China's Energy Security and Energy Diplomacy

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I. Introduction

In recent years, energy has been a significant consideration in China's economic, foreign and national defence polices. In many ways, China pursues an "oil diplomacy" in its relations with the Middle East, Central Asia, Africa and Latin America. China's military leaders have to plan for the protection of the sea routes following which the bulk of China's oil imports is transported. China National Offshore Oil Corporation's failure to acquire Unocal (no. 9 oil company in the United States) in 2005 was an issue in Sino-American relations much discussed among Chinese intellectuals in which the theme of the "containment of China" often emerged.

In 2003, China surpassed Japan as the world's second largest oil consumer, and since 2000 China has been the source of almost 40% of the world's oil-demand growth. The New China News Agency estimates that by 2020, China will import more than 500 million tons of oil per annum, an almost four-fold increase over 2005; and by 2025 China's oil imports will exceed that of Europe as a whole.[1] Since 2003, oil prices in international markets have been rising rapidly, but high oil prices do not seem to have discouraged energy consumption in China. In 2005, China's energy consumption reached 2.22 billion tons of standard coal, 9.5% higher than that of the previous year. In the same year, China's primary energy production reached 2.06 billion tons of standard coal, achieving a 9.5% increase over that of 2004. Coal production was 2.19 billion tons, a rise of 9.9% over that of 2004; oil production was 181 million tons, a rise of 2.8%; and electricity generation was 2.47 trillion kilowatt-hours, a rise of 12.3%. At the end of 2005, China's electricity-generation capacity reached a historical high of 500 million kilowatts.[2]

This article attempts to examine how China perceives its energy security issues. A survey of the research on energy issues in China's leading academic publications in recent years is interesting because a vast majority of the articles were funded by the Chinese authorities which had a role in deciding the priority of the research questions. This research work in turn has a significant impact on the Chinese leadership through their policy-research teams within the government bureaucracy. This article will then briefly look at the assessment of the energy situation in China and the policy programmes released to tackle the problems. It will analyze the policy programmes and evaluate the overall strategy. This study mainly relies on published data from China to reflect a Chinese view.

II. A Survey of China's Energy Studies

The significance of China's energy security naturally generates considerable research,

[1] Leland R. Miller, "In Search of China's Energy Authority", *Far Eastern Economic Review* 169(1) (Hong Kong), (January/February 2006), p. 39.

[2] Wei Yiming, Fan Ying, Han Zhiyong, Wu Gang, et al., *Zhongguo Nengyuan Baogao (2006) – Zhanlue yu Zhengce Yanjiu [China Energy Report (2006) – Strategy and Policy Research]* (Beijing: Kexue Chubanshe, 2006), p. 286.

mostly funded by the ministries of the central government. This research mainly concentrates on the following areas: a) international relations studies analyzing the relevant geopolitical issues, the securing of oil for China and the associated transportation problems; b) studies by oil and environment experts analyzing China's energy security focussing on China's oil reserves, the ratio of reserves to exploitation, environmental protection, etc.; c) analyses on the oil issue and its impact on China's economy from the financial angle, with special attention to oil prices; d) studies of China's energy enterprises and their competitiveness; and e) economic studies examining China's energy demand and supply, the rational allocation of energy resources among various economic sectors, the establishment of a strategic oil reserve, etc. in order to enhance China's energy security.[3]

At this stage, international relations studies on China's energy security seem to be most developed. As can be expected, Central Asia,[4] major oil exporting countries in the Middle East,[5] and Russia[6] are the foci of attention, while Japan and the United States serve as models for emulation in the formulation of China's energy security policy.[7] These government-funded research projects reflected that the security of China's oil supply, its major supplier countries, and the impact of the policies of the United States and Japan have been the major areas of concern of the Chinese authorities.

As the sharp rise of oil prices is a serious concern in China, Chinese academics have produced substantial research on the trends of oil prices recently.[8] Most of it focusses on the

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[3] Wang Limao and Lang Yihuan, "Zhongguo Ziyuan Anquan Yanjiu de Jinzhan ji Wenti [The Progress and Problems of Resources Security Studies in China]", *Dili Kexue Jinzhan [Progress in Geography]* 21(4) (Beijing), (July 2002), pp. 333-340.

[4] Shi Dongming and Zhang Jinfeng, "Zhongya Shiyou Diyuan Jingji yu Zhongguo Diyuan Zhanlue [Oil Geo-Economy of Central Asia and China's Geopolitical Strategy]", *Xueshu Jiaoliu [Academic Exchange]* 12 (Total No. 129) (Heilongjiang), (December 2004), pp. 64-68.

[5] Wu Lei, "Zhongguo de Shiyou Anquan yu Zhongdong Wuda Chanyouguo de Shiyou Zhengce [China's Oil Safety and the Oil Policies of 5 Mid-East Oil-producing Countries]", *Xiya Feizhou [West Asia and Africa]* 2 (Beijing), (March/April 2002), pp. 58-63; and Yang Guang, "Cong Nengyuan Lianxi Kan Zhongguo yu Zhongdong Guojia de Huli Hezuo [Co-operation of Mutual Benefit between China and the Mid-Eastern Countries: From the Perspective of Energy Connections]", *Xiya Feizhou [West Asia and Africa]* 5 (Beijing), (September/October 2004), pp. 52-58.

[6] Zhang Jianrong, "Zhonge Nengyuan Hezuo zhong de Wenti ji dui Zhongguo de Yingxiang [Problems in China-Russia Co-operation on Energy and Its Impact on China]", *Shehui Kexue [Journal of Social Sciences]* 1 (Shanghai), (January 2006), pp. 59-69; Luo Yingjie, "Eluosi yu Oumeng de Nengyuan Hezuo – Jianlun dui Zhonge Nengyuan Hezuo de Qishi [Energy Co-operation between Russia and the European Union: Its Lessons for Sino-Russian Energy Co-operation]", *Guoji Jingji Pinglun [International Economic Review]* 4 (Beijing), (July/August 2005), pp. 55-59; and Hao Ruibin and Wang Weiyi, "21 Shiji Zhongguo Shiyou Anquan yu Zhonge Shiyou Hezuo [China's Petroleum Security and Sino-Russia Petroleum Co-operation in 21 Century]", *Zhongguo Kuangye [China Mining Magazine]* 3 (Beijing), (March 2006), pp. 5-8.

[7] Sun Shunli and Yangdian, "Riben Nengyuan Anquan Zhengce ji dui Woguo de Qishi [Japanese Energy Safety Policy and Its Revelation to China]", *Zhongguo Kuangye [China Mining Magazine]* 15(2) (Beijing), (February 2006), pp. 13-15; Yang Guang, "Meiguo Zhongdong Shiyou Waijiao [The United States' Oil Diplomacy in the Middle East]", *Guoji Jingji Pinglun [International Economic Review]* 3 (Beijing), (May/June 2003), pp. 33-35; and Liu Hongjie, "Meiri Nengyuan Anquan Zhanlue ji dui Woguo de Jiejian [The Energy Security Strategies of the United States and Japan as well as Their Lessons for China]", *Jingji Zongheng [Economic Review]* 11 (Changchun), (November 2005).

[8] Ruan Yongping and Li Yan, "Shiyou Jiage Bodong de Yingxiang yu Duice Fenxi [An Analysis of the Impact of the Fluctuations in Oil Prices and the Policy Responses]", *Jiage Lilun yu Shijian [Price: Theory & Practice]*

mechanisms and factors determining international oil prices, foreign governments' policy responses to high oil prices, the latter's impact on China, and the policy responses of the Chinese authorities. These studies tend to have a negative view of high oil prices, highlighting issues such as China's loss of wealth and fluctuations in the exchange rate of the *renminbi*. But high oil prices have been forcing China's enterprises to engage in technological adjustments and innovations in the production processes to reduce costs; and the Chinese leadership to accord priority to improve efficiency in energy use, to reduce China's dependence on oil, and to enhance China's energy security. These aspects have relatively been neglected in China's studies on high oil prices.

There have been many forecasts of China's future energy consumption based on different types of models.[9] Similarly, China's energy density, i.e., the amount of energy consumption required for the production of one unit of GDP, has been a well-researched field.[10] Thomas G. Rawski, however, considers that the statistics on China's energy consumption and those on its GDP growth are not compatible, and casts doubt on the reliability of China's energy statistics.[11] Some Chinese scholars engage in the study of

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5 (Beijing), (May 2005), pp. 41-42; Liu Ming, "Shiyou Wenti zhong de Duoge Bianliang [The Many Variables in the Oil Question]", *Guoji Jingji Pinglun [International Economic Review]* 6 (Beijing), (November/December 2005), pp. 36-38; Liu Xing, "Yuanyou Jiage Chixu Shangzhang dui Woguo Jingji he Xiangguan Hangye de Yingxiang [The Impact of the Continued Increase in Oil Prices on China's Economy and Related Trades]", *Jituan Jingji Yanjiu [Group Economy]* 11 (Beijing), (September 2005), pp. 18-19; Li Pumin, Jia Min and Zhang Guangyao, "Zhongguo Yingdui Gaoyoujia de Zhanlue Xuanze [China's Strategic Options in Dealing with High Oil Prices]", *Hongguan Jingji Yanjiu [Macroeconomics]* 12 (Beijing), (December 2005), pp. 8-14; Tao Pei, "Guoji Youjia Zougao dui Woguo Jingji de Yingxiang ji Duice [The Impact of Rising International Oil Prices on China's Economy and Its Policy Responses]", *Shangchang Xiandaihua [Market Modernization]* 14 (Total No. 437) (Beijing), (July 2005), pp. 1-2; and Chen Mo, "Oupeike Guojia de Youjia Zhengce yu Zhongguo Nengyuan Anquan [OPEC Countries' Oil Price Policies and China's Energy Security]", *Xiya Feizhou [West Asia and Africa]* 4 (Beijing), (July/August 2005), pp. 42-46.

[9] Zheng Jianchao, "Zhongguo Shixian Kechixu Nengyuan Gongying de Zhanlue Xuanze [Strategy Options for Sustainable Energy Supply in China]", *Zhongguo Dianli [Electric Power]* 38(9) (Beijing), (September 2005), pp. 1-5.

[10] Zhao Lixia and Wei Weixian, "Nengyuan yu Jingji Zengzhang Moxing Yanjiu [A Study of the Models on Energy and Economic Growth]", *Yuce [Forecasting]* 6 (Hefei), (November/December 1998), pp. 32-34 and 49; Lin Boqiang, "Dianli Xiaofei yu Zhongguo Jingji Zengzhang: Jiyu Shengchan Hanshu de Yanjiu [Electricity Consumption and China's Economic Growth: Based on a Study of the Production Function]", *Guanli Shijie [Management World]* 11 (Beijing), (November 2003), pp. 18-27; Shi Dan, "Woguo Jingji Zengzhang Guocheng zhong Nengyuan Liyong Xiaolü de Gaijin [The Improvement of Energy Consumption Efficiency in China's Economic Growth]", *Jingji Yanjiu [Economic Research Journal]* 9 (Beijing), (September 2002), pp. 49-56; Han Zhiyong, Wei Yiming and Fan Ying, "Zhongguo Nengyuan Qiangdu yu Jingji Jiegou Bianhua Tezheng Yanjiu [Research on Changing Features of China's Energy Intensity and Economic Structure]", *Shuli Tongji yu Guanli [Application of Statistics and Management]* 23(1) (Beijing), (November 2004), pp. 1-6 and 52; Liu Hongmei and Tao Quan, "Dazhongxing Gongye Qiye Nengyuan Midu Xiajiang de Dongyin Tanxi [The Approach to the Factors Resulting in the Decrease of Energy Consumption Density of Large and Middle Industrial Enterprises]", *Tongji Yanjiu [Statistical Research]* 9 (Total no. 131) (Beijing), (September 2002), pp. 30-34; Wu Qiaosheng, Cheng Jinhua and Wang Hua, "Zhongguo Gongyehua Jincheng zhong de Nengyuan Xiaofei Biandong: Jiyu Jiliang Moxing de Shizheng Fenxi [Change of Energy Consumption with the Process of Industrialization in China: An Empirical Analysis Based on Econometric Models]", *Zhongguo Gongye Jingji [China Industrial Economy]* 4 (Total no. 205) (Beijing), (April 2005), pp. 30-37; and Yang Wenpei, "Woguo Jingji Chixu Fazhan de Nengyuan Xuqiu Fenxi [An Analysis of the Energy Demand of China's Sustainable Economic Development]", *Meitan Jingji Yanjiu [Coal Economic Research]* 3 (Total no. 285) (Beijing), (March 2005), pp. 7-8 and 24.

[11] Thomas G. Rawski, "What is Happening to China's GDP Statistics", *China Economic Review* 12(4) (New

energy use in the daily life of the Chinese population;[12] and there have been considerable studies on China's energy structure too, including China's coal consumption at this stage and the importance of the clean use of coal.[13]

III. The Emerging Chinese Energy Strategy

In the recent four or five years, partly triggered by the high oil prices, there has been a general recognition in China that its energy development will find it increasingly difficult to satisfy the demand brought by economic development and the improvement of the people's living standards. For many years, China's energy production has not been able to catch up with the increase in demand. Since 1992, China's total energy production has been below its total energy consumption. The most conspicuous shortfall has been the electricity supply. In 2004, electricity supply shortages affected twenty-one provincial units; during the peak periods of demand for electricity, the shortage amounted to 20-30 million kilowatts.[14] In 2005, the situation improved, but the shortage in electricity supply remained substantial.

Further, in 2005, China's crude oil imports amounted to 130 million tons, and total oil imports (including refined oil products) amounted to 171.6 million tons, i.e., 36.6% of China's total oil consumption (469 million tons) and 7.69% of its total energy consumption (2.233 billion tons of standard coal equivalent). In terms of the structure of energy supply, serious shortages occur mainly in the supply of oil and gas, the cleaner fuels. According to the forecast of the International Energy Agency, China's dependence on imported oil will reach 60.5%, 76.9% and 82% by 2010, 2020 and 2030 respectively. Similarly, by 2010 and 2020, China's dependence on imported natural gas will reach 30% and 50% respectively.[15]

The end uses of imported oil cannot be separated statistically from those of domestic oil as the data are not available. In general, imported oil is directed to the oil refineries most suitable for its processing because oil of high sulphur content, high wax content, etc. demands special treatment and facilities. This is why oil from Venezuela is problematic. Again, statistical data regarding the end uses of oil are not available. It can be assumed that industrial use of energy mainly depends on coal, which is also the predominant fuel for

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York), (December 2001), pp. 347-354.

[12] Wang Xiaohua and Feng Zhenmin, "Zhongguo Nongcun Jiating Nengyuan Xiaofei de Huigu yu Zhanwang [Retrospection and Expectation on Energy Consumptions of Rural Households in China]", *Nongye Jixie Xuebao [Transactions of the Chinese Society for Agricultural Machinery]* 33(3) (Beijing), (May 2002), pp. 125-128; and Wang Xiaohua, Wang Zhengkuan and Feng Zhenmin, "Zhongguo Xiaokang Nongcun Jiating Nengyuan Xiaofei Jiben Tezheng jiqi Pingjia Tixi Yanjiu [General Features and Its Appraised Index System on Comparatively Well-off Rural Household Energy Consumption in China]", *Nongye Gongcheng Xuebao [Transactions of the Chinese Society of Agricultural Engineering]* 16(2) (Beijing), (March 2000), pp. 97-100.

[13] Sun Xiaoyong, "Meitan Ziyuan Guanli yu Jiejingmei Jishu [The Management of Coal Resources and the Technology to Cleanse Coal]", *Jingji Wenti [On Economic Problems]* 1 (Taiyuan), (January 2004), pp. 18-21.

[14] Wang Qianhai, "Jieyue: Ziyuan, Huanjing yu Fazhan de Chenzhong Fuhuan [Conservation: the Heavy Appeal from the Point of View of Resources, Environment and Development]", *Zhongguo Xinxi Bao [China Information News]* (Beijing), August 11, 2005.

[15] Zhang Youwen, Huang Renwei, et al., *2006 Zhongguo Guoji Diwei Baogao [China International Status Report 2006]* (Beijing: Renmin Chubanshe, May 2006), pp. 179-180.

electricity generation and for heating purpose in urban areas. It is logical to deduce that oil is mainly used for commercial transportation, namely, cars, trucks and aeroplanes. Hence, the promotion of car ownership in urban areas has been controversial both from the point of view of energy security and that of environmental protection. In the coastal provinces, household energy consumption gradually switches to liquefied natural gas, as demonstrated by the recent major gas deal between Guangdong and Australia and that between Fujian and Indonesia.

As coal remains the most important energy resource available, the environment is adversely affected. Coal is still mainly directly burnt to produce energy in China; this low technology has led to serious air pollution in major cities producing acid rain, sulphur dioxide and dust. Despite some efforts to achieve environmental protection, pollution has been deteriorating. By 2020, China has to meet the limitations set for the increase in the release of greenhouse gases too. The extensive mode of production results in the low efficiency of energy use, causing a lot of wastes. At present, the amount of energy used in the production of one unit of GDP in China is roughly three times that in the United States, five times that in Germany and almost six times that in Japan.[16]

To deal with the pressing energy issue, the Chinese leadership released a policy document entitled "Twenty-first Century Oil Strategy" in 2003, allocating US$100 billion for a "futuristic strategic oil system" in China. This was an important theme in China's Tenth Five-Year Plan (2001-2005) which officially introduced the concept of "energy security". The above policy document was followed by a more detailed National Energy Strategy and Policy Report prepared by the State Council's Development Research Centre.[17]

In May 2005, the State Council established a State Energy Leadership Group headed by Premier Wen Jiabao, with Vice-Premiers Huang Ju and Zeng Peiyuan as deputy heads. Membership of the Leadership Group included leaders from thirteen central ministries and commissions. In early June 2005, a State Energy Leadership Office was set up as the executive organ of the Leadership Group. On June 27, 2005, the Party Political Bureau held its twenty-third collective study session on the theme of study to resolve the energy resources question of China. These measures amply demonstrated the high priority attached to the energy issue by the Chinese leadership.[18]

The Eleventh Five-Year Programme on National Economy and Social Development adopted by the Party Central Committee in the following October clearly advocated for the raising of the efficiency of energy use; and a specific target was set to reduce the energy consumed for each unit of GDP by 20% at the end of 2010 when compared with the end of 2005. At this stage, it appeared that a more clearly-defined energy strategy was in shape.

Energy conservation has been given top priority. In May 2005, the National

[16] *Ibid.*, p. 180.
[17] Leland R. Miller, *op. cit.*
[18] Zhang Youwen, Huang Renwei, et al., *op. cit.*, pp. 180-181.

Development and Reform Commission initiated ten major energy-conservation projects to implement the "Medium and Long Term Energy Conservation Plan for China". Premier Wen also appealed to the promotion of a recycling economy, the strengthening of the exploitation and management of national mineral resources, and the promotion of energy-conserving production and consumption modes.[19]

Efforts will be made to improve the energy structure, with coal as the foundation, electricity-generation as the central task, and emphasis given to the comprehensive development of oil, natural gas and new energy resources. In response to the shortage in electricity supply, electricity-generation capacity will be significantly expanded in the second half of the decade, and the national electricity grid will be expanded and improved. The relative weights of hydro-electric power, nuclear power and natural gas-generated power will be increased too. In February 2005, the National People's Congress approved the "Renewable Energy Law", offering a package of regulations and incentives in support of the development of renewable energy.[20]

Technological innovation is another priority area, which is in line with China's present development strategy to upgrade its industrial structure and develop high-tech industries with low energy consumption. Resources will be allocated to build an infrastructure in support of the development of energy resources-related technology, especially that related to energy development and the raising of the efficiency of energy use. In view of China's abundance of coal and shortage of oil and natural gas, the liquefaction and gasification of coal are priority projects. In Inner Mongolia and other coal-producing provinces, some experimental plants have been established based on imported advanced technology. It has been reported that a US$24 billion project has been planned for the liquefaction of coal.

The Chinese authorities believe that they should begin to establish a strategic oil reserve. They observe that Japan and South Korea (as members of the International Energy Agency) have strategic oil reserves which can last for 169 days and 75 days respectively; that Singapore and Thailand have strategic oil reserves lasting for 44 days and 36 days respectively; and that the oil reserves of India and China can only satisfy one to two weeks of their respective domestic needs. In 2003, the construction of four strategic oil reserve bases started in Zhenhai, Ningbo; Daishan, Zhoushan; Huangdao, Qingdao; and Xinkang, Dalian. Progress in Zhenhai under the auspices of Sinopec was satisfactory; the first stage of the project was completed at the end of 2005.[21]

According to the planning of the Chinese leadership, energy development should be in line with co-ordinated regional development and the development of western China; it should

[19] See the Government Work Report of Premier Wen Jiabao to the Third Session of the Tenth National People's Congress, *Renmin Ribao* (a Chinese newspaper in Beijing), March 15, 2005.
[20] *Zhonghua Remin Gongheguo Kezaisheng Nengyuanfa [The Law on Renewable Energy of the People's Republic of China]* (Beijing: Zhongguo Minzhu Fazhi Chubanshe, 2005).
[21] Zhang Youwen, Huang Renwei, et al., *op. cit.*, p. 182.

adequately consider the rational arrangement of production, transportation and consumption too. Xinjiang has become an important area for the exploitation and production of oil and natural gas. In March 2005, construction began regarding oil pipelines linking the oil in western China to the oil pipeline networks in the Northeast and northern China.

Finally, efforts will be made to limit the impact of energy production and consumption on the environment, which was a theme of the Eleventh Five-Year Programme on National Economy and Social Development, and prevention rather than cure will be the basic approach. The reduction in the release of sulphur dioxide (by coal-fired electricity generation plants) and greenhouse gases has been given priority.

IV. Forecasts of China's Energy Demand and Supply

China's energy shortage has attracted a lot of attention. Its own forecasts of its energy demand and supply should be a good starting point to examine its energy strategy. According to *China Energy Report (2006) – Strategy and Policy Research*, China's energy demand would range from 2.266 to 2.432 billion tons of standard coal by 2010 on the basis of six different scenarios: basic, low economic growth with high population growth, low economic growth with good technological progress, high economic growth, high economic growth with high population growth, and high economic growth with high population growth and good technological progress. By 2020, its energy demand would range from 2.888 to 3.880 billion tons of coal based on the same six scenarios (see Table III). Table IV and Table V indicate China's demands for coal and oil respectively by 2010 and 2020.

Despite China's abundance of coal, demand would exceed supply by 2010 in accordance with all six scenarios, and the shortage would range from 0.326 to 0.517 billion tons. Naturally, demand would exceed supply by 2020 in accordance with all six scenarios, and the shortage would further expand, ranging from 0.321 to 1.174 billion tons (see Table IV). The oil situation is even more serious. It is expected that China's oil imports would rise to a range of 32.34% to 37.02% of total consumption by 2010 in accordance with the six different scenarios; and would rise to a range of 57.55% to 68.36% of total consumption by 2020 (see Table VI). In terms of total energy consumption, China's oil imports would rise to a range of 8.15% to 9.33% by 2010; and to a range of 15.54% to 18.46% by 2020.

For strategic reasons and perhaps because of the consideration of "face", there are no data nor concrete discussions on what if China cannot fulfill its strategy. One may observe that electricity shortage was a common phenomenon in China's cities in summer in recent years because of the sharp rise in consumption given the prevalent use of air-conditioners, fans, etc. Under such circumstances, the city governments directed electricity supply to satisfy household needs first, while factories had to stop operation during the peak hours of the day. In many cases, rationing systems were implemented so that factories would only operate four or five days a week on the basis of district rotations. The government obviously

has the capacity to increase coal production to the extent of mobilizing the military; it certainly has the administrative machinery to implement all types of rationing measures as practised by the advanced industrial countries during the oil crisis in late 1973 and 1974. The price of course will be economic slow-down due to declines in industrial output and private consumption.

V. China's Domestic Energy Strategy

a) Energy conservation

The Eleventh Five-Year Programme on National Economy and Social Development sets a specific target to reduce the energy consumed for each unit of GDP by 20% at the end of 2010 when compared with the end of 2005. If the same target can be achieved in the following two five-year programmes, then by 2020, the energy consumed for each unit of GDP would be reduced by 50%; and the target of quadrupling China's GDP by 2020 while only doubling its energy consumption set by the 2004 "Medium and Long Term Energy Conservation Plan for China" would be met.

Actually in the period 1980 to 2000, China managed to achieve exactly the same feat of limiting China's rate of energy consumption growth to one half of that of its GDP growth. In 1980, China consumed 7.9 tons of standard coal to produce 10,000 *yuan* worth of GDP (at 1990 price level in terms of *yuan*); in 2005, China consumed 2.83 tons of standard coal to produce the same worth of GDP in constant prices. On this basis, China's energy density declined at the rate of 4% per annum in this period. To achieve the target set by the Eleventh Five-Year Programme, China's energy density has to drop 4.4% per annum in 2006-2010, which should be achievable in the eyes of China's experts. Their optimism is based on China's track record and the new emphasis on energy conservation by the Chinese leadership. The latter naturally means that much more resources will be spent on securing higher efficiency in energy use. Given the low level of energy efficiency in China, it also means that there is a lot of room for improvement.[22]

On the other hand, recent indications do not support such optimism. According to the National Bureau of Statistics of China, in the first half of 2006, the energy consumption for each unit of GDP rose by 0.8% compared with that in the first half of 2005, despite the high expectations of the Chinese authorities and experts.[23] In early August 2006, the National Development and Reform Commission admitted that meeting the annual target of 4% reduction in energy consumption was "not promising". According to its report, 90% of China's 500,000 small and medium-sized boilers were coal-fired and consumed 400 million tons of coal each year. Up to 70 million tons, however, could be saved by upgrading the

[22] Wei Yiming, Fan Ying, Han Zhiyong, Gu Gang, et al., *op. cit.*, pp. 288-289. See also K. Kenekiyo, *Energy Outlook of China and Northeast Asia and Japanese Perception toward Regional Energy Partnership* (Tokyo: The Institute of Energy Economics, 2005).

[23] *Ming Pao* (a Chinese newspaper in Hong Kong), August 2, 2006.

technology and management. More than 60 billion kilowatt-hours of electricity could be saved if energy-saving light bulbs were introduced nationwide. China is actually the world's biggest producer of energy-saving light bulbs, but only 30% are sold in the domestic market. The commission's report still argues that efficiency measures could reduce China's energy consumption by 13.5% of 2005's total (300 million tons of standard coal), but it would take time for energy-saving measures to yield results.[24]

Such energy saving efforts are obvious in China's steel industry. On July 20, 2005, the National Development and Reform Commission formally released a "Steel Industry Development Policy", with considerable emphasis on energy conservation. It specifies that by 2010, the comprehensive energy consumption per ton of steel should be reduced to 0.73 ton of standard coal and below, and to 0.7 ton and below by 2020. Earlier from 1994 to 2003, the comprehensive energy consumption per ton of steel fell from 1.52 to 0.79 ton of standard coal, a fall of 48%, with more significant declines achieved in 2001 to 2003.[25]

This improvement reflected a substantial increase in investment on the steel industry's infrastructure and technological innovations in this period. The Chinese authorities will continue their efforts to promote technological innovations to achieve energy conservation, especially in the support of related research and development in technology. Attempts will also be made to retire high-energy-consumption plants, equipment and technology. Regulations will be set to restrict market access to avoid excessive capacity building at a low level and thus a waste of resources. In the long term, the Chinese government will have to use financial and taxation policies to provide incentives for enterprises to engage in energy saving practices through technological innovations and the strengthening of management, instead of relying on administrative measures.

Energy saving can also be achieved by adjustments in the daily life patterns of the Chinese population. On the basis of the living standards in 2002, if the Chinese urban population increases 100 *yuan* per annum per capita in their expenditure on accommodation, the indirect energy consumption generated would increase by 20 million tons of standard coal, 10.15% of the total indirect energy consumption generated in the daily life of the urban population in 2002. If the temperature of air-conditioned homes in summer is raised by 1°C, electricity consumption may be reduced by 5 to 8%, or 0.56 million kilowatt-hours, based on the number of household air-conditioners in use in 2002. Similarly, if the use of domestic air-conditioning is to be reduced by an hour a day, the use of electricity can be reduced by 8.7 million kilowatt-hours, about 0.07% of the total domestic electricity consumption in 2002.

The dramatic rise in the number of cars in China has been controversial. In 2002 and 2003, the number of family passenger cars increased at an average annual rate of 50.6%. At this rate, by 2010, there will be 23.24 cars per one hundred urban families, consuming 15.6

[24] *South China Morning Post* (an English newspaper in Hong Kong), August 5, 2006.
[25] Wei Yiming, Fan Ying, Han Zhiyong, Gu Gang, et al., *op. cit.*, pp. 287-288.

million tons of gasoline (assuming the same rate of gasoline consumption per 100 km of travel for small passenger cars, the same average mileage covered per car per year, and the same number of urban families as in 2005). Similarly, it was estimated that by 2010, there will be 447 million motor cycles in China, consuming 66.8 million tons of gasoline. Chinese experts believe that if the Chinese authorities can adopt the strict standards of the United States and Germany at 3 litres per 100 km for family passenger cars, then it is possible to save up to 52.9% of the gasoline consumption. If the gasoline consumption of motor cycles in China can be reduced by 1%, their gasoline consumption can be reduced by 0.668 million tons by 2010. It is significant that the Chinese authorities still think along the line of improving the fuel-use efficiency of passenger cars and motor cycles, instead of limiting the increases in their numbers. This is because the automobile industry is considered a pillar industry in the Chinese economy; and the Chinese authorities now attempt to maintain economic growth through the stimulation of domestic consumption. Chinese families acquiring passenger cars and motor cycles is perceived as an important growth point in direct and indirect domestic consumption.

The domestic use of energy in the rural areas is another significant issue. In 1999-2002, direct domestic consumption of commercial energy resources in rural areas amounted to 3.4% of China's total energy consumption. About 68% of these commercial energy resources were coal, mainly used for heating and cooking. The efficiency of such energy use is believed to be rather low, at best at the level of that of the United States and Europe in the early 1970s. Hence, Chinese experts believe that the potential of raising the efficiency of energy use in the rural areas should be high.[26] But if the rural population becomes more prosperous, their energy consumption will also rise, since the most obvious sign of rural prosperity would be the increasing purchases of household electrical appliances.

b) The development of renewable energy resources

The "Renewable Energy Law" began its implementation in January 2006, reflecting that the Chinese authorities' energy strategy has turned its attention to renewable energy as well. According to a document of the State Planning Commission (the predecessor of the National Development and Reform Commission) in 1995, "China's New Energy Resources and Renewable Energy Resources Development Guidelines (1996-2010)", a set of targets has been set for the respective scales of key renewable energy resources to be met by 2010. They are:

- wind power: : electricity-generation capacity at 1 to 1.1 million kilowatts
- solar power: : utilization capacity at 467 million tons of standard coal
- energy produced by biological : electricity-generation capacity to exceed 0.3 million kilowatts

[26] *Ibid.*, pp. 290-291.

materials

- geothermal power : utilization capacity at 151 million tons of standard coal
- hydro-electric power produced by small power stations: electricity-generation capacity at 27.88 million kilowatts producing 117 billion kilowatt-hours of electricity[27]

According to the planning of the National Development and Reform Commission, by 2020, renewable energy resources will satisfy 15% of China's primary energy consumption, compared with about 7% in 2005. By then, overall hydro-electric power generation capacity will reach 300 million kilowatts, wind power 30 million kilowatts, solar power 1 million kilowatt, and biological materials fuel 50 million tons. In 2005, by comparison, China's overall hydro-electric power generation capacity has reached 110 million kilowatts, wind power (connected to the national electricity grid) 0.76 million kilowatts, and solar power 60,000 kilowatts (China also has over 40% of the world's solar-power water heaters). In the rural areas, there were more than 11 million marsh gas pools.[28]

The Yangtze Gorges Dam of course is a recent large-scale infrastructural project involving the generation of hydro-electric power. These large-scale infrastructural projects are funded by the central government, though no detail statistics are available. On the other hand, funding for small projects at the county-level and below is very often a serious problem. Securing budgetary allocations is difficult in the first place, and there is the danger of such allocations being misappropriated by local officials for other purposes. Typically, while money is allocated for the completion of projects, no further funding is provided for their maintenance. Hence a large number of hydro-electric power projects are in disrepair, and they have become hazards threatening the lives of local populations.

Due to technological, economic and other factors, China's exploitation of renewable energy resources has not been widespread. The rises in oil prices and the environmental-protection consciousness of the Chinese people will certainly lead to their wider use. Promotion by the government will help too. It has been suggested that preferential loans be provided to state-owned enterprises to develop various types of renewable energy resources, but there are no concrete plans yet.[29]

c) Economic development strategy

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[27] State Planning Commission, State Science and Technology Commission and State Economic and Trade Commission, *Xin Nengyuan he Kezaisheng Nengyuan Fazhan Gangyao (1996-2010)* [New Energy Resources and Renewable Energy Resources Development Guidelines (1996-2010)], 1995, Document No. 4 from the Office of the State Planning Commission on Transport and Energy.

[28] Liu Zheng, "Zhang Guobao: Zhongguo Jiakuai Fazhan Kezaisheng Nengyuan Yingdui Nengyuan Jinzhang [Zhang Guobao: China Would Accelerate the Development of Renewable Energy Resources to Deal with the Energy Crisis]", Xinhuanet.com, September 26, 2005, http://news.xinhuanet.com/fortune/2005-09/26/content_3546715.htm.

[29] Zhang Min, "Kezaisheng Nengyuan Nanyi Chengshou de Chengben zhi Zhong [The Unaffordable Cost of Renewable Energy Resources]", *Gongren Ribao [Workers' Daily]*, January 8, 2006, http://env.people.com.cn/GB/35525/4007525.html.

While China has been very successful in attracting foreign investment in support of its development through imported expertise and technology, there is an increasing concern at this stage that China will remain the low-technology, labour-intensive workshop to the world. In January 2006, speaking at a national conference on innovation, Premier Wen Jiabao indicated that "independent innovation" would be core to China's development strategy in the next fifteen years.[30] In the following month, a document entitled "Outline of National Medium and Long-term Science and Technology Development Plan" was released, revealing an ambitious plan to close the gap with developed countries and transform China into a leading technological power. China would gradually increase its investment in research and development from just 1.23% of its GDP in 2004 to 2.5% (900 billion *yuan*) in 2020, and limit its dependence on foreign technology at the 30% level by then.[31] In view of the significance of the energy issue in China's economic development, energy conservation is a focus area identified in the Outline, and it is expected that a substantial amount of this investment in research and development will go to energy-related projects.

In view of the substantial trade surpluses that China enjoys in its trade with the United States and the European Union, China is under pressure to make major purchases of equipment from them, especially during visits of China's top leaders to these countries. Energy has often been mentioned as an important item for economic co-operation, and it is expected that Chinese leaders will spend substantial sums to acquire equipment and technology in the energy sector from these countries, especially those related to energy conservation and the exploitation of renewable energy resources.

Further, China's economic development strategy at this stage begins to place much more emphasis on being resource efficient and environmentally friendly. As the Chinese people's living standards improve, the demand for environmental protection has been growing, and this demand has been gradually transformed into group action. The pollution of Sunghua River in the Northeast by poisonous chemicals by a subsidiary of the China National Petroleum Corporation in Jilin in November 2005 attracted both domestic and international attention.[32] China has to import more than 40% of its oil, but its energy consumption per unit of GDP is 2.4 times higher than the world average. Yet there is no planning and research on the development of energy-saving standards, the system in place is far from satisfactory, and most energy-consuming industrial equipment does not have energy-efficiency standards. The State Council has just started to formulate various policies on the saving of resources to regulate market and consumer behaviour.

The Chinese authorities now accept the adjustment of the prices of resources and the introduction of tax reforms in support of the resource-efficient and environmentally-friendly

[30] David Kang and Adam Segal, "The Siren Song of Transnationalism", *Far Eastern Economic Review* 169(2), (March 2006), p. 6.
[31] *South China Morning Post*, February 10, 2006; and *Ming Pao*, February 10, 2006.
[32] *China Times* (a Chinese newspaper in Taipei), November 24, 2005.

development strategy. There is an increasing awareness that the prices of resources in China cannot accurately reflect the market demand and supply conditions as well as the scarcity of the resources. Chinese leaders now accept that the ultimate solution is the marketization of the prices of resources, allowing prices to be determined in market competition, with the foci on the prices of water, electricity, oil and natural gas, coal, and land. Tax measures will soon be introduced to promote the conservation of resources through improving the efficiency in their utilization. The Chinese authorities, however, are very concerned with the control of inflation, and the impact of such price increases on low-income households. It has already been suggested that agricultural tax exemptions in the rural areas introduced in the recent two years were counter-balanced by the rise in oil prices and those of related agricultural inputs.

Foreign investment in China's labour-intensive processing industries has provided employment and promoted economic growth. But the Chinese authorities are increasingly aware that these industries' benefits for the nation and their impact on economic development are limited. Foreign exchange earnings for China from such exports are only about 20% of the amount of trade. Hence at this stage of economic development, China wants to improve its export structure and increase the proportion of hi-tech products in its exports. Production of hi-tech products typically adds more value and uses fewer resources. It will have less adverse impact on the environment too. This upgrading of China's industrial structure is probably the most important aspect of its sustainable development strategy. The latter naturally calls for the restriction of high-energy-consumption industries and industrial plants.

VI. China's Oil Diplomacy

At the end of 1992, the Chinese leadership proposed that China's development strategy would have to "fully exploit domestic and foreign resources and markets". Since then, the three major oil companies of China, China National Petroleum Corporation, China National Offshore Oil Corporation and China Petroleum & Chemical Corporation (Sinopec Corp.), have begun their overseas acquisition programmes. In March 1993, China National Petroleum Corporation successfully bid for an oilfield in Peru, marking the first entry of China's petroleum industry into the international market. By 2005, the three major oil companies had invested over US$7 billion in Africa, Central Asia, Oceania and Latin America, involving over sixty international oil and natural gas projects in thirty countries. Through these investment projects, China's major oil companies controlled oil reserves in excess of 600 million tons, and secured oil shares from 3 million tons in 1999 to over 12 million tons in 2002 and more than 15 million tons in 2005.[33] Control here refers to ownership through market operations; there is still a small risk due to possible radical nationalization policies of the governments concerned. This ownership is important to China in security terms, as the Chinese leadership believes that China cannot depend on Western oil

[33] Zhang Youwen, Huang Renwei, et al., *op. cit.*, p. 183.

companies or the international oil market in times of crises.

China's investment in overseas energy resources projects is in line with its general strategy of stepping up foreign investment to acquire resources, technology and markets to enhance the competitiveness of its major enterprises. In the oil industry, its major oil companies' overseas activities began with supplying technical services to improve the output of old oilfields and oilfield production management; they have now expanded to cover the development of oilfields, exploration ventures, laying of pipelines, contracting of engineering projects, export of equipment, trade in oil and natural gas, assets acquisition, and so on.

These business activities have been firmly supported by the Chinese leadership's energy diplomacy. Its visits to oil-producing countries in Central Asia, the Middle East, Africa, Latin America and Oceania have helped Chinese enterprises secure major deals. The Chinese authorities have been active in multilateral international organizations including the Shanghai Co-operation Organization, the China-Arab Countries Co-operation Forum and the Forum on China-Africa Co-operation to promote energy co-operation. Venezuela, Mexico and Brazil have formed strategic partnerships with China partly because of their oil resources.

While China's energy diplomacy has attracted much international attention, there are severe limitations to its progress. At present, China's energy imports mainly come from the Middle East, Africa and the Commonwealth of Independent States (CIS). Quite a number of countries in these regions suffer from political instability, and China's projection capability and influence in these regions are very limited. In strategic terms, the Chinese leadership is obviously very concerned with the Bush administration's strategy to introduce democracy to the Middle East as well as the spread of the "coloured revolutions" among the CIS member states. The Bush administration is perceived in Beijing to be a significant force behind the "coloured revolutions".

Within the East Asian region, the energy consumption structures and import structures of the major countries are similar. Hence there is substantial competition among China, Japan, South Korea and India in the international energy market. The historical legacy, lingering territorial disputes, and the competition for regional influence and status have so far prevented effective co-operation among the regional powers in the energy field. At the same time, regional organizations are far less developed when compared with the European Union. In fact, the adverse factors mentioned above may have been exacerbating the competition for energy resources, as in the cases of the Sino-Japanese territorial dispute over the oil and natural gas rights in the East China Sea and their competition for energy resources from the Russian Far East and eastern Siberia.

There is a recognition in Beijing too that the financial and technological resources of China's oil majors remain limited. The capital assets of the three leading Chinese oil companies do not add up to one third of those of Exxon-Mobil. In terms of the technology and equipment in oil exploration and exploitation, the bidding for foreign oil projects and

operational experiences, there is also a long way to catch up. The experts in China estimate that the six leading oil companies in the world (British Petroleum, Exxon-Mobil, Royal Dutch Shell, Total, Chevron and ConocoPhillips) now control more than 80% of the world's high-quality oil reserves, over 30% of the world's industrial output value of petroleum products, more than a 50% share of the oil technical services market, over 65% of the international oil trade and direct investment in oil projects, as well as more than 80% of the advanced technology in the oil and petrochemicals sectors. In comparison, China controls less than 4% of the world's oil resources, and has been attempting to achieve breakthroughs from the margin.[34]

Chinese leaders consider that energy is not purely an economic issue, and oil is no common commodity. In May 2003, Royal Dutch Shell and other five companies used their shareholders preferential purchasing rights to block the joint offer of China National Offshore Oil Corporation and Sinopec Corp. to acquire shares of an oilfield in Caspian Sea owned by Kazakhstan. In 2005, China National Offshore Oil Corporation failed to buy Unocal. These failures were interpreted as part of a scheme on the part of the Western world to contain China.

The Chinese authorities therefore have been eager to publicize co-operation projects in the energy sector, especially those between China and its neighbours who are seen as competitors. In this connection, Sino-Indian co-operation has been encouraging. For example, in 2003, ONGC Videsh Ltd. (OVL), the overseas investment arm of Oil and Natural Gas Corporation Limited of India, approached China National Petroleum Corporation for a partnership in developing a huge oilfield discovered by the Chinese firm in Sudan's Malut basin.[35] In August 2006, a new oilfield, the Neem oilfield, was discovered in southern Kordofan in Sudan; and it was run by the Greater Nile Petroleum Operating Company (GNPOC), 40% owned by China National Petroleum Corporation, 30% by Malaysian Petronas, and 25% by India's Oil and Natural Gas Corporation Limited. GNPOC also operates Sudan's main oil pipelines.[36] In December 2005, China and India also jointly acquired Petro-Canada's oil and natural gas assets in Syria at a price of US$573 million.[37]

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[34] Cui Dahu, "Daguo Nengyuan Zhanlue Boyixia de Zhongguo Shiyou Qiye Quanqiuhua Jingying Zhanlue [The Global Business Strategy of China's Oil Enterprises in the Context of the Major Powers' Energy Strategic Game]", *Shijie Jingji Yanjiu [World Economy Study]* 11 (Shanghai), (November 2005), pp. 37-43.

[35] Preliminary estimates indicated that 600 million barrels of oil could be recovered. China National Petroleum Corporation held a 41% stake in the oilfield, with the remaining stakes held by Gulf Petroleum of Qatar and two Sudanese companies. See *The Times of India*, http://www.gasandoil.com/goc/company/cna33420.htm.

[36] The Neem oilfield was bumping 24,000 barrels per day (bpd) in July 2006; it was expected to reach 40,000 bpd eventually. China was also building an oil refinery in Khartoum. Earlier in February 2005, Oil and Natural Gas Corporation Limited of India spent US$243 million to acquire 9% of China Gas Holdings Limited. See *Sudan Tribune* (Khartoum), August 3, 2006, http://www.sudantribune.com/article_impr.php3?id_article=16874 and http://www.sudantribune.com/article_impr.php3?id_article=16903.

[37] China National Petroleum Corporation and India's Oil and Natural Gas Corporation Limited acquired from Petro-Canada a 38% stake in Al Furat Petroleum Company, Syria's largest oil producer. This was the first alliance between Chinese and Indian state-owned energy enterprises. Earlier the Chinese oil firm beat its Indian counterpart in the bidding for the control of PetroKazakhstan in the hands of Canada's National Energy. See

Another breakthrough was achieved in the South China Sea. In March 2005, energy enterprises in China, Vietnam and the Philippines signed an agreement in Manila to initiate joint seismic research; the parties subsequently awarded a contract for oil exploration around the disputed Spratlys.[38] It appears that that earlier proposal from the Chinese government to "shelve the sovereignty controversy and engage in joint development" has won the endorsement of Hanoi and Manila. Meanwhile, Sino-Japanese negotiations on the oil and natural gas issues in the East China Sea continue, despite the fact that no breakthroughs are anticipated in the foreseeable future given the state of Sino-Japanese relations.

China hopes to secure technology transfer from the developed countries in the energy sector too. The transfer of nuclear technology for peaceful use has been an issue in Sino-American relations. Though limited progress has been made in recent years, China is concerned with the much better treatment given to India by the Bush administration. Assistance to China to develop nuclear energy and to improve its efficiency of energy use will help reduce its demand for energy resources and thereby stabilize the international energy market. It will reduce the United States' deficit in the bilateral trade too. Mutual co-operation, however, demands greater mutual trust.

In comparison, energy co-operation has been an important aspect of the Sino-European Union (EU) Comprehensive Strategic Partnership. There has been established a Sino-EU Energy Co-operation Task Force, and a number of conferences have been held. The EU has advanced technology in the areas of environmental protection, renewable energy, clean energy, efficient fuel use, energy conservation, etc. which is needed in China. The EU therefore is an importance source of advanced technology for China in the energy field.

VII. Conclusion

After many years of rapid economic growth adopting the extensive mode, China in some ways would like to follow Japan's example in response to the international oil crises in 1973-74 and 1978-80, i.e., to upgrade its industrial structure, to introduce energy conservation measures, to develop new sources of energy supply, and to engage in an "energy diplomacy" to diversify and guarantee its energy supply. In contrast to the two oil crises in the 1970s, China's energy policy challenge was not caused by severe cut-backs in supply due to external events, it has largely been the result of China's rapid economic growth and the perceived sharp rise in demand for energy resources in the global markets.

Similar to Japan in the 1970s, China is at the threshold of a significant economic transformation, switching its extensive mode of economic growth to an intensive mode. However, while the oil crisis in 1973-74 prompted Japan to shift its high-energy-consumption and environmentally unfriendly heavy industries, especially steel and shipbuilding, to South

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Financial Times (London), December 13, 2005.

[38] Zhang Youwen, Huang Renwei, et al., *op. cit.*, p. 178.

Korea and Taiwan, China is at present mainly in the stage of reducing the weight of its labour-intensive light industries and increasing that of its heavy industries, while developing its high-tech industries. Development of heavy industries and infrastructure will remain the backbone of China's economic development at this stage. Moreover, given the size and diversity of China, different parts of China are in different stages of development. The central authorities therefore must work hard to ensure that the interior provinces will not repeat the past mistakes of the coastal provinces, and that the phenomenon of "while there are policies from above, there are all kinds of counter-measures from below" will be effectively restricted. Chinese leaders and planners, for example, seem to be over-optimistic regarding the prospects of raising the efficiency of energy consumption.

At this stage, China's energy policy has largely been a series of policy targets from above, whose fulfillment is ensured by threats of sanctions against deviant officials at all levels. This approach exploits the substantial mobilization power of the Chinese leadership, but campaign-like mobilization may not have lasting effects. The Chinese authorities have yet to devise a comprehensive set of measures providing incentives to induce the market to respond. On the positive side, Chinese people in general are much more aware of the significance of energy conservation and environmental protection, but the impact on behaviour at the micro-level is doubtful, as reflected by the eagerness of the well-educated middle-class to buy private cars. This implies that while there is huge potential for energy conservation and the development of alternative energy resources in China, the increase in demand for energy due to the improvement in living standards cannot be under-estimated.

In recent years, the Chinese leadership has been pursuing an "energy diplomacy" which has achieved considerable success, but has also generated much international concern. China's economic growth, its accumulation of foreign exchange reserves largely from its trade surpluses, and its general "going out" strategy mean that China's investment in overseas resources projects will continue to rise. Beijing is aware that this will be perceived as an aspect of the "China threat", and has been making efforts to reduce this perception. Sino-Indian co-operation in overseas joint ventures is a good example. A Sino-American dialogue on energy policy has been established; and energy issues are an important agenda item in the bilateral strategic dialogue. There is much room for technology transfer, as China needs advanced technology in energy conservation, the development of nuclear energy, the exploitation of renewable energy resources, etc. Western countries' willingness to pursue technology transfer and acceptance of China's investment in overseas energy resources are important aspects of engaging China. Given its difficult situation, China is willing to tackle its energy problem through international co-operation.

Table I Forecast of China's Economic Growth Rates, 2005-2020

Period / Scenario	2005-2010	2010-2015	2015-2020
Basic	8.1%	7.5%	6.8%
Low Growth	7.5%	5.8%	4.8%
High Growth	8.5%	8.2%	7.7%

Source: Wei Yiming, Fan Ying, Han Zhiyong, Wu Gang, et al., *Zhongguo Nengyuan Baogao (2006) – Zhanlue yu Zhengce Yanjiu [China Energy Report (2006) – Strategy and Policy Research]* (Beijing: Kexue Chubanshe, March 2006), p. 74. The table also takes into consideration the forecast made by the Development Research Centre of the State Council, see Li Shantong, Han Yongzhi and He Jianwu, "'Shiyiwu' zhi 2020 Nian de Jingji Zengzhang Qianjing [Economic Growth Prospects from the Eleventh Five-Year Programme to 2020]", www.taxchina.cn, 2005, http://www.taxchina.cn/news/2005-05/t349452.html.

Table II Forecast of China's Population Growth, 2010 and 2020 (billion)

Period / Scenario	2010	2020
Medium Growth	1.386	1.483
High Growth	1.401	1.509

Source: Wei Yiming, Fan Ying, Han Zhiyong, Wu Gang, et al., *op. cit.*, p. 74. The table also takes into consideration the forecast made by Jiang Zhenghua, *Quanguo he Fendiqu Renkou Yuce [National and Regional Population Forecasts]* (Beijing: Zhongguo Renkou Chubanshe), 1998.

Table III Forecast of China's Energy Demand by Region in accordance with Six Scenarios, 2010 and 2020 (billion tons of standard coal)

Scenario / Region	Basic		Low Economic Growth with High Population Growth		Low Economic Growth with Good Technological Progress		High Economic Growth		High Economic Growth with High Population Growth		High Economic Growth with High Population Growth and Good Technological Progress	
	2010	**2020**	**2010**	**2020**	**2010**	**2020**	**2010**	**2020**	**2010**	**2020**	**2010**	**2020**
Demand in Eastern China	1.124	1.824	1.151	1.637	1.083	1.474	1.152	1.950	1.164	1.985	1.120	1.864
Demand in Central China	0.754	1.065	0.777	0.967	0.726	0.863	0.772	1.138	0.780	1.158	0.747	1.078
Demand in Western China	0.472	0.679	0.487	0.621	0.456	0.552	0.483	0.724	0.488	0.737	0.467	0.686
Total National Demand	2.350	3.567	2.415	3.225	2.266	2.888	2.407	3.812	2.432	3.880	2.334	3.628

Source: Wei Yiming, Fan Ying, Han Zhiyong, Wu Gang, et al., *op. cit.*, p. 77.

Table IV Forecast of China's Demand for Coal by Region in accordance with Six Scenarios, 2010 and 2020 (billion tons)

Scenario / Region	Basic		Low Economic Growth with High Population Growth		Low Economic Growth with Good Technological Progress		High Economic Growth		High Economic Growth with High Population Growth		High Economic Growth with High Population Growth and Good Technological Progress		Total National Production	
	2010	**2020**	**2010**	**2020**	**2010**	**2020**	**2010**	**2020**	**2010**	**2020**	**2010**	**2020**	**2010**	**2020**
Demand in Eastern China	1.050	1.506	1.098	1.404	1.011	1.216	1.075	1.611	1.087	1.640	1.031	1.480		
Demand in Central China	0.748	0.941	0.785	0.884	0.721	0.762	0.766	1.005	0.775	1.023	0.733	0.920		
Demand in Western China	0.480	0.619	0.504	0.584	0.464	0.503	0.491	0.660	0.496	0.672	0.469	0.604		
Total National Demand	2.278	3.066	2.387	2.871	2.196	2.482	2.332	3.276	2.357	3.334	2.233	3.004	1.871	2.161

Source: Wei Yiming, Fan Ying, Han Zhiyong, Wu Gang, et al., *op. cit.*, p. 78-79. The table also takes into consideration the coal production forecast made by the Task Force of the Macro-economic Research Institute, State Development Planning Commission, *Zhongguo Zhongchangqi Nengyuan Zhanlue [China's Energy Strategy in the Long and Medium Term]* (Beijing: Zhongguo Jihua Chubanshe, 1999).

Table V Forecast of China's Demand for Oil by Region in accordance with Six Scenarios, 2010 and 2020 (million tons)

Scenario / Region	Basic		Low Economic Growth with High Population Growth		Low Economic Growth with Good Technological Progress		High Economic Growth		High Economic Growth with High Population Growth		High Economic Growth with High Population Growth and Good Technological Progress		Total National Production	
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
Demand in Eastern China	153	301	149	249	148	244	157	322	159	328	158	327		
Demand in Central China	84	151	82	125	81	123	86	162	87	164	87	164		
Demand in Western China	39	71	38	58	38	57	40	75	40	77	40	77		
Total National Demand	276	523	269	433	266	424	283	559	286	569	285	568	180	180

Source: Wei Yiming, Fan Ying, Han Zhiyong, Wu Gang, et al., *op. cit.*, p. 79-80. The table also takes into consideration the oil production forecast made by the Research and Development Department, China National Petroleum Corporation, see New China News Agency dispatch, "2020 Nian Woguo Yuanyou Chanliang Keneng Baochi zai 1.8 Yi Dun Zuoyou [China's Oil Production May Maintain at a Level of About 180 Million Tons by 2020]", May 26, 2005, http://www.china5e.com/news/oil/200505/200505260043.html.

Table VI Forecast of China's Dependence in Oil Imports in accordance with Six Scenarios, 2010 and 2020

Year / Scenario	2010	2020
Basic	34.79%	65.58%
Low Economic Growth with High Population Growth	33.16%	58.40%
Low Economic Growth with Good Technological Progress	32.34%	57.55%
High Economic Growth	36.34%	67.80%
High Economic Growth with High Population Growth	37.02%	68.36%
High Economic Growth with High Population Growth and Good Technological Progress	36.93%	68.32%

Source: Wei Yiming, Fan Ying, Han Zhiyong, Wu Gang, et al., *op. cit.*, p. 80.