzhauli in northeast Nei Mongol to Beijing via three northeast provinces being strongly recommended). China fears that Nei Mongol will not accept that only Mongolia will get transit benefit from providing land for a pipeline, while Nei Mongol of the same ethnic group of Mongolia but a part of China will only be passed without benefit.

For South Korea, those challenges will drive up product cost and dilute the advantages of investment because natural gas transported by pipeline may lose its cost advantage over LNG. As the Sakhalin-2 LNG Project moves toward reality this year, South Korea's concerns continue to grow. They have reportedly agreed to complete a feasibility study of the project by June 2003, but details remain unclear.

5. Policy of promoting the use of natural gas

5-1 Price and taxation

China controls the natural gas business under a national policy of "controlled distribution and controlled sales." The cost of natural gas consists of three parts: production cost, processing cost, and transportation cost. The government allows suppliers and sellers to mutually determine pipeline transport costs through negotiations. Before China joined the WTO, the import tax on natural gas imported by pipeline and tax on imported LNG were both 6%. China changed its policy after joining the WTO and the tax on pipeline natural gas is to be lifted. The pipeline companies benefit from a system of reduced taxes with "2-year exemptions and 3-year reductions" (whereby income tax is totally exempt for the initial two years after turning a profit, then reduced at a certain rate for the following three years), and preferential rules under which import duty on equipment and pipe materials are exempt.

5-2 Finance

China relied on internal financing and foreign capital to raise funds for major projects. In recent years, however, it has introduced modern financing systems, such as mergers, partnerships, and corporate systems, given the prevailing open policy. In the West-East Pipeline Project, China launched a multi-source funding policy, allowing foreign companies to hold shares of the project and jointly construct urban natural-gas networks as a downstream business. The project cost totals 120 billion yuan, and 40 billion yuan will be needed to construct the 4,000 km pipeline. Former President Zhu Rongji said that China guarantees that the investment will pay off by virtue of the preferential policy, and that the pipeline will be completed in three years.[*5]

5-3 Relevant institutions

In China, the development of natural gas is proceeding as a national project. Table 5-1 lists the organizations of key governmental agencies and the Big Three of oil/gas business involved in the national project. Despite frequent arguments over the participation of foreign companies in national projects, the three major domestic oil/gas groups are likely to lead China's natural gas business for the time being.

Table 5-1. Organizations and relevant governmental agencies involved in China natural gas project

Companies and governmental agencies involved	Related Organizations	Mission
State Development Planning Commission	Industrial Planning Department (West-East Pipeline Project Office)	Planning of long-term natural gas development
State Economic and Trade Commission	Resource Rational Use Department (Petroleum Industry Bureau)	Supervising the oil/gas Big Three and controlling implementation of natural gas projects
CNPC	The Core Business ・ China National Petroleum Corporation (PETRO CHINA) Non-Core Business ・ Petroleum/Gas Production Enterprise (14) ・ Petroleum Refining/Chemical Industry Enterprise (15) ・ Petroleum/Gas Sales Enterprise (14) ・ Petroleum Project Construction Group (16) ・ Material Equipment Group (17) ・ Prospecting/Development, Technical Service, Transportation/ Communication (6) ・ The Science Research Institute (7) ・ Petroleum and Natural Gas Pipeline Bureau ・ Petroleum Geophysical Prospecting Bureau ・ China Huayou Group Corp. ・ Newspaper/Publishing (3) ・ Social Community (8) ・ China Petroleum Accounting Audit Institute ・ Zhongyou Finance Co.,Ltd. ・ Hong Kong Corp.	Conglomerate of crude oil, natural gas, oil refinery, petrochemical, oil trade, and oil plant technological services
Sinopec	The Board of Directors The President Office The Prospecting & Development Department of Oil Field Chemical Industry Department Petroleum Refining Department Sales Corp. Head Office Function Department Refining Chemistry Branch ・ China International Petroleum & Chemical Joint Corp. ・ International Business Corp. ・ Sales Branch ・ Oil Filed Branch ・ Petroleum Refining Corp. ・ Chemical Industry Department ・ Each Institute	Corporation with established sales network for exploration and development of oil and natural gas, oil processing, petrochemical industry, oil/natural gas pipeline transport, and trading of oil and petrochemical products
CNOOC	Zhonghai Petroleum Research Center Business Corp. Base Corp. Overseas Office China Offshore Oil Corp. Zhonghai Trust & Investment Co.,Ltd. Zhonghai Oil and Gas Development and Utilization Corp. Zhonghai Pretrochemical Co.,Ltd. China Offshore Oil Co.,Ltd. ・ China Petroleum Co.,Ltd. ・ China Offshore Oil International Co.,Ltd. ・ China Offshore Oil International Co.,Ltd. (Singapore)	Exploration, development, production of surface oil and natural gas, oil refinery, petrochemical industry and processing, use and sales of natural gas products

Source: ERI

[*5] Source: Japan-China Energy Forum