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FINAL REPORT

April 2002

Major Barriers and Recommendations to Cogeneration Development in China

Project: Accelerating Industrial Cogeneration in China – Planning Grant (FI/CPR/01/187)

U.N Implementing Partner:	United Nations Industrial Development Organization (R. Williams)
Associated Implementing Partners:	China Energy Conservation Investment Corporation (Wu Xiaohua, Guo Jiang, Xie Zhengwu)
	International Cogeneration Alliance (Michael Brown)
	EcoSecurities Ltd. (Veronique Bovee)

Funded by the United Nations Foundation in cooperation with United Nations Fund for International Partnerships

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Contents

Part 1: Introduction

1. Background

This investigation is a component of the UNF-funded Planning Grant "Accelerating the Introduction of Cogeneration in China", coordinated by UNIDO. The China Energy Conservation Investment Corporation (CECIC) provided cogeneration experts for the project. The Beijing Center for Energy Efficiency and Environment (BCEEE) organized activities of the international mission in China and took charge of the outcomes and preparation of the report.

2. Mission Activities

The international team (Robert Williams (UNIDO), Veronique Bovee (EcoSecurities), and Michael Brown (International Cogeneration Alliance), met with Chinese expert team composed by Ms. Wu Xiaohua, Mr. Guo Jiang and Mr. Xie Zhengwu from CECIC from Nov. 15 to Nov. 25, 2001. The mission held meetings in Hangzhou and Beijing. In Hangzhou the mission joined a cogeneration plant workshop to facilitate understanding plant level issues. Meetings with SDPC, SECT, SPC, MoC, the Chemical Sector, the Energy Foundation as well as with the Climate Change Coordinating Office of SDPC were held during the mission.

Twenty representatives participated in the cogeneration workshop in Hangzhou. All participants were experienced in cogeneration and representative of a broad range of interests. They included governmental officials, regional and industrial cogen industry representatives, as well as design professionals. The list of the Chinese participants is attached to this report.

In Beijing, meetings and discussions were held with the representatives of STEC, SDPC, MoC, Power and Economic Research Institute of the State Power, Energy Foundation, as well as the chemical industry.

This report includes a conclusions from the mission and further analysis of the barriers to cogeneration development in China. It constitutes a basis for future development of the main project.

Part 2: Major Barriers to Cogeneration Development

1. Grid Connection

Government document "Jijichu[2000]1268" issued by the State Development Planning Commission, the State Economic and Trade Commission, the Ministry of Construction as well as the State Environmental Protection Administration, regulated the concept and the favourable operating conditions for cogeneration units in China.

It requires that electric power, generated by the additional capacity of heating supply plants should be permitted to be connected to gird and exempted from grid connection fees. Electric power and grid management authorities are not to restrict the heating supply from cogeneration plants in the responses to limited electric power demand, and should not oblige cogeneration plants to decrease temperature and pressure when supplying heat.

In the process of enforcement of this policy, anomalies appeared due to the sector interests of electrical power company, which forms a barrier for cogen development. The problem can expect to be partly resolved with the deregulation of electrical power sector. In general, the problem appeared from following aspects:

1.1. Direct Distribution

Currently, the agency responsible for management of the electrical network can ask cogeneration plants to first connect to the grid. The industrial hosts for the cogeneration plants are then required to buy the electricity from the grid. Because the power tariff was controlled by the electrical sector, the price of buying is usually higher than the price of selling. Hence, the energy cost of the industrial host increased and the electrical power was wasted by transmission and distribution through the grid. If an industrial host does not agree to this stipulation, the power sector can ask the host company to disconnect from the grid which then influences the security of power supply of the company. This situation has become a barrier for the development of self-use cogeneration.

1.2 Grid Connection

Since most of the cogeneration plants in China were constructed by local government and industrial enterprises rather than by the power sector, there is a conflict of interests between the cogen plant and the power sector. Self-supply of power means loss of power sector customers.

Influenced by the financial crisis of South East Asia and the deflation of the Chinese economy around 1998, some regions in China appear to have surplus generating capacity in the past 2-3 years, which limited the amount of power generation from cogeneration plants. In some plants, annual operation hours have been restricted to as little as 3000 hours per year reducing economic benefits.

Since the design of cogeneration units is based on the heat to power ratio it is technically difficult for them to adjust to peak electrical load. Obligatory peak load adjustment causes the decline of security for cogen units, difficult production and operation, and a drop in economic benefits.

1.3 Grid Connection Approval

According to government regulation, documented approval by the power sector on grid connection for newly established cogeneration plant is a necessity for the approval of construction. Due to sectoral interests of the power sector it can take half to one year to secure the necessary documents (or grid connection agreement). This is a problem related to power sector reform.

2. Heat System Planning

The construction of regional and district cogeneration plants is closely related to municipal development. Approval of cogeneration plant construction requires a city heating plan to be in place. However, there is no national standard for heating plans. Some local governments pay great attentions to a heating plan, others do not. Some regions and cities have comprehensive and detailed heating plans and some haven't. This situation is also influenced the historical development of cogeneration in different regions.

On occasions, even when a heating plan has been formulated, the enforcement of the plan still needs to be strengthened. For example, some heating boilers are still in operation in areas served by the heat network even when a cogeneration plant has been built in that area.

3. Financing Cogeneration Projects

Cogeneration plant construction is undertaken within the context of civil infrastructure projects which means the economic benefit cannot be very high. This is responsible for difficulties with financing.

Cogeneration developed rapidly in the 1980's in China, however, technical and management problems caused low economic benefits and low recovery rate of commercial loans. At present, commercial banks are cautious about releasing loans to

small-scale cogeneration projects.

Restricted by the ratio of heat to power, the scale of cogeneration projects is small compared with other projects submitted to banks for financing. Banks usually ask for pay back period 6 years for small project and 10 years for large project.

It is easier to get loans from banks for large cogeneration projects with single unit capacity equal to or larger than 100 MW. It is also easier to get loans for self-use cogeneration with single unit capacity 25MW, 50Mw or even smaller if the host industry is in the petrochemical sector where the heat load is big. For industrial sectors where there is fierce competitive, it is hard to get commercial loans.

For regional cogeneration plants, which supply heat mainly to residential users, financing for construction is especially in short supply although the demands of dismantling small, polluting boilers and improving environment are quite urgent. The main difficulty of getting loans from banks is securing guarantees.

4. Natural Gas As Fuel

The use of gas as fuel is still beginning in China and there are several factors influencing the use of gas as the fuel of cogeneration.

4.1 Availability of Natural Gas

China is not rich in gas resources which are distributed in the west and along the southeast seashore, mainly in Xinjiang Autonomous Region, Inner Mongolia, Shi'anxi, Qinghai, and Sichuan provinces. Because of limited resources, the guiding principle for gas utilization is to satisfy residential users first, then for industrial use and power generation has the third priority.

Natural gas in Shanghai and southeast China comes from the pipeline project "Transportation of gas from west to east". Beijing, Tianjin and North China get gas from Shi'anxi. Gas from the Sichuan basin is transported to central China, and imported LNG supplies Guangdong province. This means that Beijing and the Tianjin area, the Yangzi River Delta region and Pearl River Delta region will be the main areas for the large-scale utilization of natural gas, especially in industrial cogeneration.

4.2 Gas Price

Currently, the cost of burning gas for heating is four times higher than the cost of burning coal, which greatly impacts the large-scale utilization of gas. It will be hard to expect the use of gas as fuel of cogeneration if there are no favorable policies encouraging the use of clean fuel for cogeneration.

4.3 Characteristics of the Gas Turbine

The gas turbine generator has the characteristics of fast start-up and stop and is suitable for use in power peak adjustment. . Although it is difficult for cogeneration combined cycle units to undertake power peak adjustment, the power sector still asks cogeneration plants to join in peak adjustment operations.

4.4 Utilization of Micro-gas Turbines

Micro-gas turbines are a very new technology in China. There will be a large market for the adoption of 1MW turbines in hospitals, supermarkets, hotels, airports as well as in schools. It is still in the demonstration phase and there are no relevant policies issued in China yet. Personal training, dissemination of technical information also need to be facilitated.

5. Internal Management of Cogeneration Plants

Most of cogeneration plants are state-owned-enterprises, constructed by local government, industrial hosts or local enterprises. Plant Managers lack experience of management and expertise with the technology. Many plants have the burden of excess labour, for instance, there are about 800-1000 staff in a cogen plant with capacity of 212MW units and 375t/h boilers. Shortage of technical guidance and innovation is another problem.

6. Technical Problems

Technical problems faced by cogeneration technology include:

6.1 Environmental Impact

Although cogeneration is an energy conservation technology, the cogeneration plant itself still has environmental problems caused by coal burning, in particular, emissions of SO2 and NOx. Currently, there is no desulfurization technology applicable for medium and small sized units.

6.2 Manufacture of Equipment

There are no major problems with the design and manufacture of the core parts of coal-fired cogeneration units.

After long development, China can design and manufacture the main components, but the quality of peripheral components needs to be improved.

Gas fired units with capacity equal or larger than 50MW mainly rely on imported technology. The high price increases investment and operation costs.

6.3 Technical Promotion

As mentioned above, many regional and self-use cogeneration plants were financed and constructed by local governments and enterprises with no cogeneration management experience. The power sector has no responsibilities for technical service and management for plants. This prevented access to advanced technical information. In this aspect, China's "Cogen Study Committee" plays a role in technical information exchange between Chinese cogen plants, but only about 30% of cogen plants are members.

Modern cogeneration technologies disseminate slowly in China due to lack of financial support from government for the demonstration of new technologies and the lack of a non-commercial organization to promulgate and promote the deployment of new technologies.

7. Pricing Mechanism for Heat and Power

This is a major issue throughout China among the cogeneration community.

7.1 Market Price and Government Price

Currently the prices of fuel are completely market oriented while the prices of heat and power from cogeneration are still government controlled, causing the reduction of competitiveness of cogeneration plants. For example, the price of coal increased 20-40% since the beginning of 2001, (50% in some places), but heat and power prices connected to grid did not increase. This lowers the economic benefits of cogeneration plants. In this context, cogeneration enterprises hope to adjust heat and power prices but governments would like to keep the prices unchanged.

7.2 Cost Accounting and Pricing of Heat and Power

Under China's planning economy, cogeneration plants did not seriously consider and calculate costs for the delivery of heat and power. Prices of heat and power were determined by the government. Currently, sales of power to the grid must be competitive and heating faces competition from other heating sources. Cogeneration plants now have to think about cost accounting and formulation of heat and power prices.

Currently the grid connection power price is usually higher for cogeneration than the price of electricity generated from thermal power stations with the same capacity. After power sector reform is complete all power generators must sell electricity at competitive prices. Cogeneration plants will have to reconsider the cost of electricity and formulate a reasonable price mechanism.

Cogeneration plants consider the formulation mechanism for heat prices to be unreasonable. The heat price is lower than it should be. Plants want to increase heat prices. Many have to compensate the losses caused by low heat prices from electric power sales. However, heating companies and consumers think the heat price is already high and are opposed to price increases.

Cogeneration plants usually sell heat to heating companies in GJ, while heating companies sell heat to end users according to square meters of heating area. There is no universal exchange method between these two calculating units.

In China, both the price of electricity and heat are set by government and vary dramatically in different areas due to different ways of calculating the costs of electricity and heat in cogeneration plants. No national standards have been formulated and issued in this regard.

8. Policy Issues

Preferential policies of government have had great influence on the development of cogeneration. In the 1980's, the Chinese government delivered a series of favourable policies to cogeneration projects, including appropriation of funds, favourable loans, derrating and exempting tax, as well as favourable grid connection arrangements. Cogeneration developed fast in this period but later declined with the annulment of these policies and regulations.

After 1998, cogeneration in China entered a new era with the issue of polices favourable to its development. Recently, the number of new projects approved by SDPC has exceeded the number of new thermal power projects.

8.1 Preferential Policies and Power Sector Reform

Although specific procedures for power sector reform are still in formulation, the basic guideline, "Separating power producer from grid and connecting to grid based on price competition", is already decided and will be followed and enforced in the coming 2-3 years. Since the capacity of cogeneration units is determined according to the heat load, the capacity of a single unit is usually smaller and the parameters are lower than for a thermal power unit. This will influence the competitiveness of cogeneration plants in the context of power production after the reform. In this regard, cogeneration should be considered to be an energy saving measure with attendant environmental benefits. Environmental costs should be considered and government

should formulate preferential policies for cogeneration which internalize environmental costs.

However, government considers district heating to be a monopoly market already allocated to cogeneration and thinks that the industry should not ask for additional preferential conditions. In government's opinion cogen plants need first to improve their management efficiency and improve their own competence to adjust to the new market. Even following power sector reform, cogeneration should still be in favourable position owing to the high overall efficiency of energy utilization.

Some officials of SDPC consider it difficult to give preferential policies to cogen from the tax aspect, but government could consider some supportive investment measures, favourable interest loans, etc. In addition, if power prices from cogeneration could be considered as "green power" price could also be submitted to SDPC for consideration.

8.2 New Project Approval

Representatives of cogeneration plants will argue that approval procedures are complicated and, it is possible for approval to be refused even when construction funds are available. On the other hand, government thinks that the main obstacle is not the approval procedure itself but the opinions and the agreement of related government agencies, such as the power sector, water supply agency, and environmental protection agency. As long as the proposed project is in line with the regulations and the definition of cogeneration has secured agreement for grid connection and environmental impact assessment, then approval of the project is not a problem. It appears that the SDPC will simplify application and approval procedures for cogeneration projects. This should play an important role in the development of cogeneration in China.

8.3 Construction of Heating Networks

The construction of cogeneration plants and heating networks is required to be in accordance with the overall municipal development plans, consequently, the construction of heating networks is related to different sectors, such as civil construction, transportation, water supply, communication, heat supply, as well as end users. Local governments need to have the responsibility to negotiate and solve conflicting interests during the construction of heating networks.

Some cogeneration plants agree that a heating network is, in nature, a part of infrastructure construction of a city, and government is obligated to support the construction of the heating network. It is too hard for a single cogen plant to construct its own heating network.

8.4 Ownership of Cogeneration Plants

Many cogeneration pants were constructed by local governments and enterprises. With the deepening of economic reform, some plants undertook reform in ownership in ways differing from region to region. It is believed that the reform of ownership of cogen plants will bring positive impacts to the development of cogeneration in China.

Part 3: Conclusions and Recommendations

Conclusions

During the mission, numerous barriers were brought to the team's attention by Chinese cogeneration experts already involved in specific projects and activities which could help China overcome some barriers.

Although the relevance and importance of the barriers are different from region to region and change with time, the main barriers can be concluded generally as followings:

1) Grid connection problems;
2) Heat system planning and construction;
3) Financial issues;
4) Price and technical issues related to natural gas as fuel;
5) Internal Management of cogen plants;
6) Cogen technology promotion;
7) Pricing for heat and power; and
8) Relevant policy issues.

Among these, grid connection will soon be solved with the reform of electric power sector, with the implementation of "Separation of grid and power producer, and connect and sell electricity on price competition". The reform has already started in China. Heating system planning and construction will also be opened to both domestic and international investors with both public and private natures according to the recently issued government document on the guidance of foreign investment. While, establishment of a stable and smooth channel for financing cogen projects and a guarantee mechanism for the funds is a problem to be considered. Using natural gas as fuel related to both policy and technology issues, it needs the supports of price policy and relies on the upgrading of cogen technology. Internal management mechanism of cogen plants will be hopefully solved with personal training and the involvement of private sector. The introduction and deployment of modern cogen technology plays key role to the upgrading of level of cogen technology in overall and to the direction of China cogen development. Pricing of heat and power is a policy issue and will based on the study and research on the situation of China economic reform and power sector reform.

In general, the problems could be sorted into policy issue, technology issue, and financial issue. Preferential policies and awareness raising are important for the creation of an active and healthy investment environment for cogeneration development. Financing and correct selection of cogen technology are the key factors

for China cogen development. The three factors are the main problems fronted to us which are ranking top of the others.

Recommendations

In view of above analyses, following recommendations are proposed for the reference of government and interested international funding organizations.

1. Establish China Cogeneration Development Center.

The mission of the center is (1) to carry out cogen related policy research, provide government policy recommendations, (2) to explore the potentials and operating model of cogeneration service company in China and to facilitate the formulation of cogen based ESCO in China, and (3) to act as a cogen CDM project center (or clearinghouse).

In particular, the center will keep close and good relations with cogeneration authorities in several government agencies in order to express its opinions and make recommendations to government officials. The ultimate objective of the center is to create an active investment environment for foreign capitals and technologies for cogen development in China. The center will operate in market way.

Policy study and research. Specifically, the center is hoped to conduct following policy related tasks and activities:

1) Pricing mechanism study on heat and power (connected to grid) of cogeneration under the circumstance of power sector reform;
2) Market assessment and feasibility study on mini-CHP technology in China.
3) Formulation of China National Cogen Development Plan to the year 2010.
4) To carry out studies on the price of natural gas in order to recommend government encouraging the efficient utilization of natural gas, like the use of gas in cogeneration.

Facilitation of cogen ESCO. To explore the potentials and operating model of cogeneration service company in China, the center will carry out following activities:

1) Create awareness among potential Chinese and foreign investors about the ESCO potential in China and provide business development support for starting ESCO companies;
2) Developing CDM procedures for cogeneration ESCO projects and facilitate the submission of ESCO projects in the CDM;
3) Assist in the mobilization of other sources of commercial and soft finance for ESCO enterprises;
4) Focus on tackling the institutional, policy and price barriers for the ESCO market such as raising awareness among utilities, government departments, local

governments and industry and enthuse them to participate with ESCOs;
5) Provide capacity building activities and training courses for ESCOs and other relevant stakeholders.

With regard to CDM, the Centre could facilitate in the development of cogeneration activities as CDM projects by bundling projects and develop standard procedures in order to reduce transaction costs. These procedures could be developed based on the experience gained by the Centre from the first pilot projects. It is envisaged the Centre will carry out following tasks with this regard:

1) Bundling of projects, could be from individual projects as well as from one or more ESCOs, or an ESCO with one or more individual projects;
2) Develop standardized guidelines and Handbook for cogen project developers, including a list of information they need to provide, required for the CDM.
3) Centre acts as the focal point the Chinese CDM projects, rather than each individual company or organization.
4) Ideally, Centre develops a standardized baseline (benchmark), which is applicable for cogeneration projects in China, and approved by the Chinese authorities for climate change.

It is recommended to develop the guidelines and standards in close consultation with the Chinese CDM office and other parties that have been involved with the development of pilot CDM projects in China so far (i.e. CRE, Renmin University, SDPC, etc.).

2. To set up cogen-based ESCO(s).

Energy Services Companies (ESCOs) are most often private companies that provide energy efficiency or load reduction services to customers that own or operate facilities such as factories and buildings. Considering the purpose and services of ESCOs in general, it is likely that ESCOs can address the following, regarding the barriers identified during the mission to China:

1) Connection to the grid
2) Guarantee energy supply to customers
3) Obtain or arrange financing
4) Assist in project management (see barrier)
5) Develop Joint Venture with client company to execute cogeneration
6) Assist in monitoring of project performance and maintenance of efficiency measures
7) Training
8) Facilitate the deployment of modern cogeneration technology.

ESCO and CDM

With the existence of the Kyoto Protocol and opportunity to claim credits for certain energy saving activities, the incentives for energy saving activities have increased. The business case for ESCOs may thus become more viable. However, the CDM will only positively contribute to cogeneration projects and ESCOs if the transaction costs are not too high.

Especially for small to medium size energy efficiency projects the transaction are expected to be relatively high compared to the carbon revenues. Firstly, because baseline development will be rather complex as it involves two steps, a baseline for the specific projects and a baseline for the ESCO as well as an electricity baseline and a heat baseline. Secondly, both components will have to be monitored and for the that component , monitoring can be quite complicated. Bundling projects and streamlining procedures and modalities for developing CDM projects might overcome this barrier. When streamlining procedures the focus could be to standardise a baseline for cogeneration projects in China as well as to standardise procedures for developing a heat baseline and monitoring of emissions. ESCOs seem to be the ultimate solution to address both issues (bundling and streamlining) and can thus contribute in reducing transaction costs of developing cogeneration projects as CDM projects. This will be successful in case an ESCO manages various cogeneration projects.

List of Participants in Hangzhou Cogeneration Workshop

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