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EAST-WEST CENTER

PROGRAM ON RESOURCES:
ENERGY AND MINERALS

CHINA ENERGY UPDATE

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Economic Development in China

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CHINA ENERGY UPDATE

This report is based on a variety of published and unpublished sources. The information is deemed reliable, but accuracy cannot be guaranteed. The briefing is intended to be an information source rather than an investment guide.

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I. Commentary and Summary¹

The People's Republic of China is the world's third largest energy producer (after the United States and Russia) and the second largest energy consumer (after the United States). Although rich in energy resources, China's per capita energy production is nonetheless well below the world average, and the country therefore requires more energy than it can produce to meet its growing economic and industrial needs. Since the economy continues to grow strongly, China is striving to further develop its domestic energy resources, to make greater efforts to reduce the inefficient use of energy, and to actively seek cheap and stable energy imports from international markets. China's energy sector development thus provides enormous investment and trading opportunities for the outside world.

With a primary focus on oil, gas, and petrochemicals, this report summarizes China's energy production, trade, and consumption during the fourth quarter of 1996, as well as providing the most reliable energy data available for the whole of 1996. Information on domestic energy projects, energy market developments, foreign investment projects, and government policy changes is provided up to March/April 1997.

Total crude oil production in China reached 3,137 thousand barrels per day (b/d) in 1996, making it the world's sixth largest oil producer. The total includes 2,837 thousand b/d of onshore output and 299 thousand b/d from offshore. The onshore production in 1996 represents little change over the 1995 production level, which was 2,833 thousand b/d. However, production from Xinjiang Uigur Autonomous Region and the Tarim

Basin reached 286 thousand b/d in 1996—an increase of 13% over the 1995 level of 253 thousand b/d. Offshore production rose sharply in 1996, up 77.9% from the 1995 level of 168 thousand b/d. China's domestic refineries, with a total capacity of 4.3 million b/d at the end of 1996, are running at utilization rates of just under 70%. China consumes much of its oil output, and the amount available for export has been declining or has stagnated. However, in 1996, crude exports from China rose to 405 thousand b/d from 377 thousand b/d in 1995. China also exported approximately 99 thousand b/d of various products in 1996. The 1996 refinery throughput was about 3 million b/d, 5.1% higher than the crude intake of 2,854 thousand b/d in 1995. Crude oil imports rose by 33% from 342 thousand b/d in 1995 to 455 thousand b/d in 1996. In 1993, the country became a net overall oil importer — that is, both crude and product trade combined. Then in 1996, for the first time since 1971, China reverted to the status of a net crude oil importer. China imported 416 thousand b/d of refined products (including LPG) in 1996, up from 358 thousand b/d in 1995. Fuel oil, LPG, and diesel (mostly light diesel) constituted the majority of oil product imports in 1996, totaling 358 thousand b/d, or 88%. In 1996, China's apparent oil consumption, defined grossly as crude production plus net crude and product (excluding LPG) imports, reached 3,408 thousand b/d in 1996, up 8.3% from 1995. With adjustment of stock changes and elimination of losses, the real consumption of petroleum products (including LPG and crude oil burning) in 1996 is estimated to be 3.3 million b/d, up 6.2% from the 1995 consumption level of 3.1 million b/d.

¹ This section was prepared by Kang Wu.

During the fifteen years from 1980 to 1995, China's **natural gas** production grew at an average annual rate of only 1.5%, increasing the output from 14.3 billion cubic meters (m^3) to 17.9 billion m^3 . However, the gas industry has been boosted recently, following the completion of the gas field at Yacheng 13-1 off Hainan Island and the development of the giant Shan-Gan-Ning gas field in northern China and the Pinghu gas field off Shanghai. In 1996, China's gas output jumped 11% to reach 19.9 billion m^3 . The incremental gas production mainly comes from the offshore gas fields. China's gas market is still fragmented, and substantial investment is needed to link the producing fields and the market. At the present time, about 38% of the gas is used for fertilizer production, 15% is used as industrial fuels, 12% is used in residential sector, and up to 31% is used in the oil and gas fields. In other words, commercial gas supplied out of the oil and gas fields accounts for 69% of total gas produced in China.

China is the world's largest **coal** producer. Raw coal production amounted to 1.29 billion tonnes in 1995, more than doubling the output of 620 million tonnes in 1980. By exporting 28.6 million tonnes and importing 1.6 million tonnes, China consumed about 1.27 billion tonnes of coal in 1995. In 1996, China's coal production rose to 1.37 billion tonnes, up 6.2% from the 1995 production level. It exported 29 million tonnes and imported 3.2 million tonnes of coal (doubling the 1995 imports), resulting in an apparent coal consumption of 1.34 million tonnes. During the period 1980-1995, coal consumption in China increased at an average annual rate of 5.4% a year, faster than the average growth rate of 5.1% a year for the total primary commercial energy consumption during the same period. Coal has a vast variety of uses in China, including

power generation, residential use, steel production, and other industrial uses. Residential use of coal increased from 115.7 million tonnes in 1980 to 130.5 million tonnes in 1994, but its share in total coal use declined from 18.5% to 10.6%. At the present time, coal accounts for about two-thirds of all installed electric capacity and contributes about three-quarters of the power generated in China.

China's **electric power** generating capacity is the third largest in the world, although per capita consumption remains very low. The country's installed capacity amounted to 217 GW at the end of 1995. Electricity generation reached 1,075 TWh in 1996, 6.7% higher than the 1995 level of 1,007 TWh. During 1996, the installed generation capacity is estimated to have increased by 15 GW, of which new and expanded projects with an installed capacity of at least 25 MW accounted for 12.8 GW. The rest of the added capacity is accounted for by expansions of existing plants through technical renovation and capital replacements,² as well as new and expanded projects with capacities of less than 25 MW.³ At the end of 1996, China's total installed electric generation capacity exceeded 230

² China's installed electricity generation capacity is increased through two channels: (a) investment in basic construction, for new or expanded projects; (b) investment in technical renovations and replacements, for the expansion of existing plants.

³ According to China's current classification, a new project or the expansion of an existing plant through capital investment is considered a medium-to-large project if the added capacity is 25 MW and above. Any project with added capacity of under 25 is a small project.

GW. During 1996, 875.7 TWh or 81.5% of China's electric power was generated by thermal plants, 185 TWh or 17.2% by hydropower, and 14.3 TWh or 1.3% by nuclear power. For 1997, the Chinese government's target is to produce 1,145 TWh of electric power.

One of the important structural changes for China's power industry in late 1996 and early 1997 was the establishment of State Power (SP). SP's primary responsibilities are to administer the state assets of the utilities, to be in charge of intergrid electricity transfers, and to manage the national grids. By expanding commercial loans, issuing bonds, and borrowing from abroad, SP also plans to help Chinese power companies to strengthen their financing capabilities. Mr. Shi Dazhen, Minister of the Electric Power Industry, was appointed President of SP. As a result of these developments, the Ministry of Electric Power Industry no longer manages any electric enterprises and utilities, and will become a regulatory agency of the government.

Since the early 1980s, the government has put great emphasis on new power plant construction. China's Ninth Five-Year Plan calls for the country's installed capacity to increase to 290 GW by the end of 2000. To meet this target, approximately 15 GW of new capacity will have to be added each year during the period 1997-2000. Also according to the Plan, electric power generation is targeted to reach 1,400 TWh in 2000, translating into an average annual growth rate of 6.8% during the period 1997-2000. Given the speed of power construction during the past few years, China's targets for installed electric capacity and electricity generation for 2000 may be achievable, but huge investment, including foreign capital, is needed in the power sector. In the meantime,

China's power producers still have a long way to go to improve the industry's efficiency, profitability, and reliability in order to stay competitive, should market reforms continue in China.

II. Oil and Gas Developments, 1996-1997⁴

The following information regarding China's oil and gas production, imports, exports, and processing refers to the entire year of 1996.

- ◆ Total oil production reached 3,137 thousand barrels per day (b/d), 4.5% or 136 thousand b/d higher than the production level in 1995. Natural gas production was 19.9 billion cubic meters (m³), 11% higher than the output in 1995. Of the total crude produced, onshore oil output was 2,837 thousand b/d. Offshore oil production was 299 thousand b/d.
- ◆ China remained a net oil importer during 1996. It exported 405 thousand b/d of crude oil and 83 thousand b/d of products (excluding LPG). The crude exports were up 7.6% and the product exports were up 0.8% from 1995. Imports of crude oil and products (excluding LPG) rose to 455 thousand b/d and 316 thousand b/d, respectively, 13.3% and 9.6% higher than the imports in 1995. With overall oil imports of 771 thousand b/d and exports of 489 thousand b/d, China's net oil imports were 282 thousand b/d.
- ◆ Japan was the largest importer of Chinese crude in 1996, accounting for

⁴ This section was prepared by Xin Li and Kang Wu.

57% of China's total crude exports, followed by South Korea (16%), the US (13%), Indonesia (6%), North Korea (5%), and others. About 39% of China's refined product exports went to Hong Kong, followed by South Korea (27%) and Japan (14%). Indonesia remained the largest crude exporter to China, accounting for 28% of China's total crude imports in 1996, followed closely by Oman (25%), Yemen (16%), Iran (10%), and Angola (7%). In comparison, Singapore provided 58% of China's product imports, followed by South Korea (16%), Japan (8%), and Russia (just under 8%).

- ◆ The total processed volume of crude oil was about 3 million b/d, 5.1% higher than the refinery throughput in 1995. More of every refined product was produced in 1996 than in 1995 except for fuel oil. The results are: gasoline, 750 thousand b/d, 6.7% higher; kerosene and jet fuel, 113 thousand b/d, 21.6% higher; gasoil, 921 thousand b/d, 11.2% higher; fuel oil, 393 thousand b/d, 17.7% lower; and lubricants, 50 thousand b/d, 14.7% higher.

The following are selected important events in China's oil and gas industries in late 1996 and early 1997.

- ◆ (April 1997) CNPC's Shengli Petroleum Administration Bureau has recently succeeded in developing Chengdao offshore oil field. As the largest shallow water oil field in Bohai Bay, Chengdao can produce 21 thousand b/d of oil. Advanced offshore exploration technology, including 3D seismic and oil reservoir description, is employed in the development of the oil field. The exploration success rate has reached 100%.
- ◆ (April 1997) The Yizheng oil depot upgrading project is close to completion. The storage depot, with an annual sales capacity of 2 million tonnes, is located in Yizheng City, Jiangsu Province. The project was conducted at the Yizheng station, the Yizheng riverside metering station, and the Yizheng Changjiang River oil port for the upgrading of auxiliary heating systems, pipeline networks, storage tanks, specialized berths, and specialized meters associated with the unique quality of Orimulsion oil.
- ◆ (April 1997) The National Development Bank of China and fifteen foreign financial agencies granted a US\$100 million loan to the Daqing ethylene upgrading project. The upgrading, a key national project, involves the importation of advanced technology and equipment from foreign countries to upgrade the existing facilities of the Daqing ethylene unit. The upgrade will increase the unit's annual capacity from the present 350,000 tonnes to 480,000 tonnes and reduce energy use for ethylene production by 12%.
- ◆ (April 1997) US company DuPont and German company BASF are choosing a location for their colossal joint chemical project in the Asia-Pacific region. The 50-50 joint venture, at a total cost of between US\$750 million and US\$800 million, will manufacture feedstocks for nylon and other products from natural gas. The site of this joint venture is likely to be in China, as DuPont's business is expanding rapidly in this country, with a total investment of more than \$300

- million and a forecast business growth rate of over 25% in 1997. However, cities outside China are also being considered for siting.
- ◆ (April 1997) On February 27, 1997, Zhenhai Refinery transported 35,000 tonnes of high octane unleaded gasoline to the west coast of the United States. This is the first time that a Zhenhai product has been exported to the US, marking the beginning of its entry into the international market.
 - ◆ (April 1997) China increased import tariffs on fuel oil from 3.0% to 6.0% in April. The new import tariff rate came into force on April 1. The tariff was 12% for most of 1996; it was then reduced to 3.0% in November 1996. Officials said the cut was made to meet increased winter fuel oil demand in China at a time when international prices were hitting five-year records. SINOCEM, China's state trading firm, imports an average of 2.6 to 3.3 million barrels of fuel oil every month. Customs figures showed that China imported 154 thousand b/d of fuel oil in 1996.
 - ◆ (March 1997) Taicang gas field of CNPC has recently started production, yielding 1,000 m³ of gas daily. The field, located in the south of Jiangsu Province, is under the administration of Jiangsu Oilfield Natural Gas Development Corp. (JONGDC). The Corporation, established in August 1996, is responsible for the exploration, development, and marketing of natural gas in the region. It plans to bring annual gas sales up to 1 million m³.
 - ◆ (March 1997) An LPG joint venture agreement has been signed among Shell China Holding Corp. Ltd., Jibao Engineering Pte. Corp., and the Yangtze River Resources Development General Corp. of Zhangjiagang City. The joint venture, Zhangjiagang Shell LPG Corp. Ltd., in Zhangjiagang, Jiangsu Province, is valued at about US\$17 million. It will be engaged in importing LPG and other hydrocarbons and producing the Shell-brand LPG products for sale to industrial and residential users in Zhejiang and Jiangsu Provinces.
 - ◆ (March 1997) Luoyang Petrochemical Corp. and Tianjin Petrochemical Corp., both under Sinopec, have recently signed contracts with banks from Japan, the US, and Germany for funding their PET projects. Under the contracts, these foreign banks will provide export loans to the Chinese partners, to be used for financing the two 200,000 tonne/year PET projects. The projects, requiring a total investment of US\$430 million, are expected to be finished by the end of 2000.
 - ◆ (March 1997) In January 1997, China National Offshore Oil Corporation (CNOOC) awarded a production sharing contract to Chevron Overseas Petroleum Corporation and Petronas of Malaysia for exploring the 02/31 block in Liaodong Bay, northeast China. The block, covering an area of 5,180 km², is located about 400 km northeast of Beijing and is adjacent to Suizhong 36-1, China's biggest offshore producing oil field. The seismic survey started in December 1996 in the licensed area, which has a potential oil reserve of 1.5

billion barrels. Chevron has 60% of the project and Petronas, 40%.

- ◆ (February 1997) South Korea's Yukong Ltd. is waiting for approval to build a refinery in China. Analysts said Yukong's prospects were still uncertain after a year and 4 months' wait. However, the project could have better luck than the Royal/Dutch Shell's joint-venture project, which was dropped in February after an even longer wait. The Yukong project involves building a 100,000 b/d export refinery in Shenzhen, bordering Hong Kong. The project would include a 40,000 b/d residue fluid catalytic cracker and a 50,000 b/d residue hydro desulfuriser. Yukong had expected China would reach a decision on the refinery by early 1996, but the deadline has already passed, making analysts doubt about whether China really wants foreign refiners.
- ◆ (February 1997) Wuhu Pacific LPG Ltd., a joint venture between China and Malaysia, was set up in Anhui Province at the end of 1996. The partners, including Wuhu Municipal Fuel Corp., China Petroleum Engineering and Construction Corp., and a company from Malaysia, will invest US\$11 million to construct 4,000 m³ LPG tanks with a throughput capacity of 120,000 tonnes/year. The Malaysian company, holding a 70% stake, will be in charge of supplying LPG once the tanks are built. The project is expected to be completed in early 1998.
- ◆ (February 1997) Sinochem's LPG storage base in Dongshan Island, Fujian Province, has recently started operation. Construction of the LPG storage project was started in June 1996 and cost a total of 38 million RMB yuan. The storage facilities include four LPG tankers with a total capacity of 4,000 m³ and a 3,000 DWT berth at Dongshan harbor. Annual turnover capacity of these facilities combined is expected to reach 60,000 m³. The imported LPG will supply the local market in eastern Fujian Province.
- ◆ (February 1997) Yangzi Petrochemical Corp. of Sinopec has just started an ethylene expansion project to raise its annual production capacity from 400,000 tonnes to 600,000 tonnes. Yangzi's original ethylene cracker, with a capacity of 300,000 tonnes/year, was built in 1987 using American technology. In 1995, it was upgraded to 400,000 tonnes/year. Apart from the expansion project, Yangzi is also planning to construct another 600,000 tonnes/year ethylene complex in cooperation with Germany's BASF in 1997. Total cost for the construction project is estimated at US\$5.78 billion.
- ◆ (February 1997) A Royal/Dutch Shell joint-venture refinery project in China has been abandoned, after pending for eight years. The US\$6 billion, 160 thousand b/d refinery and petrochemical complex was waiting for state approval in December 1996, but surprisingly, the refinery project was finally dropped. Industry sources said the news would raise doubts about the future of other joint-venture refinery plans in China.
- ◆ (February 1997) Dagang Oilfield Group Corp. plans to build a refined product tank with a storage capacity of up to 1 million tonnes. In 1996, Dagang refinery increased its processing capacity from 20

thousand b/d to 50 thousand b/d. The current land transportation capacity, however, is not sufficient for delivery and marketing need. The tank will be built near the Tianjin Port, so that sea transportation can be used to relieve the bottleneck. In the meantime, two pipelines will be laid to connect Dagang refinery and the storage tank. Total investment for this project is 200 million RMB yuan (US\$24 million), which will be provided by Dagang Oilfield company and the Sales Corp. of CNPC. Dagang, as the holding company, will contribute 51% of total investment. Construction will start in May 1997 and is expected to finish by May 1998.

- ◆ (February 1997) On December 20, 1996, Zhenhai Refinery & Chemical Corp. (ZRCC) brought on stream a 24 thousand b/d hydrorefining unit. This marked the final completion of ZRCC's refinery upgrading project. The large-scale upgrading project began in late 1994 and covers seven units, including a 16 thousand b/d continuous reformation unit (which upgrades the refinery's gasoline to 90 RON), an 8 thousand b/d aromatics extraction unit, a 24 thousand b/d hydrorefining unit and other units.
- ◆ (February 1997) At the end of 1996, Shanghai Petrochemical Corp. (SPC) started its ethylene expansion project to boost the annual yield to 550,000 tonnes. The expansion, expected to be completed in early 1998, will involve one of the two existing ethylene units with annual capacities of 300,000 and 145,000 tonnes. During the first half of 1996, SPC signed an agreement with BP to build a new 650,000 tonnes/year ethylene cracker.
- ◆ (February 1997) Dow Chemical of the US is conducting a feasibility survey for constructing a large petrochemical plant in Tianjin, a port city in north China. The project under assessment includes a 600,000 tonnes/year ethylene plant and a chlorine manufacturer. The ethylene plant will use naphtha as feedstock. Dow's possible partner, Sinopec Tianjin Petrochemical Corp., currently owns an ethylene capacity of 140,000 tonnes/year.
- ◆ (January 1997) Caltex Ocean Gas and Energy Ltd., a joint venture between Caltex China Ltd. and Shantou Ocean Enterprise, appointed LG Engineering Corp. Ltd. as the major contractor to design and construct its 200,000 m³ liquefied petroleum gas (LPG) terminal at Shantou, China. LG Engineering of South Korea signed an engineering, procurement and construction contract in Shantou in January 1997. The Shantou LPG terminal is located at the Guang Ao deep-water port in the southern province of Guangdong. It will include China's first underground storage caverns and will become the largest LPG storage base on the mainland. The Shantou terminal will include a 50,000 tonnes berth, two 5,000 tonnes berths, two underground caverns with a capacity of 100,000 m³ each for the storage of propane and butane, as well as supporting facilities. The initial import target is 1 million tonnes per year once the plant is completed in 1999, and the capacity could increase to 1.9 million tonnes thereafter. Caltex holds a 60% share and Ocean Enterprises Group, 40%. Financing is expected to be raised through the International Financing Corp. of the World Bank, and a group of international commercial banks.

According to Chinese reports, the facility would have a total investment of US\$99 million, with US\$66 million in loans and US\$33 million jointly invested by Caltex and Shantou Ocean. The project has been approved by the State Planning Commission and the Ministry of Foreign Trade and Economic Cooperation.

- ◆ (January 1997) The year end of 1996 saw Daqing oil field produce 1,117 thousand b/d of crude, which surpassed the national target by 12 thousand b/d. Ever since 1975, annual production at Daqing oil field has remained at over 1 million b/d. For the last three years, Daqing's crude output has stabilized at 1.12 million b/d.
- ◆ (January 1997) In 1996, China's total ethylene output reached 3.012 million tonnes. It is estimated that the ethylene yields of China Petrochemical Corp. (Sinopec) and CNPC in 1996 increased approximately 30.97% and 0.5%, respectively, over those of 1995. Sinopec hit a record output of 2.4504 million tonnes in 1996, an increase of 0.579 million tonnes over 1995.
- ◆ (January 1997) On March 29, 1996, China's Yangzi Petrochemical Company and Germany's BASF Company agreed to invest 50 billion RMB yuan for the Yangzi-BASF integration project. The project includes installing 600,000 tonnes/year of ethylene processing facilities. Some funds for this project will come from domestic and international financial agencies. The overseas financing was completed in October 1996 in Germany, while the domestic financing started more recently. Representatives from 9 major banks, including China National Industry & Commerce Bank and China Construction Bank, participated in this project's financing activities.
- ◆ (January 1997) On December 31, 1996, Mr. Zhou Yongkang was appointed president of CNPC, replacing Mr. Wang Tao, the retired former president. Mr. Wang will serve as CNPC's senior advisor after his retirement. Three new vice-presidents were appointed. One, Mr. Ma Fucui, is a former president of Shengli Petroleum Administration Bureau. The other two, Mr. Huang Yan and Mr. Wu Yaowen, are former assistants to the president. Mr. Zhang Hong still holds his former position as vice-president.
- ◆ (January 1997) Phillips China Inc., an affiliate of Phillips Petroleum Company, has dropped its first exploratory well in China's Bohai Bay after having failed to discover commercial oil reserves. Phillips began drilling the Bozhong 1 well in June 1996, with a total depth of 14,105 feet in 85 feet of water. The drilling site is located southwest of the 2.3-million-acre Bozhong Block in the Gulf of Bohai, 150 miles east of Beijing. Phillips was granted the right to explore the Bozhong Block in 1994, under a contract with China National Offshore Oil Corp. (CNOOC). The company conducted a major seismic survey in the bay in 1995 and currently holds a 100% interest in the block. CNOOC will acquire up to a 51% interest in any proposed developments, should commercial oil or gas be discovered. The Bozhong contract area is the third Phillips-operated exploration and production project in China.

- ◆ (January 1997) Tianjin Petrochemical Corp. not long ago brought on stream a large-scale delayed coking unit. The coking unit, the third largest in China, has a processing capacity of 1 million tonnes/year and cost about 205 million RMB yuan to build. The unit was designed and constructed by Sinopec's Beijing Design Institute.
- ◆ (January 1997) In recent years, China has developed tertiary recovery techniques to enhance crude production at its mature eastern oil fields. For the next five years, China plans to implement polymer flooding and other techniques at six major oil fields and build 103 injection and terminal stations. It is expected that an additional crude output of 140 to 200 thousand b/d will be obtained by the year 2000 through these efforts.
- ◆ (January 1997) China National Petroleum Corporation (CNPC) will team up with the municipal government of Tianjin to construct the Tianjin section of the pipeline from northern Shaanxi Province to Beijing. Based on the contract recently signed by the two parties, up to 400 million m³ of natural gas will be supplied to Tianjin from northern Shaanxi by the year 2000. Test runs of the pipeline will be conducted by CNPC on July 1, 1998 and formal supply will start on January 1, 1999.
- ◆ (January 1997) On November 30, 1996, the China International Engineering Consultant Corp. approved a program to build a 2 million m³ crude depot in Huangdao, Shandong Province. The state crude depot will be used for delivering imported oil and for storage of imported and domestic crude oil. Initial work on the project has already started.
- ◆ (January 1997) On August 5, 1996, a new atmospheric and vacuum distillation installation was brought on stream in Daqing. This installation, with a capacity of 30 thousand b/d, will increase Daqing's annual crude processing capacity from 20 to 50 thousand b/d. The initial investment for the project is 1.2 billion RMB yuan.
- ◆ (January 1997) Shell has recently opened three new offices in Xi'an, Qingdao, and Dalian. The establishment of the new offices will promote Shell's marketing of lube oil in these cities and the nearby areas through cooperative services, market research, and technological exchange. Shell's participation in China's oil and gas exploration, development, and oil product trade began during the 1980s. Shell has so far set up offices in more than ten cities in China, including Beijing, Shanghai, Guangdong, Shenzhen, Chengdu, and Hangzhou.
- ◆ (January 1997) On December 17, 1996, Phillips Petroleum Corp. and China Petrochemical Corporation (Sinopec) signed a letter of intent to continue their high density polyethylene (HDPE) project. Phillips's joint venture with Sinopec started last January. The two parties signed a US\$100 million contract, with Phillips and Sinopec's Shanghai Petrochemical Corp. Ltd. holding 40% and 60% shares, respectively. The two companies have plans to make additional investment to increase the annual HDPE production capacity to 200,000 - 250,000 tonnes after 1998. About 40-49% of the needed funds for capacity

expansion is expected to come from Phillips.

- ◆ (January 1997) According to Chinese sources, China plans to import more oil in 1997 for processing by refineries and raise natural gas output to meet its ever increasing domestic demand. Nearly all of the imported oil is processed in Sinopec refineries. Sinopec's refineries processed more than 400 thousand b/d of imported oil in 1996 and are expected to process a greater volume of imported oil in 1997.
- ◆ (January 1997) Amoco of the U.S. and the Huaneng Company of China were scheduled to complete the first stage of their refrigerated LPG terminal in Taicang by January 1997. The joint project, with a capital outlay of US\$29.9 million, consists of two 31,000 m³ propane tanks and two 16-inch pipelines connecting the jetty with the tanks. The second stage of the project involves building a 38,000 m³ refrigerated butane tank and a compressor. An additional investment of US\$10 million will be needed.
- ◆ (January 1997) Two Dutch oil companies, Van Ommeren and Pakhoed, will join China's Zhuhai International Engineering and Constructing Company in building a VOPAK terminal in Zhuhai, Guangdong Province. Each of the two foreign companies will hold a 47.5% share, and the remaining 5% will be taken by the Chinese company. The first phase of the project includes a 175,000 m³ storage capacity for oil products, chemicals, and gases, at a cost of US\$85 million. Later expansion will bring the capacity up to 320,000 m³. The terminal is expected to begin operation by the end of 1998.
- ◆ (January 1997) Since its startup of operation in November 1994, the single point mooring (SPM) system in Shuidong port of Maoming Refinery has accommodated a total of over 44 million barrels of imported crude. The 250,000 tonnes/year SPM helped to save nearly 60 million RMB yuan (US\$7.2 million) in transportation costs in 1996 for the refinery. With a construction cost of 600 million RMB yuan (US\$72.3 million), the system, the first one in China, is capable of handling 280,000 tonne oil tankers.
- ◆ (December 1996) On November 19, 1996, the first production well was drilled at the Pinghu gas field in the East China Sea. Total investment for the Pinghu condensate gas field project is estimated at US\$0.56 billion. The project includes the buildup of 13 wells, a multifunction platform (drilling, producing, and accommodating), a 385 km, 14 inch sea-bed gas pipeline, and a 306 km, 10 inch sea-bed oil pipeline. In addition, an onshore gas processing plant and crude entrepot station will be constructed. The project is to be completed in 1998. Once in operation, the Pinghu field will have an annual output capacity of 0.42 to 0.5 billion m³ of natural gas and over 6 million barrels of light crude oil. A total of 1.2 million m³ of gas will be delivered to Shanghai daily, starting from the end of 1998.
- ◆ (December 1996) Qilu Petrochemical Corp. officially started its ethylene upgrading project on November 5, 1996. The project is divided into two phases. The first phase, involving the upgrading

of 330,000 tonnes of annual production capacity, was completed in 1996. The second phase of the project is to raise the production level from 330,000 tonnes per year to 450,000 tonnes per year and is expected to be completed by October 1998. Funds for the project are estimated at 4.08 billion RMB yuan (US\$491.6 million).

- ◆ (December 1996) Lanzhou Refinery and Chemical General Works recently completed a high pressure lube hydrotreater. The hydrotreater, the first of its kind in China, has an annual capacity of 8 thousand b/d. Built with the technology of French company IFP Corp., the unit yields high quality lube base oil, which will be used to blend medium and high grade lube oil. The total cost for the project is 0.6 billion RMB yuan (US\$72.3 million).
- ◆ (December 1996) America's Amoco Oriental Corp. and China's Zhejiang Provincial Economical Construction Engineering Institute plan to jointly develop China's LNG and power resources industry. Amoco has recently completed a preliminary survey to study the feasibility of an LNG depot and power plant, which are to be built in the Pearl River Delta, at a cost of US\$3 billion. The projects, if built, will supply 6 million tonnes of LNG and electricity from the 5,000 MW power plant to the city of Shanghai and to Jiangsu and Zhejiang Provinces.
- ◆ (December 1996) CNOOC recently signed a contract with three U.S. companies (KerrMcgee Petroleum Ltd., Santa Fe Energy Resources, and Sino-American Overseas Energy Corp.) to jointly explore its 27/11 block in the South China Sea. The contract was the 17th signed between CNOOC and foreign firms in 1996. The block, covering 3,050 km², is located 150 km southeast of Hong Kong in the Pearl River Mouth basin. According to the contract, the three American partners will assume all the risks in the exploration. KerrMcgee Petroleum Ltd., Santa Fe Energy Resources, and Sino-American Overseas Energy Corp. will hold 50%, 40%, and 10% shares, respectively.
- ◆ (December 1996) A 24 thousand b/d residue catalytic cracker was brought on stream by the Lanzhou Refining & Chemical Complex in late October 1996. The project, a joint venture between Sinopec and China Travel Services (Hong Kong), has expanded the refinery's processing capability of heavy residue from 18 thousand b/d to 42 thousand b/d and will increase the refinery's light product recovery rate by 7%. The total capital outlay for the project is 509 million RMB yuan, with Sinopec and China Travel Services holding 51% and 49% shares, respectively.
- ◆ (December 1996) Several steel plants and pottery kilns in east China have tried using Orimulsion with some success. This new fuel has turned out to be more economical than the old ones, such as heavy oil and oil residue. It has a higher heat value and lower steam consumption. China imported 52,000 tonnes of Orimulsion from Venezuela in September 1996 for experimental use, and will mostly likely import more.

- ◆ (December 1996) In October 1996, Sinopec's Jinan Refinery, Shangdong Province, expanded its secondary refining capacity of 100 thousand b/d with the addition of a 28 thousand b/d RCC. The newly added refining unit, a 360 million RMB yuan (US\$43.4 million) project, will enhance the production of lighter products from heavier residue oil. The Refinery also plans to develop several petrochemical projects in the future. One of the planned projects is the 70,000 tonnes/year polypropylene unit which is to be on operation by 1998.

III. Centerpiece Focus

Petrochemical Industry Outlook in China

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1. Introduction

China is the world's second largest energy consumer after the U.S., and the third largest energy producer after the U.S. and Russia. While rich in energy resources, the country lacks ready energy supplies to meet all of its growing economic and industrial needs. Meanwhile, oil consumption continues to rise rapidly. In 1993, for the first time since the mid-1960s, China became a net overall oil importer, and in 1996 it also became a net crude oil importer. For petrochemicals, which mainly use petroleum as primary feedstock, China's reliance on imports is much higher than the average share of oil imports in total petroleum product consumption.

China's petrochemical industry has achieved spectacular growth since the early 1980s. It

is one of the four pillar industries⁵ identified by the government for rapid modernization and further expansion in the 1990s and beyond. The Chinese government's strategy is to build more petrochemical facilities (although there will still not be enough to meet domestic demand in the early twenty-first century) and to reduce the overall dependence on imported chemicals. The planned expansion, along with rising demand for petrochemicals in China, has provided tremendous investment and trade opportunities for the industrial world.

2. Petrochemical Industry: Recent Developments and a Look Ahead

While China currently produces most of the refined products it needs, the country still has to import main petrochemicals in nearly every category. In 1996, China's imports of chemicals and related products amounted to US\$18.1 billion, up 4.6% from \$17.3 billion in 1995, while exports were \$8.9 billion, down 2.3% from \$9.1 billion in 1995. The trade deficit was therefore \$9.2 billion in 1996, up from \$8.2 billion in 1995. The continuous trade deficit in chemicals and petrochemical feedstock is largely due to the spectacular growth of the demand for these products in the 1990s, which has been fueled by rising living standards and a strong economy.

Among individual products, the basic organic chemical feedstock, certain synthetic petrochemicals (resins, rubbers, and fibers), fine chemicals, and fertilizers are generally in short supply, and various amounts of imports are therefore needed. In the meantime,

⁵ The other three pillar industries are mechanical engineering, electronics, and automobiles.

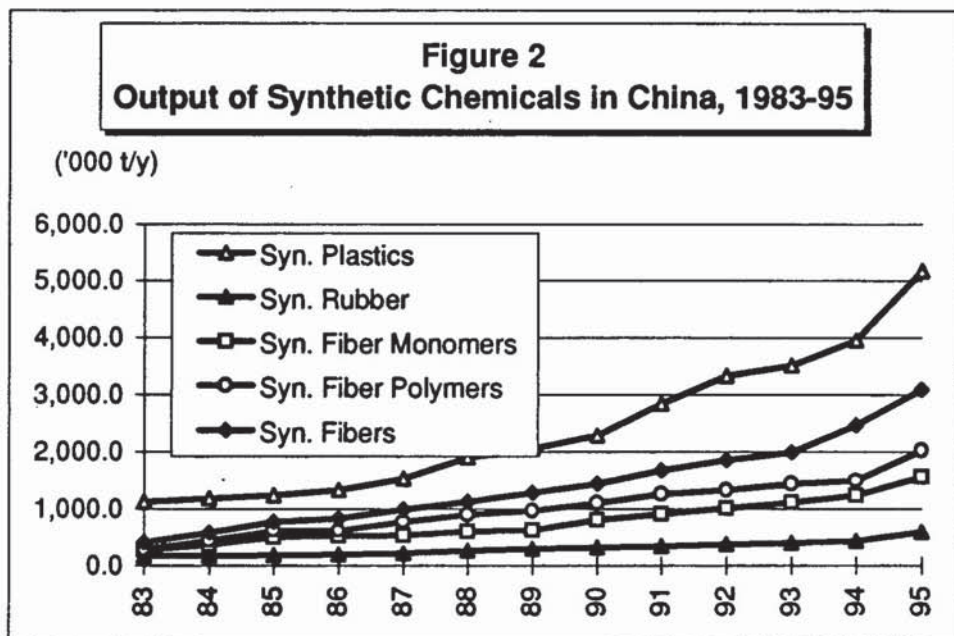
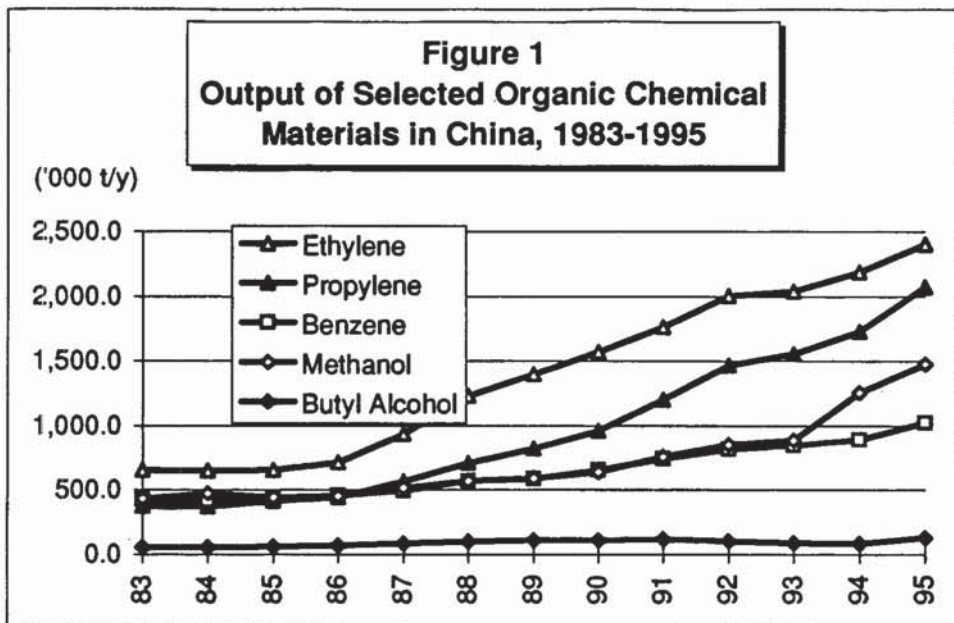
domestic production of these products has also been rising rapidly.

Olefins and aromatics are two of the basic organic chemical feedstocks in China. In 1995, China's ethylene producing capacity was 2.78 million tonnes per year (t/y). By the end of 1996, the capacity jumped to 3.86 million t/y. The ethylene production was 2.4 million tonnes in 1995 and 3 million tonnes in 1996. From 1985 to 1995, China's propylene (PP) output grew at an average annual rate of 15.4%, reaching 2.1 million tonnes in 1995. Both feedstocks are still in short supply, and new expansion projects are currently planned. For aromatics, China imported 81 thousand tonnes of benzene, 414 thousand tonnes of xylene, and 316 thousand tonnes of mixed xylene. While China remains a net exporter of pure benzene (except for 1995), the imports of xylene and mixed xylene were both larger than their respective domestic production and much larger than their respective exports in 1995. Among the intermediate organic chemical feedstocks, methanol production increased very rapidly, up from 443 thousand tonnes in 1985 to 640 thousand tonnes in 1990 and 1.48 million tonnes in 1995. Phenol is in short supply, and imports account for nearly half of the country's demand. From 1992 to 1995, China's phenol production increased only from 101 thousand t/y to 112 thousand t/y, whereas imports tripled from 28 thousand t/y to 93 thousand b/d. Figure 1 shows the output of selected organic chemical materials in China during the period 1983-1995.

China needs to import large amounts of various synthetic resins (plastics). Total production of plastics reached 5.2 million tonnes in 1995, up from 2.3 million tonnes in

1990 and 1.2 million tonnes in 1985 (Figure 2). In 1995, China produced 1.37 million tonnes of polyethylene (PE) but imported 1.83 million tonnes, up from 949.8 thousand and 653 thousand tonnes, respectively, in 1991. The imports of PE further increased to 2.19 million tonnes in 1996. China is also a large importer of polystyrene (PS). From 1991 to 1995, while domestic production increased from 108 thousand t/y to 230 thousand t/y, imports jumped from 272 thousand t/y to 1.1 million t/y. For polypropylene (PP), domestic demand exceeds domestic production by about 50%. In 1995, China produced 1.1 million tonnes of PP, and the consumption amounted to 2.2 million tonnes. In both 1995 and 1996, the PP imports remained at about 1.1 million tonnes. For ABS resins, nearly all of the consumption is imported. From 1990 to 1995, imports of ABS resins increased more than sevenfold, from 108 thousand to 804 thousand tonnes—and further increased to 992 thousand tonnes in 1996. China is also a large importer of polyvinyl chloride (PVC). In 1995, China produced 1.4 million tonnes of PVC and imported 1.2 million tonnes. The imports increased to 1.4 million tonnes in 1996.

China has fairly large production capacities for various synthetic fibers, synthetic fiber monomers and polymers, but the utilization rates of these facilities are not high enough to produce enough for the domestic markets. Certain synthetic monomers need to be imported. In 1995, the share of imports in consumption was 55% for caprolactam, 35% for nylon 66 salt, 31% for purified terephthalic acid (PTA), and 22% for acrylonitrile in 1995. The PTA and caprolactam imports in 1996 were 448 and 155 thousand tonnes, respectively. Total



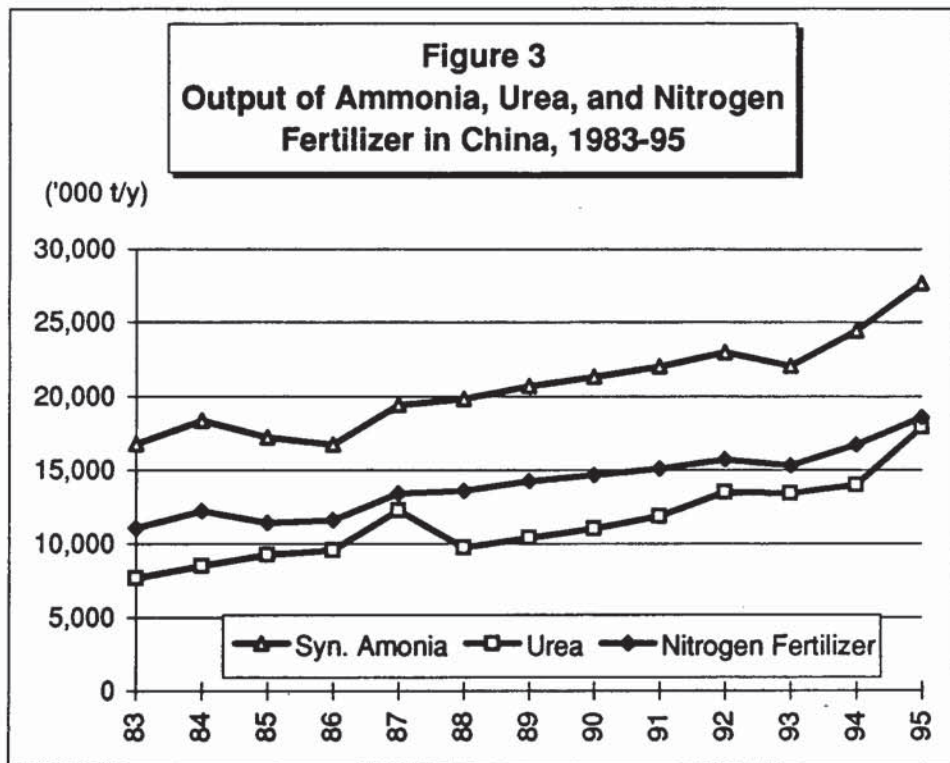
synthetic monomer production was 1.56 million tonnes, up from 799 thousand tonnes in 1990 (see Figure 2). For synthetic fiber polymers, the shares of imports in total consumption are relatively small, except for fiber polypropylene (PP). Production of total

synthetic fiber polymers increased from 607 thousand tonnes in 1985 to 1.1 million tonnes in 1990 and 2 million tonnes in 1995 (see Figure 2). In 1995, China imported 107 thousand tonnes of fiber PP, which represents 63% of the domestic consumption. For major synthetic fibers,

China imported 342 thousand tonnes of polyester and 374 thousand tonnes of acrylic fiber. The imports increased to 460 and 478 thousand tonnes, respectively, in 1996.

China currently needs to import a certain amount of synthetic rubber to meet its domestic demand. In 1995, China produced 586 thousand tonnes of synthetic rubber (see Figure 2) and imported 311 thousand tonnes. The imports increased to 367 thousand in 1996. During the period 1990-1995, polybutadiene rubber (BR) production increased at an average annual rate of 13.5%, while consumption was up 15.3% each year on average.

China is one of the world's largest chemical fertilizer producers, but its production still falls far short of demand. In 1995, China produced 25.46 million tonnes of chemical fertilizer; 73% of this amount (18.6 million tonnes) was nitrogenous fertilizer. The country also had record high fertilizer imports of nearly 2 million tonnes in 1995. It took months for China to absorb the over-imports in 1995, which led to a fall in fertilizer prices during the next year. In 1996, imports decreased to 1.86 million tonnes. Production of synthetic ammonia and urea also increased in recent years, reaching 27.7 and 18.9 million tonnes, respectively, in 1995 (Figure 3).



Not all petrochemicals are in short supply in China. The country has surplus or enough capacity for chlo-alkali especially caustic

soda, and certain synthetic fibers. On an overall basis, however, the domestic production cannot meet the demand for

major petrochemicals. The government therefore attaches great importance to the development of the petrochemical industry over the next ten to fifteen years. The prospects for China's petrochemical sector development in the near future are generally bright. Potential petrochemical investment opportunities are therefore huge, especially in areas where domestic production capacities are well below the consumption levels. In this regard, foreign investment is needed in China to help expand the country's petrochemical production capabilities.

3. Ethylene: Current Situation and Future Prospects

Ethylene is one of the most important organic chemical feedstocks for final petrochemicals. The size of a country's petrochemical base is often described by its ethylene capacity. China's ethylene capacity has been expanded vigorously since the beginning of the 1990s, and further expansion of capacity is under way or planned for the coming years.

At the present time, China's 16 major ethylene complexes have a combined capacity of 3.85 million t/y. Seven of the 17 complexes have capacities of over 300 thousand t/y—the largest one being Yanshan Petrochemical Corp.'s 450 thousand t/y units. Of the total existing capacity, 1.53 million t/y, or nearly 40% of the existing capacity, was added during the period 1994-96. In 1996, four new plants with a total capacity of 840 thousand t/y were added, including Maoming, Guangzhou, Jilin, and Tianjin. All but the Jilin plant belong to Sinopec.

Sinopec's existing ethylene capacity is 2.86 million tonnes, accounting for 74% of the national total. China National Petroleum

Corp. (CNPC) currently owns three plants with a total capacity of 410 thousand tonnes. The Ministry of Chemical Industry (MOCI) now has two complexes with a combined capacity of 580 thousand t/y. The latest addition to MOCI is the 300 thousand t/y unit by Jilin Chemicals Inc., which increases total capacity to 440 thousand t/y at this site.

As the capacity has expanded, ethylene production has likewise increased rapidly. According to Chinese government sources, ethylene output reached a record high of 3.012 million tonnes in 1996, up 24% from 1995. During the period 1985-96, ethylene production in China grew at an average annual rate of 14.9%, up from 652 thousand t/y in 1985 to over 3 million t/y in 1996. Production from Sinopec reached 2.45 million tonnes in 1996, or more than 81% of the country's output, down from 92% in 1990. Sinopec's ethylene recovery rate has been raised by 0.5 percentage point. Feedstock consumption has at the same time fallen by 40 kg/tonne. In 1996, several companies increased their production of ethylene, owing to the great demand for intermediate and final petrochemical products in China. Major producing companies include:

- Yanshan Petrochemical Corp., which logged an output of 463,000 tonnes, exceeding its expanded capacity of 450,000 t/y;
- Yangzi Petrochemical Corp., which announced that its output by the end of 1996 would reach 410,000 tonnes, thus surpassing its capacity of 400,000 tonnes/year;
- Daqing Petrochemical General Plant, which fulfilled its goal of 350,000 tonnes last year, with an average daily output of 1,000 tonnes;

- Qilu Petrochemical Corp. in east China, which produced 348,100 tonnes in 1996, after boosting its ethylene capacity to 330,000 tonnes/year;
- Shanghai Petrochemical Corp., with a yearly ethylene capacity of 445,000 tonnes/year, posted a record high 465,000 tonnes; and
- Fushun Petrochemical Corp., whose 1996 production (its first year of output) was 115,000 tonnes.

The Qilu Petrochemical Industry Corporation upgraded its facilities in 1996 and imported a 140,000 tonne low density ethylene unit. The project was meant to expand production, optimize product structure, improve product quality, and increase profits. In March of last year Germany's BASF signed a letter of intent with Sinopec's Yangzi Petrochemical Works to help build 600,000 t/y of ethylene capacity. Other major ethylene producers in China last year included Liaoyang Petrochemical Fiber Corporation (89,000 tonnes), Tianjin Petrochemical Corporation (80,000 tonnes), and Maoming Petrochemical Corporation (54,600 tonnes).

China's ethylene producing capability is set to expand over the next fifteen years. By 2000, a total of 1.15 million tonnes of ethylene capacity is likely to be added, raising the country's refining capacity to 5 million tonnes. All of the likely new capacities by 2000 are expansions of the existing ones, although some grass-roots projects may finish early. Between 2000 and 2010, it is possible and probable that additional plants with a total capacity of 5.9 million t/y (many of which are grass-roots plants) will be constructed, increasing the country's overall capacity to 8.8 million t/y in 2005 and 10.9 million t/y in 2010. Many

of these projects, however, are merely on the planning board, and much remains to be seen for the implementation of these plans.

4. The Role of Government and Foreign Investment

In China, nearly all large petrochemical plants are state owned. The most important players in the area are Sinopec and MOCI. Sinopec builds its huge petrochemical facilities based on its large refineries. In 1995, Sinopec had shares of more than two-thirds in the national total outputs for each of the following products: ethylene, propylene, PE, PP, total synthetic rubbers, BR, SBR, total synthetic monomers, PTA, DMT, etc. (Table 1). However the declining of Sinopec's shares for many petrochemicals during the first half of the 1990s indicated a trend of diversification of the petrochemical ownership in China. MOCI is another huge producer of petrochemicals and chemicals. It has a dominant share in the production of synthetic fibers, synthetic ammonia, chemical fertilizer, urea, caustic soda, and certain fine chemicals. Some small to medium-size plants belong to local governments and CNPC.

The Chinese government's targets for 2000 are to produce 5 million tonnes of ethylene and to greatly expand the producing capacities of other organic chemical materials and petrochemicals. By 2010, the government hopes to raise ethylene output to 8-10 million tonnes. To realize these targets, both Sinopec and MOCI have adopted strategies of building large chemical producing facilities, in order to realize economies of scale, and of calling for large amounts of foreign investment. Sinopec's slogan for years has been "large, advanced, progressive, intensive," meaning a strategy of large enterprises, advanced technologies, progressive development, and intensive

Table 1
Sinopec's Share of Petrochemical Production, 1985-95
(percent)

Product	1985	1990	1995
Ethylene	84.5	91.6	84.6
Propylene	87.1	94.1	88.3
Synthetic Resins (Plastics)	40.4	59.5	48.4
PE	98.2	99.2	87.5
PP	95.0	91.1	83.0
PS	82.2	75.9	39.1
PVC	0.0	17.2	12.1
Synthetic Rubbers	71.0	75.3	68.3
BR	100.0	100.0	97.3
SBR	51.5	66.8	70.3/a
Synthetic Fibre Monomers	98.7	98.9	85.2
PTA	100.0	100.0	84.0
DMT	100.0	100.0	97.9
Synthetic Fiber Polymers	73.6	45.8	32.6
Synthetic Fibres	40.0	28.0	17.8
Polyester Fibre	35.9	21.9	22.4
Synthetic Ammonia	15.0	15.0	12.7
Nitrogen Fertilizer (100% N base)	16.5	15.8	13.8
Urea	42.1	45.0	30.7

a. Refers to 1994.

Source: East-West Center Energy Database.

operations strategy. Its management strategy is "conglomeration, internationalization, shareholding system, and diversification." MOCI's top strategies are to establish large enterprises, large corporate groups, and major production bases. In doing so, the existing enterprises may be restructured and merged. With these strategies adopted, Sinopec and MOCI have aimed to substantially increase China's domestic supply of petrochemicals by 2000 and beyond. However, self-sufficiency is not and should not be the ultimate target of the government. The government policies for petrochemical development are driven

largely by the demand and the high value-added realized by the petrochemical industry. Under these circumstances, China is expected to continue to import large amounts of petrochemicals in the future, although the shares of imports in total consumption could be declining.

Foreign investment and advanced technologies are considered very necessary to enable Sinopec and MOCI to realize their ambitious targets. Indeed, foreign technology acquisition has played a key role in the modernization of the Chinese petrochemical industry. For instance, all the existing

ethylene plants with capacities of over 300,000 t/y use imported technology. Of the installed ethylene units in China, the Lummus design accounts for over 60%. Foreign investment is also indispensable for China's petrochemical expansion. Already, international majors and foreign companies have invested hundreds of millions of dollars in various petrochemical joint ventures in China. Most major new ethylene projects are indeed contracted with foreign companies. Joint venture projects account for over 80% of the possible ethylene capacity additions during the period 2000-2005. In short, without foreign investment and technology acquisition, future development and expansion of China's petrochemical industry would be constrained.

The biggest challenge to foreign investors is overcoming the numerous barriers—including a long approval process, lack of infrastructure, and lack of stable feedstock supply—in order to enter China's petrochemical sector. Foreign joint venture partners also have to face the increasingly competitive market, which can be flooded by both domestically produced products and high-quality (but not necessarily expensive) imported petrochemicals, as the liberalization of the economy and economic reform continue in China.

5. Concluding Remarks

China's petrochemical industry expanded successfully in the 1980s and especially the 1990s. The future of China's petrochemical industry, though full of uncertainties, appears promising. Several factors contributed to the rapid development of China's modern petrochemical industry during the 1980s; these factors will also affect developments during the rest of the decade. First, a fast-growing economy provides unprecedented

impetus for the expansion of the petrochemical industry. Second, the nearly two-decade-long open-door policy and a speedup of economic reform since early 1992 have brought a huge amount of foreign investment and technologies to China, which are particularly necessary for the petrochemical industry. Indigenous technologies still lag behind in China compared with those in the industrialized world. Third, the efforts of the government to convert its petrochemical industry into a world-class industry have also been crucial for the industry's expansion. Finally, the industrial world and international petrochemical companies continue to demonstrate a strong interest in the Chinese petrochemical industry. They will provide part of the capital needed for the industry's modernization and expansion.

IV. Review of Recent Electricity Developments⁶

Foreign attitudes toward investing in China's power industry seem to shift every few years between periods of extreme optimism, if not euphoria, and periods of pessimism. At the moment we seem to be shifting back toward optimism. This will be the second such phase during the 1990s.

McGraw-Hill recently identified sixteen operating private power plants in China with a total capacity of 4,919 MW. This capacity rated China number two among nations (excluding Canada and the United States) that are open to private power investments. Over half of this capacity, 2,680 MW, was in the Shajiao B and C power plants of

⁶ This section was prepared by Ronald Hagen.

Consolidated Electric Power Asia (CEPA), which were initiated in the late 1980s and early 1990s.

The Shajiao plants initiated a stampede of would-be investors, in which virtually every international power generating firm created plans to invest in China. China's power industry's bureaucracy fully saw the benefits of international capital and technology infusions that might come with such investments, but had not fully adjusted institutionally to the idea of such activity in a "domestic" market. This lack of preparedness found China with an array of regulatory requirements and initiated detailed planning discussions that made the process of approving power investments seem unending. Regulators were also concerned with issues that were unpopular with investors, such as placing caps on investors' rates of returns and pricing retail electricity below wholesale prices.

Moreover, policy decisions and positions at local government levels often seemed inconsistent with central government policies. Consequently, during several years of the early to mid-1990s, no private foreign investment in the power sector was fully approved, and no unified national law governed such enterprises. China thus earned a reputation as an area that was effectively closed to private power plant investments.

Times may have recently changed in China's power sector. A Vice Minister of Electric Power has recently stated that China will require an additional 14,000 MW of generating capacity each year to meet the ambitious schedules of the 1995-2000 Ninth Five-Year Plan. He added that one-fifth of this amount, 2,800 MW, might involve private, presumably foreign, investment

sources. The remainder would be developed by central and local government agencies.

Another Ministry official has said that there no longer are ceilings or caps on rates of return that are permitted to foreign power sector investors. Returns are now determined through negotiation and are tailored to particular projects. While the uncertainty of potentially extended negotiations concerning returns is not welcomed by most investors, an end to caps on returns is a considerable improvement over former policies that discouraged many outsiders in the early to mid-1990s. Many problems also remain in the power sector, including inconsistent power pricing policies and weak laws governing the industry.

At least three means actually developed during the mid-1990s when most people considered China's power sector closed. These now facilitate foreign investments in China's power industry. These were: (1) investors could build small power plants in cooperation with local utilities and institutions; (2) a firm could supply equipment or technological services for larger plants; or (3) one might buy shares in the China Huaneng Group or one of its affiliates.

Small power plants have the advantage of bypassing many regulations of the State Planning Commission (SPC), which are seen as having delayed larger investments. Instead, an investor negotiates primarily with local power authorities and purchasers, and proceeds under local approvals. Small projects would also disperse and reduce the risks of investing in a nation, China, that is sometimes not seen as fully open to foreign investments. Examples of such investors include AES Chigen, Sithe Energies,

Coastal, Enron, Cheung Kong, and Sikap. Each of these firms now has several plants completed or in advanced stages of construction. Plants are generally below 100 MW, though they might include several stages totaling in excess of 100 MW. Initial investments have often used equity rather than debt. Debt is then introduced after the project is initiated. Similarly, other, often local, partners are allowed to buy into the project once it is started. There is now a significant rush of firms seeking to initiate such projects. Among the firms now taking this approach is Britain's National Power.

Investments in equipment and technology (including contracting) in power plants has been less visible than equity investments in China, but such contracts probably have a more significant total value. Foreign equipment makers must compete with Chinese manufacturers, many of whom claim low costs. This has led several foreign manufacturers to locate plants within China. Because China is also a large market for power equipment, there probably has not been much coercion in the process. Nuclear plants have also involved considerable foreign technology with French, Canadian, and Russian firms active in projects.

The China Huaneng Group is an umbrella organization for several state controlled firms that operate power plants throughout China. Shares in Huaneng itself and in some of its affiliates (notably Shandong Huaneng) are traded on international exchanges. Control of Huaneng's assets remains under the control of Huaneng and the Ministry of Electric Power. Huaneng has lately shown an interest in joint ventures with foreign firms. An investor who wants a degree of control over his funds might thus not be interested in Huaneng shares themselves, though the

Group or one of its components might become an avenue for investments.

There are also several new approaches to power investments now developing in China. During 1996 China reorganized its build-operate-transfer (BOT) contracting system, which had become inactive following the Shajiao C project. BOT contracts are awarded under bidding arrangements, and at least two projects—Laibin B (700 MW) and Zhuhai (2,640 MW initially)—won initial approval during 1996. Unlike the small power plant projects, a large portion of BOT negotiations must be undertaken with central government approvals as well as local regulations. Because the BOT contracts have only recently been issued, such projects are only now entering construction phases. Experience might lead to yet more new investment arrangements that might eventually not require the transfer of assets.

Another recent innovation in China has been "strategic alliances" between Chinese interests and foreign power firms. In September 1996, for example, Exxon Energy, Duke Energy, and China Huaneng Group signed a memorandum to jointly develop power projects in China. Exxon had previously developed an investment relationship with Hong Kong's China Light and Power (CLP), covering many investments in China and elsewhere. CLP in turn has recently permitted investment in its shares by the China International Trade and Investment Corp. (CITIC). Another alliance has arisen from a recent agreement between Sithe Energies (U.S. based but 29% owned by Japan's Marubeni) and China National Offshore Oil Company (CNOOC) to jointly produce power from gas discovered by CNOOC off Hainan Island.

Finally, the Ministry of Electric Power itself has been undergoing reorganization. Business activities of the Ministry have been incorporated under a single umbrella organization, State Power (SP). While SP seeks to unite China's many power grids under a single corporate umbrella, officials also envision that SP will facilitate many joint ventures on the local level with foreign firms. SP is thus both a centralizing of China's power bureaucracy and a potential means for freeing access to local business opportunities. This decision to centralize the industry is a unique approach to power when compared with most of Asia, where decentralization is now the rule. The joint venture approach, though, is more in line with other Asian practices. Future policy

shifts will probably be based on the future success of each element.

China is too large for any one conclusion to represent a universal "truth." If China's power industry is not yet fully corporatized, corporations have been rapidly developed. Corporations at local, provincial, and national levels are now active in the industry, and more are slated. It can reasonably be expected that local power institutions will increasingly resemble private firms. If so, it will only be a matter of time before such firms seek to invest outside their present market territories. The next few years in China's power sector might thus be very interesting indeed.

V. Statistical Appendix

Table 1
China: Major Economic Indicators, 1996

Indicator	Unit	Value	Percentage change over 1995*
GDP	Rmb billion	6,780.0	9.7
Gross Value of Industrial Output	Rmb billion	1,906.2	13.1
Total Investment in Fixed Assets	Rmb billion	2,380.0	12.5
Retail Sales of Consumer Goods	Rmb billion	2,461.4	13.0
Foreign Trade	US\$ billion	289.9	3.2
Exports	US\$ billion	151.1	1.5
Imports	US\$ billion	138.8	5.1

*All in real terms except for foreign trade.

Errata

In Table 1 of Vol.3, No.4 (December 1996), the state investment in fixed assets during January-September 1996 should be 826.1 Rmb billion Yuan.

Table 2a
China: Primary Energy Balance
Third Quarter 1996 Balance: Original Units (Final)

	Unit	Production	Export	Import	Apparent Consumption
Petroleum					
Jul	kt	13,437	1,900	3,280	14,817
Aug	kt	13,139	2,870	3,330	13,599
Sep	kt	12,834	1,480	2,530	13,884
IIIQ	kt	39,410	6,250	9,140	42,300
Crude Oil					
Jul	kt	13,437	1,660	1,560	
Aug	kt	13,139	2,370	1,880	
Sep	kt	12,834	1,360	1,380	
IIIQ	kt	39,410	5,390	4,820	
Products					
Jul	kt		240	1,720	
Aug	kt		500	1,450	
Sep	kt		120	1,150	
IIIQ	kt		860	4,320	
Natural Gas					
Jul	mmcm	1,594	0	0	1,594
Aug	mmcm	1,568	0	0	1,568
Sep	mmcm	1,652	0	0	1,652
IIIQ	mmcm	4,814	0	0	4,814
Coal					
Jul	kt	114,932	1,990	200	113,142
Aug	kt	110,723	3,590	280	107,413
Sep	kt	114,425	3,160	480	111,745
IIIQ	kt	340,081	8,740	960	332,301
Hydroelectricity					
Jul	GWh	19,300	0	0	19,300
Aug	GWh	21,085	0	0	21,085
Sep	GWh	18,733	0	0	18,733
IIIQ	GWh	59,118	0	0	59,118
Nuclear Power					
Jul	GWh	1,373	0	0	1,373
Aug	GWh	1,458	0	0	1,458
Sep	GWh	1,610	0	0	1,610
IIIQ	GWh	4,441	0	0	4,441

kt=thousand tonnes; mmcm=million cubic meters.

Table 2a, Continued
China: Primary Energy Balance
Third Quarter 1996 Balance: Standard Units (Final)

	Unit	Production	Export	Import	Apparent Consumption
Petroleum					
Jul	kboe/d	3,164	447	772	3,489
Aug	kboe/d	3,094	676	784	3,202
Sep	kboe/d	3,123	360	616	3,378
IIIQ	kboe/d	3,127	496	725	3,356
Crude Oil					
Jul	kboe/d	3,164	391	367	
Aug	kboe/d	3,094	558	443	
Sep	kboe/d	3,123	331	336	
IIIQ	kboe/d	3,127	428	382	
Products					
Jul	kboe/d		57	405	
Aug	kboe/d		118	341	
Sep	kboe/d		29	280	
IIIQ	kboe/d		68	343	
Natural Gas					
Jul	kboe/d	349	0	0	349
Aug	kboe/d	344	0	0	344
Sep	kboe/d	374	0	0	374
IIIQ	kboe/d	356	0	0	356
Coal					
Jul	kboe/d	13,532	234	24	13,322
Aug	kboe/d	13,037	423	33	12,647
Sep	kboe/d	13,922	384	58	13,596
IIIQ	kboe/d	13,492	347	38	13,184
Hydroelectricity					
Jul	kboe/d	391	0	0	391
Aug	kboe/d	427	0	0	427
Sep	kboe/d	392	0	0	392
IIIQ	kboe/d	404	0	0	404
Nuclear Power					
Jul	kboe/d	28	0	0	28
Aug	kboe/d	30	0	0	30
Sep	kboe/d	34	0	0	34
IIIQ	kboe/d	30	0	0	30
Total					
Jul	kboe/d	17,465	682	796	17,579
Aug	kboe/d	16,931	1,099	817	16,650
Sep	kboe/d	17,845	745	674	17,774
IIIQ	kboe/d	17,409	843	763	17,330

kboe/d=thousand barrels of oil equivalent per day.

Table 2b
China: Primary Energy Balance
Fourth Quarter 1996 Balance: Original Units (Preliminary)

	Unit	Production	Export	Import	Apparent Consumption
Petroleum					
Oct	kt	13,401	2,950	4,160	14,611
Nov	kt	13,120	1,690	3,350	14,780
Dec	kt	13,228	3,410	4,050	13,868
IVQ	kt	39,750	8,050	11,560	43,260
Crude Oil					
Oct	kt	13,401	2,640	2,730	
Nov	kt	13,120	1,410	2,120	
Dec	kt	13,228	2,370	2,090	
IVQ	kt	39,750	6,420	6,940	
Products					
Oct	kt		310	1,430	
Nov	kt		280	1,230	
Dec	kt		1,040	1,960	
IVQ	kt		1,630	4,620	
Natural Gas					
Oct	mmcm	1,713	0	0	1,713
Nov	mmcm	1,719	0	0	1,719
Dec	mmcm	1,626	0	0	1,626
IVQ	mmcm	5,058	0	0	5,058
Coal					
Oct	kt	119,530	3,170	210	116,570
Nov	kt	118,092	1,740	160	116,512
Dec	kt	127,808	4,020	360	124,148
IVQ	kt	365,430	8,930	730	357,230
Hydroelectricity					
Oct	GWh	16,663	0	44	16,707
Nov	GWh	14,486	0	20	14,506
Dec	GWh	13,180	0	18	13,198
IVQ	GWh	44,329	0	83	44,412
Nuclear Power					
Oct	GWh	1,548	0	0	1,548
Nov	GWh	1,354	0	0	1,354
Dec	GWh	1,091	0	0	1,091
IVQ	GWh	3,993	0	0	3,993

kt=thousand tonnes; mmcm=million cubic meters.

Table 2b, Continued
China: Primary Energy Balance
Fourth Quarter 1996 Balance: Standard Units (Preliminary)

	Unit	Production	Export	Import	Apparent Consumption
Petroleum					
Oct	kboe/d	3,156	695	980	3,441
Nov	kboe/d	3,193	411	815	3,596
Dec	kboe/d	3,115	803	954	3,266
IVQ	kboe/d	3,154	639	917	3,433
Crude Oil					
Oct	kboe/d	3,156	622	643	
Nov	kboe/d	3,193	343	516	
Dec	kboe/d	3,115	558	492	
IVQ	kboe/d	3,154	509	551	
Products					
Oct	kboe/d		73	337	
Nov	kboe/d		68	299	
Dec	kboe/d		245	462	
IVQ	kboe/d		129	367	
Natural Gas					
Oct	kboe/d	376	0	0	376
Nov	kboe/d	389	0	0	389
Dec	kboe/d	356	0	0	356
IVQ	kboe/d	374	0	0	374
Coal					
Oct	kboe/d	14,074	373	25	13,725
Nov	kboe/d	14,368	212	19	14,176
Dec	kboe/d	15,048	473	42	14,617
IVQ	kboe/d	14,498	354	29	14,173
Hydroelectricity					
Oct	kboe/d	338	0	1	338
Nov	kboe/d	303	0	0	304
Dec	kboe/d	267	0	0	267
IVQ	kboe/d	303	0	1	303
Nuclear Power					
Oct	kboe/d	31	0	0	31
Nov	kboe/d	28	0	0	28
Dec	kboe/d	22	0	0	22
IVQ	kboe/d	27	0	0	27
Total					
Oct	kboe/d	17,974	1,068	1,005	17,911
Nov	kboe/d	18,281	623	835	18,493
Dec	kboe/d	18,809	1,276	996	18,529
IVQ	kboe/d	18,356	993	947	18,309

kboe/d=thousand barrels of oil equivalent per day.

Table 3a
China: Value of Energy Trade
Third Quarter 1996: '000 US\$ (Final)

	Export	Import	Balance
Petroleum			
Jul	258,066	485,782	(227,716)
Aug	424,833	483,390	(58,557)
Sep	212,989	357,678	(144,689)
IIIQ	895,888	1,326,850	(430,962)
Crude Oil			
Jul	211,319	225,559	(14,240)
Aug	322,002	278,899	43,103
Sep	186,635	201,063	(14,428)
IIIQ	719,956	705,521	14,435
Products			
Jul	46,747	260,223	(213,476)
Aug	102,831	204,491	(101,660)
Sep	26,354	156,615	(130,261)
IIIQ	175,932	621,329	(445,397)
Coal			
Jul	82,435	8,047	74,388
Aug	132,440	12,176	120,264
Sep	117,066	24,664	92,402
IIIQ	331,941	44,887	287,054
Hydroelectricity			
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
IIIQ	0	0	0
Total Energy			
Jul	340,501	493,829	(153,328)
Aug	557,273	495,566	61,707
Sep	330,055	382,342	(52,287)
IIIQ	1,227,829	1,371,737	(143,908)

Table 3b
China: Value of Energy Trade
Fourth Quarter 1996: '000 US\$ (Preliminary)

	Export	Import	Balance
Petroleum			
Oct	427,429	627,398	(199,969)
Nov	283,654	567,819	(284,165)
Dec	590,983	672,819	(81,836)
IVQ	1,302,066	1,868,036	(565,970)
Crude Oil			
Oct	361,291	414,240	(52,949)
Nov	220,377	353,619	(133,242)
Dec	366,443	348,284	18,159
IVQ	948,111	1,116,143	(168,032)
Products			
Oct	66,138	213,158	(147,020)
Nov	63,277	214,200	(150,923)
Dec	224,540	324,535	(99,995)
IVQ	353,955	751,893	(397,938)
Coal			
Oct	127,867	7,935	119,932
Nov	66,811	8,243	58,568
Dec	152,181	16,160	136,021
IVQ	346,859	32,338	314,521
Hydroelectricity			
Oct	0	1,004	(1,004)
Nov	0	466	(466)
Dec	0	356	(356)
IVQ	0	1,826	(1,826)
Total Energy			
Oct	555,296	636,337	(81,041)
Nov	350,465	576,528	(226,063)
Dec	743,164	689,335	53,829
IVQ	1,648,925	1,902,200	(253,275)

Table 4
China: Crude Oil Exports by Destination
Fourth Quarter 1996

Destination	tonnes	b/d
Japan	3,185,391	252,754
South Korea	1,346,872	106,871
U.S.	1,208,699	95,908
Indonesia	244,074	19,367
North Korea	187,455	14,874
Philippines	108,326	8,595
Others	142,182	11,282
Total	6,422,998	509,651

Note: A standard conversion factor is used for numbers expressed in b/d.

Table 5
China: Product Exports by Destination
Fourth Quarter 1996

Destination	tonnes	b/d
Hong Kong	619,722	49,174
South Korea	431,410	34,231
Japan	187,786	14,900
Singapore	114,245	9,065
Russia	55,874	4,434
Panama	32,683	2,593
Taiwan	29,376	2,331
Vietnam	29,294	2,324
North Korea	23,887	1,895
Thailand	15,605	1,238
Burma	11,286	896
Macau	10,944	868
Germany	7,240	574
U.S.	7,043	559
France	5,206	413
Switzerland	4,834	384
Greece	4,349	345
Norway	4,083	324
Cyprus	3,371	267
St. Vincent & Gren	3,134	249
Others	35,123	2,787
Total	1,636,495	129,852

Note: A standard conversion factor is used for numbers expressed in b/d.

Table 6
China: Crude Oil Imports by Sources
Fourth Quarter 1996

Source	tonnes	b/d
Indonesia	2,461,423	195,309
Oman	1,538,355	122,065
Iran	847,786	67,270
Yemen	637,480	50,583
Vietnam	514,788	40,847
Angola	260,379	20,660
Papua New Guinea	257,026	20,394
Russia	186,731	14,817
Congo	125,517	9,960
U.S.A.	111,426	8,841
Others	14	1
Total	6,940,925	550,747

Note: A standard conversion factor is used for numbers expressed in b/d.

Table 7
China: Product Imports by Sources
Fourth Quarter 1996

Source	tonnes	b/d
Singapore	2,444,753	193,986
South Korea	788,783	62,588
Japan	460,736	36,558
Russia	418,457	33,204
U.S.	101,576	8,060
Saudi Arabia	81,243	6,446
Kuwait	70,421	5,588
Philippines	61,105	4,849
Malaysia	53,188	4,220
India	32,524	2,581
Belorussia	27,319	2,168
Hong Kong	22,153	1,758
Bahrain	20,000	1,587
Others	37,344	2,963
Total	4,619,602	366,555

Note: A standard conversion factor is used for numbers expressed in b/d.

Table 8
China: Crude Oil Exports by Destination
(1996 Total)

	tonnes	b/d
Japan	11,580,919	230,986
South Korea	3,158,734	63,002
U.S.	2,654,150	52,938
Indonesia	1,145,918	22,856
North Korea	936,170	18,672
Singapore	395,461	7,888
Philippines	225,528	4,498
Australia	163,544	3,262
Thailand	68,923	1,375
Others	0	0
Total	20,329,346	405,476

Note: A standard conversion factor is used for numbers expressed in b/d.

Table 9
China: Products Exports by Destination
(1996 Total)

	tonnes	b/d
Hong Kong	1,588,996	31,693
South Korea	1,067,127	21,284
Japan	552,250	11,015
Singapore	162,355	3,238
Panama	108,501	2,164
Taiwan	76,735	1,530
Thailand	74,558	1,487
Vietnam	70,123	1,399
Russia	68,082	1,358
North Korea	66,533	1,327
U.S.	26,666	532
Germany	25,167	502
Greece	19,897	397
Mozambique	19,748	394
Switzerland	18,362	366
Macau	17,992	359
France	17,135	342
Burma	16,828	336
St. Vincent & Gren	14,149	282
Philippines	13,290	265
Others	153,532	3,062
Total	4,178,026	80,270

Note: A standard conversion factor is used for numbers expressed in b/d.

Table 10
China: Crude Oil Imports by Source
(1996 Total)

	tonnes	b/d
Indonesia	6,350,156	126,656
Oman	5,732,154	114,330
Yemen	3,765,693	75,108
Iran	2,311,105	46,096
Angola	1,662,372	33,157
Vietnam	1,006,864	20,082
Papua New Guinea	471,383	9,402
Russia	318,932	6,361
Saudi Arabia	310,740	6,198
Malaysia	219,345	4,375
Australia	188,165	3,753
Libya	139,065	2,774
Congo	125,517	2,503
U.S.A.	113,742	2,269
Canada	80,261	1,601
Others	33,128	661
Total	22,828,620	455,325

Note: A standard conversion factor is used for numbers expressed in b/d.

Table 11
China: Products Imports by Source
(1996 Total)

	tonnes	b/d
Singapore	9,181,372	183,126
South Korea	2,608,202	52,022
Japan	1,269,848	25,328
Russia	1,234,962	24,632
U.S.	233,338	4,654
Philippines	221,091	4,410
Malaysia	216,319	4,315
Saudi Arabia	182,262	3,635
Kuwait	121,102	2,415
Taiwan	120,630	2,406
Hong Kong	116,216	2,318
India	102,186	2,038
Belorussia	84,712	1,690
Thailand	60,833	1,213
Bahrain	20,000	399
U.K.	10,696	213
Others	43,699	872
Total	15,827,469	315,684

Note: A standard conversion factor is used for numbers expressed in b/d.

Table 12
Energy Indicators: Fourth Quarter 1996 Versus Fourth Quarter 1995

	IVQ 1995	IVQ 1996	% Change
Total Energy Exports ('000 US\$)	1,141,389	1,648,925	+44.5
Total Energy Imports ('000 US\$)	1,437,939	1,902,200	+32.3
Primary Energy Consumption (kboe/d)	17,720	18,309	+3.3
Apparent Oil Consumption (kb/d)	3,282	3,433	+4.6
Crude Oil Exports (kb/d)	438	509	+16.3
Crude Oil Imports (k/bd)	461	551	+19.4
Products* Exports (kb/d)	89	129	45.5
Products* Imports (kb/d)	339	367	8.2

*Excluding LPG.

Table 13
China: Summary of Oil Balance, Monthly Data, 1995-1996
 ('000 b/d)

	Crude /1			Products /2		Apparent Consumption	
	Production	Export	Import	Export	Import	QTY	Change (%) /3
Jan-95	2,940	292	85	54	94	2,772	
Feb-95	2,967	349	76	47	141	2,787	
Mar-95	2,974	337	424	130	219	3,151	
Apr-95	2,930	375	243	80	268	2,986	
May-95	2,911	422	487	80	243	3,140	
Jun-95	2,984	363	350	83	309	3,198	
Jul-95	2,969	360	231	68	473	3,244	
Aug-95	2,984	313	219	89	313	3,113	
Sep-95	3,025	399	586	90	370	3,492	
Oct-95	3,051	450	360	45	292	3,208	
Nov-95	3,022	338	409	83	324	3,333	
Dec-95	2,955	523	612	139	400	3,306	
Total /4	2,976	377	342	83	288	3,146	
Jan-96	3,105	306	339	38	193	3,293	18.8
Feb-96	3,156	214	365	68	224	3,463	24.2
Mar-96	3,041	386	476	71	283	3,343	6.1
Apr-96	2,893	332	506	54	221	3,235	8.3
May-96	3,370	398	478	121	380	3,710	18.2
Jun-96	3,093	407	495	54	356	3,481	8.9
Jul-96	3,164	391	367	57	405	3,489	7.5
Aug-96	3,094	558	443	118	341	3,202	2.9
Sep-96	3,123	331	336	29	280	3,378	-3.3
Oct-96	3,156	622	643	73	337	3,441	7.2
Nov-96	3,193	343	516	68	299	3,596	7.9
Dec-96	3,115	558	492	245	462	3,266	-1.2
Total /4	3,126	405	455	83	316	3,408	8.3

1. Monthly crude production figures may not be exactly the same as in previous issues owing to some adjustments.

2. Exclude LPG.

3. Monthly and annual percentage change in 1996 over the same period in 1995.

4. "Total" figures may not always match the annual numbers reported elsewhere.

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