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Oil from Chinese Deposits

by Kurt Wiesegeart, Hamburg*

From 18-25 March the United Nations' "International Meeting on Petroleum Geology" will take place in China, a country whose oil reserves up to the mid-sixties had been judged by foreign observers to be minute and the development of her oil sector of no major importance. Today, with an annual crude output of 106 mn tons, China already ranks ninth among the world's oil producers. And, with the prospect of a further advance towards leadership among producers and exporters of the coveted energy material, the West is showing growing interest in China's energy potential. How real is this prospect?

With tension mounting in the energy sector the industrialized countries which depend on mineral oil imports have a growing interest in diversifying their sources of supply. Attention is being paid also to China with her extensive oil deposits as a possible future exporter.

According to western forecasts China's crude oil production may rise to anything up to 400 mn tons in the course of the next decade. Such forecasts are however highly speculative and may easily prove wrong. A sceptical view is, for instance, supported by the fact that China is unable to fulfil her 1978 agreement with Japan which provided for deliveries of about 48 mn tons of crude oil by 1982.

Moreover, China recently made a request for delivery of 1 mn tons of oil from Kuwait, which clearly indicates China's present difficulties to meet even her domestic demand.

What importance, if any, China will gain as an oil exporter in the future depends mainly on the development of her domestic energy needs, the potential for lowering the share of mineral oils in her total energy consumption, and the speed of raising the crude output by opening up new deposits.

The output of primary energy sources (coal, mineral oil, natural gas, hydro-electric power) as a whole¹ has increased at a relatively high rate in the course of China's economic development. The average annual growth rate of primary energy production of 10-11 % (1952-1979) matched the average growth of the industrial sector and exceeded the growth rate of the economy as a whole. Very high average annual growth rates were recorded in the oil sector. The crude oil output increased at an average annual rate of 24 %

(1952-1978) – more than twice as fast as the total primary energy consumption. In 1978-1980 however the production of coal and oil showed no further significant increase. The crude oil output rose at a rate of barely 2 %.

The expansion of oil production in developed oilfields and the drilling of new production wells is now coming up against the limits set by China's own technical and human potentialities. Lacking modern technologies can no longer be offset by increased labour inputs. Gauged by Western standards most of the productive installations are obsolete. The well-drilling productivity in Chinese oilfields is, according to Western experts, low in comparison with the technologies available in the West.

The intention is to lay the foundation for future expansion of oil exports by economies in domestic consumption of energy and oil in particular and by structural changes in energy production until a significant increase of the crude oil output becomes a possibility.

Although the production of energy has grown relatively fast compared with the gross national product, the energy sector is – like the transport sector and the human capital – regarded as one of the bottlenecks in China's development process. Machines stood idle and factories were forced to interrupt production in recent years because of lack of regular energy supplies. In individual provinces, e. g. in Zhejiang province, up to 30 % of the factories had to interrupt production², and low energy efficiency was according to Chinese sources the main cause.

¹ The term "energy sources" is used in the following for the commercial kinds of energy and thus does not include traditional energy sources like fuel wood, biomass, etc.

² Cf. Yao jianchi jianshe hongnan meikuang de fangzhen, in: Renmin Ribao, Beijing, Aug. 28, 1979.

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The energy efficiency is put by Chinese sources at about 28 %. In West European countries it is between 35 and 40 %, in Japan around 50 %. From a technical point of view energy conservation seems perfectly feasible, not least because the technologies employed in China lag generally 20-30 years behind Western standards and are marked by low energy efficiency.

The industrial sector which uses about 70 % of all energy is dominated by the energy-intensive iron and steel industry. Chinese steelworks are using two to three times as much energy per ton of crude steel as modern steel plants in the West, and in the numerous small iron and steel works set up in the course of the decentralization moves during the "Great Leap Forward" in the late fifties the energy consumption is even higher.

The aim is therefore to raise energy efficiency by technical improvements in the conversion process and in the energy consuming industries. Besides, more coal, and especially more hydro-electric power, are to be used in order to save oil. Increasing quantities of fossile energy sources are to be released for export by slowing the growth of consumption and expanding the production of energy.

First Conservation Successes

As it was possible to raise the production of oil quickly in the early seventies, oil was used increasingly in thermal power stations, and many thermal power stations have been converted from coal to oil. Now oil-heated power stations are, as far as is possible and economically advisable, to be re-converted to coal. Increased use of coal is, for the time being, not limited by availability of domestic coal. The coal deposits amount to about 600 bn tons of which, to go by Chinese sources, 30 bn tons can be extracted immediately³.

The conservation measures yielded their first results in 1979. While crude oil and coal outputs rose by 2 and 2.8 % respectively, the gross output of industry increased by 8 %. The energy savings in industry were put at 11 mn tons coal equivalent. The energy

³ Concerning the planned expansion of the coal sector cf. K. Wiesegart: Rohstoffe aus China? (Raw materials from China?), in: WIRTSCHAFTSDIENST, 60th year, 1980, No. 4, p. 192 ff.

⁴ Cf. XNA, No. 11302, Dec. 25, 1979.

⁵ Cf. Renmin Ribao, March 6, 1980, *ibid*.

⁶ Cf. Renmin Ribao, March 6, 1980, *ibid*., and Wo guo qu nian fa shuidian wushiduo yi du, in: Renmin Ribao, Jan. 4, 1980.

⁷ Cf. Zhongshi nongcun nengyuan jianshe, in: Renmin Ribao, Aug. 6, 1980.

Table 1

China's Production of Primary Energy Sources

(in 1979)

	Coal Equivalent (mn tons)	Share in %
Mineral oil	148	21
Coal	508	74
Natural gas	18	3
Hydro-electric power	16	2

Source: Author's own calculations based on XNA, No. 11430, May 1, 1980, and, for hydro-electric power, Renmin Ribao, June 3, 1980. The following conversion rates were used for the translation into standard coal equivalent: Mineral oil 1.4; coal 0.8; natural gas 1.3; hydroelectric power 0.328.

consumption in the big iron and steel centres, for instance, was reduced by 7 % while the crude steel output was unchanged and rolled steel production rose by 10-11 %⁴.

The thermal power stations also used less oil – 17-18 mn tons in 1979 compared with about 20 mn tons in 1978⁵. Technical improvements and conversions to coal seem to have been achieved already.

Not only is oil to be replaced by coal but oil and coal are gradually to be replaced by hydro-electric power. A concept for increased use of hydro-power had been formulated in the late fifties already. In 1959 it accounted for 25 % of all generated electricity. According to the energy concept of that time its share was to be raised to 50 % by the end of the sixties. In the meantime it has however declined to 17 %⁶ because in the sixties investments were concentrated on thermal power stations which could be built more cheaply.

The more hydro-electric power is being used, however, the more oil and coal is left for export. China's hydro-power reserves amount to 580 mn kw and are among the largest in the world. The capacity of the hydro-electric power stations erected to date exploits only 4 % of the usable reserves for the generation of electricity. The expansion in this field is therefore pushed forward. Many small and large hydro-power stations are under construction or planned. Even now about 30 % of all electricity used in agriculture is supplied by small hydro-electric plants with an average capacity of less than 500 kw⁷; their total capacity was raised by 20 % last year.

To advance the large-industrial use of hydro-power the existing power stations are being modernized, new ones are being built and others are planned. The

construction of a huge power station at "Three Gorges" (Sanxia) on the Upper Yangtse is once more under consideration. If it is decided to go ahead with this project, it will after completion (in 15 years' time) have a capacity of 25,000 mw and according to the plan supply 111 bn kwh a year – equal to 39.4 % of all electricity generated in China last year or 20 times the 1979 output of China's so far largest hydro-power station, at Lujiaxia on the Upper Huanghe⁸.

Unsolved Problems

Although the use of hydro-power has advantages, it involves many problems the solution of which is bound to be difficult and time-consuming. Over 70 % of the hydro-power reserves are concentrated in south-west China, far from the industrial centres. The utilization of hydro-power will involve heavy investment outlays on the construction of power stations and a supraregional national grid of electricity transmission lines with supra-high voltages. The construction of reservoirs involves the flooding of agricultural lands and resettlement of inhabitants⁹. It is unlikely that the technical and financial demands of the erection of big hydro-power stations and the requisite transmission grid can be met without foreign technology and foreign capital.

Nuclear power is being considered as a complement to the fossile energy materials and hydro-electric power. While the advocates of the use of nuclear energy point to the problem created by the uneven distribution of coal deposits and hydro-power resources and consequent demands on transport – two-thirds of the coal deposits are in north China while the hydro-power reserves are concentrated in the south-west of the country – its opponents dwell on the problems of nuclear energy – long building times, environmental problems, safety risks, high foreign exchange costs. Negotiations with France on the purchase of two 900 mw power stations have been proceeding tardily since 1978 and have not yet been concluded.

Growing Domestic Requirements

With an annual output of about 800 mn tons coal equivalent China ranks third, behind the USA and the USSR, among the primary energy producers. China's own consumption of primary energy amounted last year to about 750 mn tons coal equivalent – a little less than twice that of the Federal Republic of Germany. The per-capita consumption in Germany is however nearly 7 tons a year whereas in China it is less than 0.8 tons coal equivalent – just one-tenth of the average

per-capita energy consumption in the industrialized countries¹⁰.

Estimates of the future trend of the domestic energy demand are bound to be unreliable because so many individual factors are involved and adequate structural and planning data are not available. An estimate using the elasticity coefficient¹¹ is not very informative because it treats such factors as the technological level or the structure of energy demand as constants. The future trend of internal energy requirements will however to a significant extent be determined by precisely these factors. For this reason it is impossible to attempt more than a broad outline of the increase of energy consumption to be expected on the basis of the planned economic development.

In a country like China the technological dualism (the existence side by side of traditional production methods and modern technicized production processes) and the growing share of modern technologies will probably require an overproportional rise of energy consumption compared with the GNP. In the last two years, it is true, China still achieved economic growth without a major increase of energy production. But last year and during the current year the outputs in some areas of the heavy industry were raised only slightly if at all in order to benefit agriculture and light industries and consolidate the general economic position. The demand for energy must however be expected to increase rapidly, at the latest when the consolidation phase of 1981/82 is over. In energy-intensive areas like mining, iron and steel, non-ferrous metals, cement, mineral fertilizers and the chemical industry production will then be raised at a forced pace, and their requirements will necessitate larger inputs of energy raw materials as it will be impossible to counterbalance them by raising the energy efficiency alone.

Opening Up New Oil Deposits

Proved oil reserves of 2.7 bn tons have been found in China to date, which puts the country in tenth place among the world's oil countries (see Table 2). The geophysical structures suggest the existence of more

⁸ The world's currently biggest hydro-power station (at Krasnoyarsk in the USSR) has a capacity of 6,093 mw. That at Itaipu (Brazil/Paraguay) is to have, after its completion, a capacity of 10,710 mw.

⁹ The Sanxia project would necessitate the flooding of 44,000 hectares of farmlands and the evacuation of 1,400,000 people. Cf. The China Business Review, May-June 1980.

¹⁰ World Bank, World Development Report 1980.

¹¹ This coefficient indicates the percentage change of energy demand in the case of a one per-cent growth of GNP. It is used for estimates of the increased energy requirements in the event of certain changes in GNP.

Table 2
Confirmed Oil Reserves in Major Oil
Producing Countries
(in bn tons)

Saudi Arabia	22.3
USSR	9.1
Kuwait	9.0
Iran	7.9
Mexico	4.4
Iraq	4.2
Abu Dhabi	3.7
USA	3.6
Libya	3.1
PR China	2.7

Source: OEL-Zeitschrift für die Mineralölwirtschaft, May 1980.

large onshore and offshore deposits, so that the total reserves which can be economically exploited by means of today's technologies are probably much larger. Western estimates mention probable reserves of 10 bn tons and more but their full size will only be known after exploratory drilling on the spot. The work of exploration is in China still in an initial stage.

The Chinese press last year reported successes in the exploration of oil- and natural gas-bearing strata. Promising exploratory drillings were reported from Xinjiang, Qinghai, Sichuan and Jiangsu provinces. Huge deposits are believed to exist in north-west China, in Xinjiang and Qinghai provinces. The Tarim basin in southern Xinjiang which covers 560,000 square kilometres is China's largest sedimentary rock basin. Geological surveys and prospecting work have been going on for years in an attempt to assess the size of the deposits. Large infrastructural investments will however have to be made – over a correspondingly long time – before these deposits can be opened up. The present Chinese pipeline network of approximately 8,000 km is quite inadequate. The bulk of the oil brought to the surface at present has to be moved at considerable cost by rail. Besides, two-thirds of China's industry are situated in the eastern part of the country. The establishment of industries in the interior and the north-west has only just begun.

The decisive break-through in China's oil sector has been achieved in offshore exploration. The discovery of three oil deposits in the South China Sea was reported by the Chinese press late last year and early this year. High-yielding oil wells have been sunk here, and the papers make a point of the fact that the discoveries are a result of China's own explorative

activities¹². Foreign companies have however been given a share in the work on other coastal deposits in order to open them up earlier.

Participation of Foreign Firms

More than 30 foreign companies have been carrying out seismic surveys in eight offshore concessions since last year. Among them are Japanese firms, BP, Exxon, Mobil, Caltex, Phillips, Atlantic Richfield and Amoco. The seismic surveys were carried out by these firms at their own expense and risk, spurred only by the prospect of favoured treatment when exploration and production licences are issued.

The second phase of the opening of Chinese energy raw material resources by foreign oil multinationals began towards the end of the second half of last year with the signing of contracts with Japanese and French companies on the exploration of hydrocarbon deposits. Other contracts are likely to be concluded. Under the agreement between China and Japan on the opening of a 25,500 sq. km area in the central and northern parts of the Bohai Gulf Japan will bear the entire prospecting costs of US\$ 210 mn. The total cost of developing the bay are estimated at US\$ 1 bn of which China will bear 51 % and Japan 49 %¹³.

When production wells have been sunk, Japan will receive 42 % of the oil produced in this area for 15 years, probably from 1984/85 onwards. The extractable reserves are estimated by Japanese sources at 100 mn tons. Similar conditions apply to Elf Aquitaine and Total, the French companies which will explore areas of 9,400 sq. km in the Bohai Gulf and 10,190 sq. km in Beibu Wan (the Gulf of Tonkin).

If exploitation of these or other deposits proves economical, the oil output can be raised quickly through massive deployment of modern technologies and highly skilled specialists, as is shown by high oil output growth rates in a number of other producing countries. However, nothing is as yet known for certain about the extent of the deposits and the practicability of their exploitation. Promising geophysical structures have been found and the results of the seismic surveys are encouraging but exploratory drilling is needed to provide information about the existence and size of deposits. Exploratory drilling in geological structures believed to contain oil or natural gas is necessarily a hit-or-miss affair – to go by the experience to date, the chance of finding oil or gas in commercial quantities is no more than one in ten.

The lead time from the beginning of a successful exploratory well-drilling to the commencement of

¹² Cf. XNA, No. 011303, Dec. 26, 1979; XNA, No. 11435, Feb. 6, 1980; XNA, No. 11354, Feb. 15, 1980.

¹³ Cf. Japan Economic Journal, Tokyo, Dec. 11, 1979.

production is put at three to four years. Only if the expectations are borne out by the exploratory drillings will China – assuming that her own needs are fully met – be able to export increasing quantities of mineral oils from the mid-eighties onwards. The onshore reserves proved up to now would last 25 years if production and consumption in China do not change – if the internal requirements rise, they will run out before the end of this century.

China's Export Policy

China's willingness to step up her oil production and exports in accordance with the technical potentialities will play a crucial role in the expansion of her oil shipments. Small quantities of mineral oils were exported to North Korea and North Vietnam as early as the late sixties. The rapid rise of crude production in the early seventies allowed the oil exports to be increased. In 1973 China signed the first contract on the supply of Chinese crude to Japan. This country has become the most important buyer of Chinese crude oil, followed by North Korea, the Philippines and Romania. Last year Chinese oil was also shipped, for the first time, to industrialized countries like Italy, the Netherlands and the USA.

Since the middle of the seventies China has been able to export about 10-12 % of her oil output. Crude oil earned for her about US\$ 1.7 bn last year and was thus, together with textiles, one of the major sources of foreign currencies. The oil price rises lifted the foreign

currency earnings from exported oil by about 60 % while the volume of oil exports rose only by 16 %.

China's increased imports of refinery equipment in the past two years suggest moreover that she aims to raise the proportion of oil products in her export business so as to raise her foreign exchange earnings above what can be obtained by exporting only crude oil¹⁴.

Against One-sided Dependence

China will hardly be in a position to provide herself the investment funds needed for speedy expansion of the raw material sector. The decision of the Chinese Government to direct more public resources into the consumer goods sector will rule out any but small increases in the investments in this area. The stringency of energy supplies and the efforts of oil importing countries to find new suppliers as well as the political situation in the world are helping China to secure assistance from the industrialized countries for the expansion of her energy sector.

Japan, depending in great measure on imports of mineral oils, acts as a pioneer among interested countries. The public Japan National Oil Corporation (JNOC) is a member of the consortium of Japanese companies engaged in deals with China so that the Japanese state contributes part of the 49 % of "risk capital" for the exploration investments. In addition, Japan has, beside other concessions, granted a loan of about US\$ 2 bn to China on development aid terms for the extension of a part of the transport system intended to improve the export facilities for coal and oil.

As in her requests for offers for the supply of plant and equipment and in the acceptance of credits in the past three years, China takes great care however to avoid one-sided dependence in the development of her oil resources by foreign firms. This is reflected by China's policy of letting as many companies and countries as possible participate in the prospecting and exploration work and likewise in her indigenization efforts. In her contracts with foreign firms China insists on participation by Chinese personnel in prospecting and exploration and on training programmes for Chinese technicians. This is intended to ensure speedy transfer of the know-how of the foreign oil multinationals and create as quickly as possible the preconditions for medium- and long-term employment of the modern technologies by China herself so that she can cut loose from partial dependences to which she has submitted.

Table 3
China's Crude Oil Exports 1975 - 1979,
by Quantities and Countries
(1000 bbls/day)

	1975	1976	1977	1978	1979
Australia			0.9		
Brazil				1.0	19.0
Italy					7.8
Japan	157.6	121.1	132.2	150.3	146.6
Netherlands				1.3	
North Korea	18.0	18.0	8.0	20.0	20.0
Philippines	7.9	10.7	16.1	22.7	19.0
Romania	4.7	9.1	9.8	20.0	20.0
Spain					1.9
Thailand	1.4	3.4	2.9	9.3	14.0
USA					11.3
All countries	189.6	162.3	169.9	224.6	259.6
= mn tons per annum ^a	9.44	8.08	8.46	11.19	12.93
Total cost (in mn US\$ cif)	831.3	704.0	803.9	1041.4	1667.8

^a The barrels/day figures were multiplied by a factor of 49.8 based on the average weight of the crudes to state the exports of crude oil in mn tons per annum. Slight upward deviations may be due to crudes of different specific gravities being exported.

Source: Petroleum Economist, July 1980.

¹⁴ Cf. China Trade Report, Hongkong, March 1980.