



ZERI

**Report of
ASSESSMENT ON BARRIERS OF
CHP/TRIGENERATION PROMOTION
AND POTENTIAL COUNTERMEASURE IN
CHINA**

2004

Report of assessment on barriers of chp/trigeneration promotion and potential countermeasure in China

Author(s): Hunag Dongfeng
Organisation: Zhejiang Energy Research Institute (ZERI)
Address: 218 Wen'er Road, CN-310012, Hangzhou, China
Tel.: +86 571 88 84 07 92
Fax: +86 571 88 82 36 21
E-mail: huangdf@zeri.org.cn
Web: www.zeri.org.cn

The project "OPET CHP/DH Cluster" has obtained financial support from the European Commission (Directorate-General for Energy and Transport) under the contract no. NNE5/2002/52 for Community Activities in the Field of the specific programme for RTD and demonstration on "Energy, Environment and Sustainable Development - Part B: Energy programme"

The responsibility for the content on this publication lies solely with the authors. The content does not necessarily represent the opinion of the European Community and the Community is not responsible for any use that might be made of data appearing herein.

CONTENTS

1. INTRODUCTION	2
2. GENERALS OF CHP/TRIGENERATION	4
2.1 Concepts of CHP/Trigeneration.....	4
2.2 Advantages of CHP/Trigeneration.....	5
3. OVERVIEW OF CHP/TRIGENERATION IN CHINA	6
3.1 Situation of CHP	6
3.2 Situation of Trigeneration	6
4. CASE STUDY	8
4.1 Cases in Shanghai	8
4.1.1 Trigeneration System in Pudong International Airport.....	8
4.1.2 Huangpu Central Hospital of Shanghai.....	9
4.1.3. Minhan Hospital of Shanghai	9
4.2 Cases in Beijing	10
4.2.1 A Case in Control Centre of Beijing Natural Gas Group.....	10
4.2.1 Other Cases	10
5. BARRIERS ON CHP/TRIGENERATION IN CHINA.....	12
5.1 Less Public Awareness	12
5.2 Incentive Policies and Instruments	12
5.3 Technical Issues.....	13
5.4 Connection of power grid	13
5.5 Price and supply pressure of natural gas.....	14
5.6 Manufacture of equipment.....	14
6. POTENTIAL COUNTERMEASURES	15
6.1 Potential Market of CHP/trigeneration	15
6.1.1 Resources of Natural Gas in China.....	15
6.1.2 Potential market of CHP/trigeneration in China	15
6.2 Potential Countermeasures.....	16
6.2.1 Policy making	16
6.2.2 Principles and codes for design.....	16
6.2.3 Strengthen R&D.....	16
6.2.4 Establishment of ESCO's	17
6.2.5 Localization of equipment production	17

REPORT
of
**ASSESSMENT ON BARRIERS OF CHP/TRIGENERATION PROMOTION
AND POTENTIAL COUNTERMEASURE IN CHINA**

1. INTRODUCTION

China has been experienced five-decade's history of CHP development, with great achievements in terms of coal-fired CHP technologies, equipment manufacture, and design of CHP systems and so on. CHP technology has been playing an important role in enhancing energy efficiency, alleviating pollution emission, and improving urban infrastructure and improving of living condition in China.

With rapid development of economy and increase of living level in China, particularly booming of real estate industry, the demand on electricity, heat and cooling has been increasing in the latest years. There is a tendency that heating areas is enlarging to southern parts (i.e. provinces in the south of the Yangtze River, in which used to no space heating in winter). And, cooling load in summer is also rapidly increasing. Power-driven air conditioner has contributed a certain part of power grid load, even 40% in some municipalities of China. Since summer of 2003, many provinces in the eastern China have been hit by "electricity crisis", blackout becomes frequent, which has resulted in great losses of socio-economic aspects.

China is a one of largest coal consumers in the world. Coal accounts for great share in Chinese energy mix, and there exist more than 500 thousands of small coal-fired boilers with less 50% of energy efficiency, both of which have led to heavy air pollution in China at present. With the view of sustainable energy development and environmental protection, China stresses the strategic impacts of energy efficiency, and adjusts energy mix through gradual replacement of coal by natural gas and other clean energies.

Under the situations mentioned above, advantages of CHP/trigeneration fuelled with natural gas are highlighted, in terms of high energy efficiency, reduction of

pollutant emission, diversified energy supply, and shaving peak load of power grid, and balancing of seasonal load of gas pipeline and so on.

It is indicated that there is great potential market for promotion of CHP/trigeneration in China, to comply with Chinese energy policy of diversified energy mix and enhance energy utilization efficiency, according the results of OPET project 2000-2002, which was carried out by Zhejiang Energy Research Institute (ZERI-OPET), in cooperation with EU partners. Among OPET activities in China, an “*international workshop on CHP promotion, financing mechanism and collaborative potential in China market*” was held on June 13-14, 2002 in Hangzhou of China, from which attendants had concluded that Chinese CHP/trigeneration development is now facing great opportunity and challenge, under the progress of liberalized electricity market in China and increasing supply of natural gas in Eastern China, and there are cooperative potentials between China and EU, in terms of study of legislations, policies and incentive instrument on, and transfer of technologies related to efficient utilization of natural gas, in the field of CHP/trigeneration. As a follow-up, an action of “*Increasingly promotion and market penetration of EU energy-efficient measures in China*” has been implemented, within OPET Contract NNE5/2002/52, to assess barriers on CHP/trigeneration promotion in China and identify gap between China and EU, as finalized in this paper, and organise an “*international workshop on CHP/trigeneration promotion and collaborative potentials in Chinese*” on April 26-28, 2004 in Hangzhou of China (see [http://: www.opet.org.cn](http://www.opet.org.cn) for more).

2. GENERALS OF CHP/TRIGENERATION

2.1 Concepts of CHP/Trigeneration

The Combined heat and power (CHP) - also called cogeneration - is the simultaneous conversion of primary fuel into electrical/mechanical energy and useful heat which can be used for heating purposes or as process steam in industrial applications. While the need for heating winter and cooling in summer, heat by a cogeneration plant is used to produce cooling via absorption cycles, this “expanded” cogeneration process is known as trigeneration. Trigeneration implies the simultaneous production of electricity, heat and cooling from a single fuel.

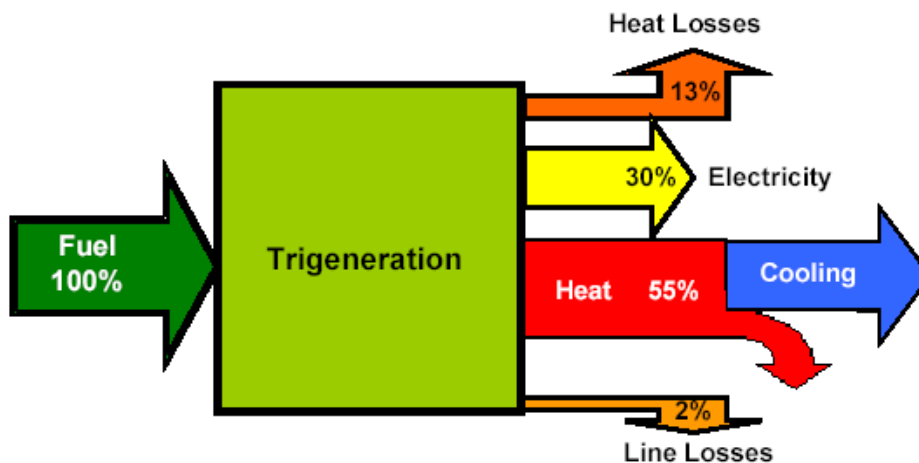


Figure 1. Typical Diagram of Trigeneration

CHP/trigeneration is a highly efficient and environmental sound process to meet existing parallel electricity and heat/cooling demands. While conventional thermal power plants convert only 1/3 of the fuel energy into electricity, and the rest is dispersed in the atmosphere as waste heat. CHP/trigeneration plants convert more than 4/5 of the fuels energy into usable energy, as shown in Figure 1, with both financial and environmental benefits. The efficiency of CHP/trigeneration is up to 40% higher than separate production of electricity and heat/cooling based on the same fuels.

CHP/trigeneration is applied in industrial sector and buildings where there is simultaneous demand of electricity and heat/cooling, and, usually, when period of operation exceeds 4000 hours annually.

CHP is a well-known as short form of cogeneration, combined heat and power production, and CHCP may be a less familiar short form of trigeneration, combined heat, cooling and power production. In American, BCHP is short form of Building Cooling, Heating and Power, for trigeneration application in buildings.

2.2 Advantages of CHP/Trigeneration

The successful installation of CHP and CHCP is dedicated to reduction of fuel consumption by approximately 25% compared with conventional power production, and proportional reduction of pollutants into the air. While fuelled with natural gas, rather than oil or coal, emissions of SO₂ and smoke may be zero.

For the benefits of uses, energy costs of trigeneration units are lower than those of the “conventional” units of separation production of electricity, heat and cooling. In successful installations of CHP, the price reduction is in range of 20-30%.

The reliability of the energy supply increases. The CHP station connected to the electric network, where it provides or absorbs electricity guarantees uninterrupted operation of the unit, in case of interruption of the station’s operation or electricity supply from the network. On country level, it reduces the need of installation of large electric power stations and increases the stability of the electric network of the country. It also improves employment at local level. Trigeneration units offer significant relief in power grids in summer, and increase use efficiency of grids and gas pipelines if they are fuelled with natural gas. Because cooling load is transferred from electricity to fossil fuel networks through change of cooling process from compression cycles to absorption ones.

3. OVERVIEW OF CHP/TRIGENERATION IN CHINA

3.1 Situation of CHP

Up to 2001, there was capacity of 32 GW of totalling CHP installations (6 MW/per unit and up), which accounted for 13.37% of thermal power installations.

At present, 60% of central heating in urban is of CHP (the combined heat and power) in China. From 1991 to 2001, heating area had rose by five times, up to 1.2 billion square meter, and 12,874,369 TJ of heat per year. In recent years, annually average increment of heating area has been more 200 million square meter. Compared with separation production of electricity and heat, CHP has contributed to energy saving of 25 million tce, and reduction of 65 million ton of CO₂ in China.

In the past years, CHP has been mainly used in industrial sectors, and central heating in northern cities of China as follows:

- **For industrial use:** there are many self-provided cogeneration plants in energy-intensive enterprises, such as in petroleum, chemical, metallurgical and light industrial sectors;
- **For central heating:** manly space heating for residential use in northern cities, and for commercial building and industrial use in southern municipalities and provinces, such as Shanghai, Jiangsu, Zhejiang and Anhui along the Yangtze River in the recent years,
- **Industrial parks:** Cogeneration plants servers as one of important energy infrastructure in industrial parks the southern China, particularly in the Delta of Yangtze River and the Delta of the Pearl River in China and so on.

2.2 Situation of Trigeneration

The promotion of trigeneration fuelled with natural is at early stage in China. But, there are a few of pilot projects of gas-fuelled trigeneration carried out in Shanghai, Beijing of China, where natural gas supply is available, as listed in Table 1. Besides, in the Delta of Pearl River, there are some internal combustion engine generator units fuelled with oil fuel, some of them equipped with waste heat utilizing devices.

Table 1 List of Pilot Trigeneration Projects in China

	Location of project	Specification of Equipment	status
1	Huangpu Central Hospital, Shanghai	1 x 1000kw Solar diesel gas turbine 1 x 3.5t/h waste steam boiler	operation
2	Shanghai Pudong International Airport	1 x 4000kw Solar NG gas turbine 1 x 5t/h waste steam boiler	operation
3	Minhang Hospital, Shanghai	1 x 400kw Gentaic gas engine 1 x 350kg/h waste steam boiler	operation
4	Control Centre of Beijing Natural Gas Group	1 x 480kw and 1 x 725kw gas engine 1x BZ100 and 1 x BZ 200 waste heat direct fired absorption chillier	debug
5	Ciqu Natural Gas Distribution Station, Beijing	1 x 80kw Bonman gas turbine 1 x BZ20 waste heat direct fired absorption chillier	debug
6	Zongguancun Software Plaza, Beijing	1 x 1200 kw gas turbine, 1 x BZ250 direct fired absorption chillers	Design
7	Zhongguancun International Mall, Beijing	1 x 4000KW Solar Renma 40 gas turbines, 2 x 20T/H waste heat boilers	feasibility study
8	China Science Promotion Mansion, Beijing	4 X 80KW Bowman micro gas turbines 2 x Broad VII waste heat bromide lithium chillers	Proposal.
9	Beijing International Trade Center	2 x 4000KW Solar Renma 40 gas turbines 2 x 20T/H waste heat boilers	proposal.
10	Gaobeidian sewage treatment plant, Beijing	4 x 6GTLB methane-fuelled engines of 513 kW 3 x JMS316GS-B,L methane-fuelled engine of 710 kW	operation
11	Dongwang Shoe Plant, Guangdong	11 x 102kw diesel engine 11 x 0.5t/h steam boiler	operation
12	Guangzhou Aluminium Group	1 x 725kw heavy oil engine 1 x BZ200 direct fired absorption chillers	operation

Those projects above have provide useful experience and lessons to promotion of CHP/trigeneration in China, and details of case study is mentioned as following section.

4. CASE STUDY

4.1 Cases in Shanghai

Shanghai has been leading in promotion and dissemination of trigeneration at the end of 1990's, it provide practical experience and lessons to other projects. Up to now, there were three projects completed as follows:

4.1.1 Trigeneration System in Pudong International Airport

In Shanghai Pudong International Airport, an energy centre was designed as trigeneration system, equipped with

- 4 MW natural gas turbine and
- 11 t/h of waste heat boiler
- cooling units of four OM 4000PT/h, two YK 1200RT/h, and four 1500RT/h steam bromide lithium
- three 30t/h gas boilers and one 20t/h as stand-by for heat supply.

It was installed and put into trial operation in the end of 1999, but can not economically run till June 2002, because of lower power load (2 MW) from this Airport. By connecting more electricity users around the Airport to this Centre, the system can run at 70%-80% of rated power and longer operation hours, electricity cost dramatically dropped from over 4 BMB yuan (approx. 0.483 US\$) to 0.68 RMB yuan (approx. 0.082 US\$) that was cheaper than average electricity price from the grid. The system has gradually realised economic performance of trigeneration in the last tow years, especially in winter and summer.

Economic and efficient operation of this energy system is directly influenced by following factors:

- **Grid connection:** Due to no special codes and specifications for CHP/trigeneration available now, power companies/distributors reject grid connection of CHP/trigeneration units with many technical reasons, such as safety and reliability etc. In this case, the system didn't connected to the grid in the firs two years. With coordination by local government, the power company approved grid connection, with prerequisites of no power sale to the grid from the system etc.
- **Supply pressure of natural gas:** natural gas used in Pudong District of Shanghai comes from the East China Sea. During the period of design, 25 kgf/cm² of gas pressure is guaranteed by local natural gas company, but it is less 7□8 kgf/cm² in practice, which can not meet gas pressure

need by the gas turbine. Because no compressors in the system, light diesel was used when gas pressure was low, which led to poorer economic performance.

- **Price of natural gas:** although the natural gas company offers a preferential price to this system, but the price of 1.9 Yuan/m³ (which is just less than that for residential use) is still high. The advantages of this system cannot be highlighted under such kind of circumstance.
- **Electricity tariffs:** According to peak and off-peak electricity tariffs in Shanghai (0.889 yuan/kWh for peak, 0.30 yuan/kWh for off-peak, and 0.632 yuan/kWh in average, before 2004), the system can economically operate at average electricity tariff and up, so operation time was shortened, but back-up boilers run for supplementary steam in the off-peak condition in summer and winter.

4.1.2 Huangpu Central Hospital of Shanghai

The area of this Hospital was 30000 m², with 450 beds. A trigeneration system was designed with 3000 kW of rate capacity and 5.5t/h steam heat load (cooling and hot water included).

This is one of the earliest trigeneration system fuelled with urban gas in China, it was put into operation in March 1998, and ran for 8000 hours. Because of less experiences, the rate capacity of this system was designed higher than real power demand (only 300-400 kW) of this Hospital, the gas turbine ran only at lower load condition, which resulted in insufficient steam supply and needed for back-up boiler. Together with discrimination from the grid with lower interconnection electricity price, the system is of poor economic performance, and finally closed down.

4.1.3 Minhan Hospital of Shanghai

The area of this Hospital was 53506 m², with 600 beds. A trigeneration system was equipped with 400 kW natural gas engine generation unit and a heat exchanger, and gas-fuelled boilers to supply steam for sterilization, cooling in summer and hot water and space heating in winter.

In a word, the cases in Shanghai are pilots of CHP/trigeneration projects in China, but many problem and barriers in Pudong International Airport case existed similarly in others.

4.2 Cases in Beijing

For Olympic Game 2008 Beijing, it is significant for Beijing to improve environmental quality. Use of clean energy is one of fundamental solutions to air pollution, i.e. increasing the shares of natural gas and electricity in Beijing energy mix.

Since 1997, Beijing has been supplied with natural gas from Shannxi-Guansu-Ningxia in the northwest of China. Till 2001, natural gas supply increased to 17900 million m³, among which 51% was directed combusted for spacing heating in winter. As a result, big difference between of peak and off-peak load of gas pipeline in winter and summer happens, large scale storages were built and led to higher cost of gas. Questions raised are how to rationally and efficiently use natural gas and ensure reliability of energy supply in Beijing. Till 2008, gas supply to Beijing will be 5000 million m³ annually. Trigeneration is an alternative of supplying electricity, heat/cooling at on-site level, such as office, commercial and residential buildings, and relieving load of power grids as well as balancing pipeline load.

At present, two trigeneration systems were respectively installed in Control Centre of Beijing Natural Gas Group, Ciqu Natural Gas Distribution Station in Beijing detailed below.

4.2.1 A Case in Control Centre of Beijing Natural Gas Group

The Control Centre of Beijing Natural Gas Group has 32000 m² of building area, with 10 stories. It is forecasted that power load ranges from 100 to 1000 kW, cooling load from 500 to 3000 kW, and heat demand from 550-2700 kW.

According to load of electricity, heat/cooling in this Centre, a trigeneration system was designed, and equipped with

- One unit 480 kW and one unit of 725 kW of gas internal combustion engine
- One unit BZ100 and one unit BZ200 waste heat direct fired absorption chillers to meet the demand of heat and cooling.

4.2.1 Other Cases

- A trigeneration in Ciqu Natural Gas Distribution Station, which has 3000 m²

of building area, was designed with one unit of 80 kW Bonman gas turbine and one unit of BZ20 waste heat direct fired absorption chillers.

- Zongguancun Software Plaza of Beijing has 57630 m², with 900 kW of basic power load, 2690 kW of heat demand for space heating and hot water in winter, and 3489 kW of cooling demand in winter. Based on the principle of “grid connection without output of electricity”, a trigeneration system was designed with 1200 kW of gas turbine, and direct-fired absorption chillers as well as back-up units.

5. BARRIERS ON CHP/TRIGENERATION IN CHINA

Although Chinese power industrial sector is now undergoing reform on liberalising power market, its monopoly status remains unchanged to certain extent, and there is another monopoly of natural gas formed in China in recent years. Hence, barriers on CHP/trigeneration exist, in relation to less public awareness, incentive policies and instruments, advanced technology and equipment manufacture, and relations with power grid and gas pipeline networks, energy pricing etc.

5.1 Less Public Awareness

At present, Chinese public is still less awareness on advantages of CHP/trigeneration, including governmental decision makers, industrialists, designers and potential users etc. CHP/trigeneration is not easily accepted by market, particularly power companies and natural gas companies, while promotion and penetration into the market.

5.2 Incentive Policies and Instruments

To promote CHP development, Chinese government had formulated a number of CHP incentive policies, in following laws and regulations:

- “Measures of Encouraging the Development of Small Cogeneration and Strictly Limiting the Construction of Small Condensing Thermal Power” (JZY□1989□No. 937).
- “China 21st Century Agenda” issued on March 25, 1994.
- Article 39 of “Energy Conservation Law of People's Republic of China” into force 1998.
- “Regulations of Developing Cogeneration in China” formulated in 1998 (JJN [1998] No. 220), and revised in 2000 ([2000] No. 1268).
- “Air Pollution Control Law of People's Republic of China”, and others.

But in practice, there are difficulties of grid connection due to lack of specified and operational provisions in legislative document and regulations and rules concerned, and poor economic performance resulted from higher gas price and externalisation of environmental cost etc.

5.3 Technical Issues

CHP/trigeneration is a mature technology in the world. But the barriers in technical aspect still exist in China as follows:

- **Difficulties in design.** In China, there are no special norms and standards for design, selection of equipment, and operation modes of a trigeneration system, those for thermal power plant are taken as references. And load data of a variety of building are not available yet, inaccurate load analysis might lead to unreasonable design in system capacity and selection of equipment. The lessons in Shanghai cases indicated that higher installed capacity (than real power load) led to poor economic performance of a system.

The design should be flexible through computerization and modules, to fit with difference in terms of geographical climate, demand of power and heat/cooling, and supply of local power and natural as well as energy prices and so on.

- **Intelligent control.** Contrary to thermal power units, CHP/trigeneration systems consist of different facilities for electricity and heat/cooling, coupling of which is significant to better performances of system. The load of systems is varied frequently by seasons, by day and night, by working days and weekend, even by hours. Therefore intelligent control on system is necessary, but not available in existed projects. Additionally remote control can also reduce manpower on duty and cost.

5.4 Connection of power grid

According to “Regulations of power supply and utilization of China”, self-provided generator connected to power grids should be permitted by the power distributor. So that CHP/trigeneration units were rejected to be connected with power grids by the power company, due to following reasons:

- Unsafe to power grids.
- No technical codes on CHP/trigeneration units available

At present, CHP/trigeneration units connected to power grids are not permitted to sale electricity to the grids, or at lower prices, which has make the design not to be based on useful heat.

5.5 Price and supply pressure of natural gas

With the completion of gas transmission pipeline from West to East China, the average price of natural gas is 1.27 yuan/m³ (approx. 0.12 euro/ m³), and portal prices at different municipality and provinces along this pipeline vary with transmission distance from West China.

Comparison with world average level, price ratio of natural gas to coal is about 3-4 in China, but about 1.2- 1.5 in USA and EU, about 2.5 in Japan. As a result, natural gas-fired units are less competitive than coal-fired units, while environmental cost is not internalised and no preferential policies on natural gas-fired CHP/trigeneration.

In many cities, natural gas pipelines are of low pressure that cannot meet requirements on gas inlet pressure of gas turbines (but increase of gas pressure by compressors will further rise costs of investment and operation), although internal combustion engine is applicable.

5.6 Manufacture of equipment

A CHP/trigeneration system consists of gas turbines /engines, waste heat boilers, steam turbines, compression chillers, absorption chillers, and storage of heat/cooling as well as control facilities, among which manufacture of gas turbines in China is technically backward to advanced level in the world. At present, gas turbines for CHP/trigeneration projects were imported abroad, which is one of factors on higher cost of the system, and timely maintenance and supply of spare parts are also problems. Localization of equipment production and supply is a tendency, with the development of CHP/trigeneration in China.

6. POTENTIAL COUNTERMEASURES

6.1 Potential Market of CHP/trigeneration

6.1.1 Resources of Natural Gas in China

In China, resources of natural gas are about 38 Tera cubic meters, 13 Tera cubic meters of exploitable reserves, 2.24 Tera cubic meters of the proved reserves. It is forecasted that natural gas supply will be 65-80 billion cubic meters, totalling 40–50 billion cubic meters of inland NG production capacity and 25-30 billion cubic meter of piped NG and LNG from sea and imported from neighbour countries in 2010.

There are a gas pipeline from Shannxi-Gansu-Ningxia to Beijing and its adjacent Tianjin and Hebei province, another gas pipeline crossing 10 provinces and autonomous regions from Nalun of Xinjiang in West China, to Shanghai in East China, as shown in Figure 2. Besides, LNG is imported from abroad to South China, e.g. Guangdong and Fujian province.

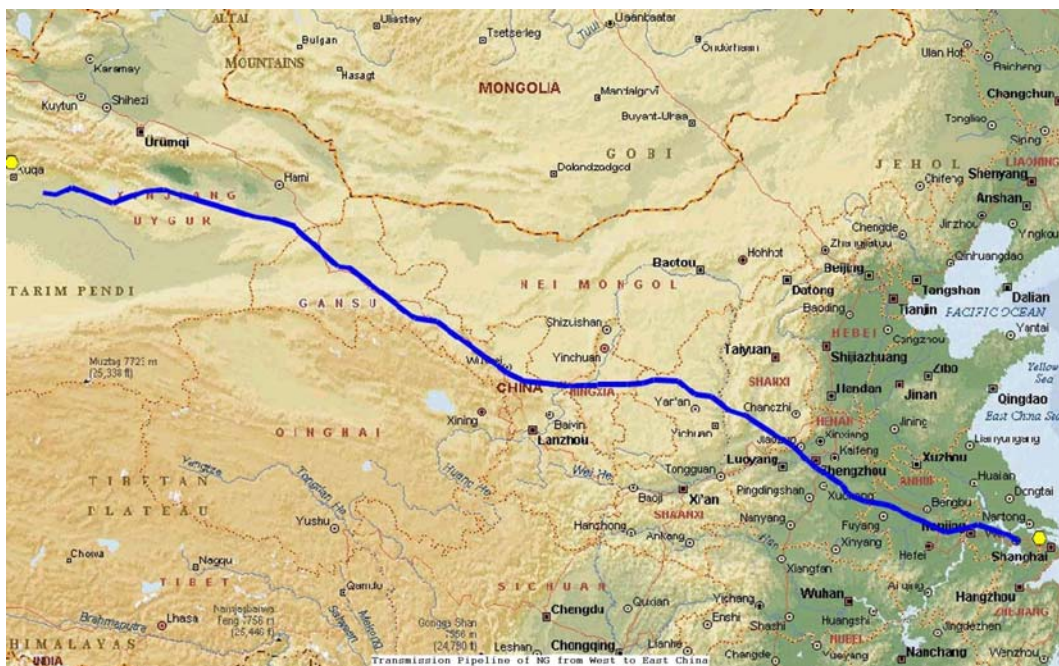


Figure 2 The Route Map of Natural Gas Transmission Pipeline from West to East China

6.1.2 Potential market of CHP/trigeneration in China

In China, there is almost 400 million of population lived in 664 cities, booming of real estate industry in urban creates potential market for CHP/trigeneration in

commercial building and residential zones.

it is foreseen that key potential markets for natural gas-fuelled CHP/trigeneration are located in :

- Beijing and Tianjin.
- Regions in the Yangtze River Delta, including Shanghai, Jiangsu and Zhejiang Provinces etc., where direct coal combustion is now forbidden in many cities. These regions are “hot in summer and cold in winter”, the period of spacing heating and cooling is more than 6 months, even extra 10 months.
- Regions in the Pearl River Delta.

6.2 Potential Countermeasures

6.2.1 Policy making

To promote CHP/trigeneration, it is necessary for Chinese government to formulate operational incentive policies, regulations, and standards etc.:

- **Policies of grid connection.** CHP/trigeneration connected to power grid is technically feasible and safety on the grid, but codes/standards related should be formulated,
- **Preferential price policies** in related to natural gas price and electricity tariff to the grid both of which are important factor to economic performance.
- **Environmental policy** is formulated to encourage application of advanced technology and use of clean energy, such as charge of pollutant emission and tax on coal and so on.

6.2.2 Principles and codes for design

According to practical experience and lessons in those projects mentioned above, the research on principles and codes of CHP/trigeneration feasibility study and design, even installation as well as operation management should be done, and regulations and rules related are needed to be worked out, based on investigation on exited pilot projects in China and best cased in the world.

6.2.3 Strengthen R&D

Although CHP/trigeneration is a mature technology, CHP/trigeneration system

integration, intelligent control and manufacturing of core equipment etc. are weak points in China, R&D should be strengthened through cooperation, technology transfer and capacity building.

6.2.4 Establishment of ESCO's

Good performances of CHP/trigeneration system are greatly dependent on optimal design, integrated installation and operation & maintenance as well as service after sale. Financing is also important to success of a project. ESCO's is professional in promotion of CHP/trigeneration, and Establishment of ESCO's will be beneficial to raise CHP/trigeneration market in China.

6.2.5 Localization of equipment production

To reduce costs of investment and operation of a CHP/trigeneration system, local production of equipment and auxiliary devices are needed, through introduction of foreign investors into China in forms of wholly-invested, cooperation and joint venture etc., to building manufacturing capacity of quality CHP/trigeneration equipment in China, and create production bases in China.