Where China is headed

Energy and environmental issues

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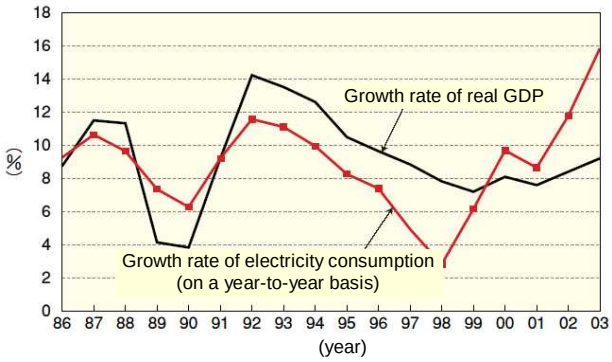
Rapidly increasing energy consumption and serious air pollution

Energy shortage

China's GDP grew at an annual rate of 7-8% from 2000, at 9.1% in 2003 and at 9.5% in 2004, respectively. As GDP increased, energy demand rapidly rose. Measured on an electricity demand basis, demand for energy showed a year-on-year increase of over 10% from 2001 and14.9% in 2004. The year-on-year increase is expected to rise to 13%. (Source: China Electricity Council)

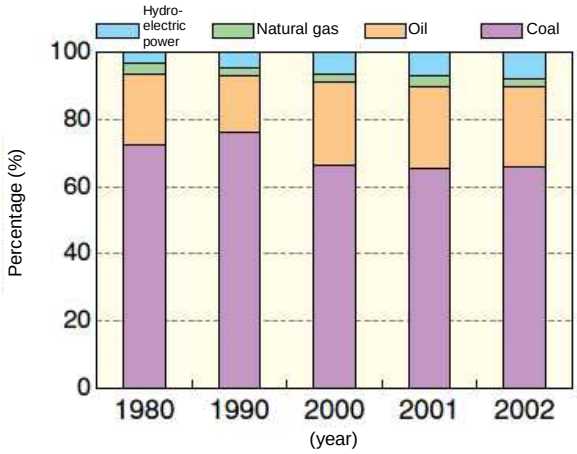


Source: Mizuho Asia Insight: Increasingly serious power shortage problem, Mizuho Research Institute, July 23, 2004

Figure 1 Growth rate of electricity consumption and real GDP in China

China's energy consumption in 2002 was 1.02 billion tons in crude oil equivalent, accounting for 10.8% of total world consumption and 34.1% of Asia's, respectively. It also corresponds to just twice Japan's consumption. (BP Amoco Statistical Review of Word Energy, 2003) Viewing the structure of energy consumption by source, coal, oil, natural gas and hydroelectric power account for 66.1%, 23.4%, 2.7% and 7.8%, respectively, indicating that the rich reserves of domestic coal are the main source of electricity. (China Statistical Abstract)

The energy problems confronting China can be categorized as (1) effects of supply shortages on the socioeconomy, (2) problems with energy use and (3) environmental problems.

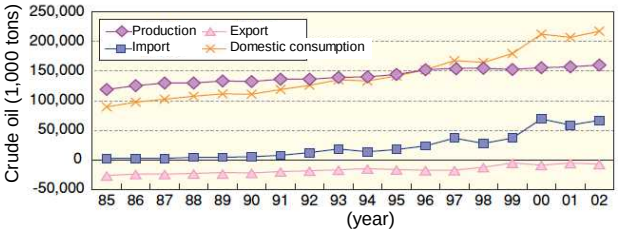


Source: China Statistical Abstract

Figure 2 Structure of energy consumption by source in China (Percentage by consumption)

As regards (1), supplies of electricity were limited in 24 out of 31 administrative regions (provinces, autonomous regions and municipalities) in 2004. The overall electricity shortfall throughout China was about 30 million kW, accounting for 8% of total electric power supply capacity (as of the end of 2003). Crude oil demand exceeded domestic production in the mid-1990s and petroleum imports (including imports of petroleum products) in 2003 were about 100 million tons, a figure comparable to that of Japan and projected to increase by a factor of

two to three in two decades. This is a cause for concern regarding energy security in the future. (The Institute of Energy Economics, Japan) The electric power shortage is attributed to various causes, including delays in plant power plant construction, undeveloped distribution networks and shortages of coal due to accidents at coal mines, the closure of small-scale mines that gave rise to environmental issues and inadequate capacity to transport coal by rail.



Source: APEC Energy Database

Figure 3 Supply and demand of crude oil (including NGL and others) in China

As regards (2), energy utilization efficiency is not very high. The energy consumption per unit of nominal GDP (in 2000) was 8 times that of Japan and 3.8 times that of the U.S., respectively. In addition, 60% of energy consumption is by the industrial sector, which seems largely due to delays in the reordering of the industrial structure and technical innovation. (The Institute of Energy Economics, Japan and others)

Environmental issues likely to affect Japan

Problem (3) is associated with the fact that the country relies heavily on coal as a source of energy for electricity generation. The burning of coal generates air pollutants such as particulates and sulfur dioxide as well as heat-trapping gases such as carbon dioxide. In addition, coal mine development leads to water pollution and the disruption of ecosystems, while the massive amount of ash and residues resulting from coal combustion becomes a source of pollution.

Photo 1 Air pollution due to a temperature inversion layer (Baotou, Nei Mongol Autonomous Region, in November)

Photo 2 Coal mine (Guizhou Province)

Environmental issues throughout China are fairly serious. As regards air pollution, cities failing to satisfy minimum air quality standards accounted for 65.9% of the 343 cities monitored, or 73.7% on a population basis, in 2002. For example, about 20 million tons of sulfur dioxide is emitted per year, making China the world largest emitter of sulfur dioxide with an output more than 20 times that of Japan. Emissions of heat-trapping carbon dioxide are second in the world after the U.S. and account for about 15% of the world's total. As regards water pollution, more than 70% of the country's top seven

river systems, 75% of lakes and marshes and 60% of groundwater are polluted and unfit for drinking. Water resources per capita are a quarter of the world average. Water is not supplied in sufficient quantity in 400 out of 600 cities in the country. (China Environmental Statistics)

Photo 3 Waste treatment facility at a chemical plant (Henan Province)

Photo 4 Garbage landfill under construction in mountainous area (Guangxi Zhuang Autonomous Region)

Photo 5 Smoke from an aging factory (Yunnan Province)

The problem of energy supply and resulting air pollution in China should be given special emphasis. It is likely to have an effect on the international energy balance and on cross-border pollution affecting Japan and other neighboring countries. Sulfur oxides cause acid rain. The results of a survey suggest that sulfur dioxide emitted in China affects acid rain in Japan. According to the survey, 10-30% of the annual deposition of sulfur oxides in Japan originates in China, reaching more than 60% in the high season. (Acid Rain Monitoring Survey, Ministry of the Environment, June 2004) Emissions of heat-trapping carbon dioxide are large in absolute terms. Taking future economic growth into consideration, emissions are projected to increase, raising concerns about their effect on the entire globe.

Future direction

A variety of measures have already been taken to address environmental problems resulting from the use of coal as a source of energy. These include using coal with a low sulfur content, cleaning the coal, and installing flue gas desulfurization plants. In respect of financial measures, a sulfur dioxide emissions trading system has been implemented on a trial basis in some districts. Considering the fact that about 30 power generation projects were punished for being implemented without the approval of environmental impact assessments in February 2005 and the regulation of environmental monitoring and emission standards violations is insufficient, systems for environmental management need to be strengthened. In particular, in provinces facing poverty and employment problems, the popular idea that regional economic development should come before environmental conservation needs to be changed.

From a medium- and long-term standpoint, the development of clean or renewable energy

alternatives to coal and oil and a shift to an energy and resource saving orientation are required. The Chinese government has just begun to deal with the problems through new schemes and measures: dealing with the former through the utilization of the Clean Development Mechanism (CDM: a heat-trapping gas emissions trading system) of the Kyoto Protocol and the latter through the introduction of a recycling-oriented economic system.

Chimneys disappeared from the town: Introduction of a project

– A district heating project that maintains harmony between energy, environment and resources: a project in Heilongjiang Province with financial assistance received from the Japanese government

Jidong County in Heilongjiang Province

Jidong County is situated in the southeast of Heilongjiang Province and bordered on the east side by Russia. The project site is about 400 km east of Harbin, the capital of Heilongjiang Province, at almost the same latitude as Wakkanai in Hokkaido. The annual mean temperature is 3-4°C, and the temperature falls to about minus 35°C during midwinter. Heating is used for half a year from mid-October until mid-April.

Photo 6 Harbin, capital of Heilongjiang Province. There are many buildings with Russian architecture.

Photo 7 Power generation and central heat supply plant (front view)

Photo 8 Same plant (rear view: coal conveyor)

The central town of Jidong County has a population of 90,000 and covers an area of 6 km^2. As a result of continuing urbanization, the population and area will soon increase to 10,000 and 10 km^2, respectively. Heating is essential in the harsh winter. Individual houses burned coal and in some cases heat was supplied to groups of houses from small-scale coal-fired boilers. There were about 280 small boilers and more than 180 chimneys in the town. Environmental standards were not satisfied because of the massive amount of particulates emitted from the

boilers, causing serious air pollution.

Jidong County has an abundance of coal resources, with a proven reserve of 650 million tons. In 2003, 8.7 million tons of coal were mined. The annual output of coal waste (coal sludge), a byproduct of coal mining, increased to 600,000-800,000 tons. Because coal sludge has a low unit calorific value of just 873 kJ, it was treated as waste and deposited in mines, taking up a huge area of land and polluting water and soil. Further, this waste is self-ignitable and dangerous.

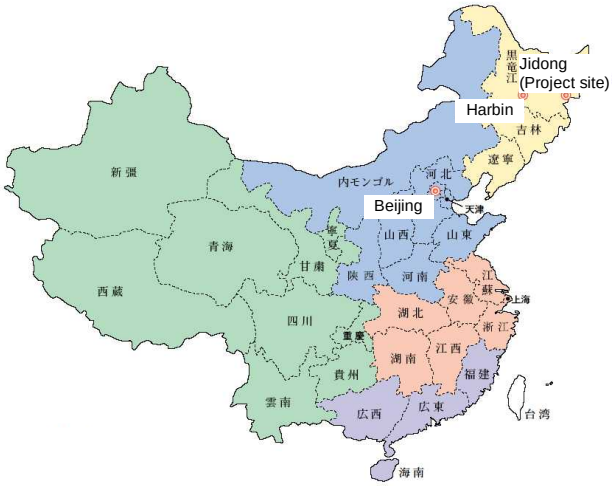


Figure 4

Power generation and central heat supply project

Urbanized Jidong County's solution to all these problems — supplying energy for heating, curbing air pollution resulting from coal combustion and disposing of the enormous quantities of coal waste —is an electricity generation and central heat supply project using coal waste as a source of energy. Coal and coal waste are mixed and burned to generate steam, the steam is fed to a turbine for power generation and hot water condensed from the steam is supplied for circulation in houses, commercial premises and factories.

Annual electricity output is 120 million kW/h (500,000 kW/h a day) and hot water is supplied to an area of about 700,000 m^2, corresponding to more than 50% of residential property in central Jidong County. The total length of hot water supply pipe is about 4 km. Total investment was 270 million yuan (3.5 billion yen).

The project plan was prepared around 1997. After approvals from relevant institutions in Heilongjiang Province, financial assistance from the Japanese government was agreed in 1998. Construction of the plant commenced in 2001 and was completed in 2003. The plant has been operating successfully since then.

Completion of the project allowed 36,000 residents in the central area to receive hot water-based heating services and coverage reached 40%. At the same time, 180 low-efficiency, highly polluting small-scale boilers and 100 chimneys disappeared from the central area.

Photo 9 Central control center of the plan. Plant operators are receiving training during the construction stage of the plant.

The effects of this project on the environment are (1) reduction of pollutants by the elimination of small-scale boilers and (2) reduction of pollutants by desulfurization and electrostatic precipitation in the boiler combustion process at the power generation and central heat supply plant. As regards (1), coal consumption has fallen by 186,000

tons (as base coal), while 3,700 tons of sulfur dioxide emissions and 5,100 tons of particulate emissions a year have been cut. As regards (2), the reduction is 2,000 tons of sulfur dioxide and 3,100 tons of particulates per year. The total reduction in sulfur dioxide and particulate emissions as a result of the project are estimated to account for 30-40% of the total emissions of the county. Tall buildings in the city that could not be seen in the winter due to awful air pollution have recently come into unobstructed view.

As a result of the elimination of small-scale boilers, energy consumption is reduced and about 80% of combusted material is coal waste, resulting in a significant reduction in waste. This is highly effective in terms of resource saving.

Challenges for the future

Some challenges remain to ensure continuing effectiveness of the project. One example is the necessity of assuring the quality of lime used in the desulfurization system. Accordingly, it is important to strengthen management with respect to the process of mixing coal and lime and also to develop human resources and establish a framework for monitoring desulfurization effects. Further, 220,000 tons of clinker and 70,000 tons of fly ash are generated by the plant every year. It will be necessary to study the use of these as a resource, such as the use of fly ash as a raw material in cement.

Assistance is expected from Japan for recycling technology and the development of human resources.