

## The China s opportunities in solving energetic problems

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**Abstract.** This report contains comprehensive analysis of the Chinese energy resources market and the Chinese production potentialities estimation in the field of energy supply to maintain the high growth rate of GDP and to build the “small welfare” society. The conclusion of the report is: in spite of the fact of large energy resources presence in the country, China will need to import additional oil, oil products, natural gas and coal and to develop alternative sources of energy.

**Index Term.** - energy resources, coal, oil, natural gas, import and export of energy supply, energy production and consumption, PRC energy balance.

To estimate Chinese potential of energy resources production in necessary volume one needs to analyze the real Chinese market situation and estimate it's possibilities of energy resources import from the other countries. At present China is one of the largest energy resources consumers in the world. China ranks the second place in the world by total energy production and consumption volume, after USA, and it's share comes to more than 10% of world primary energy consumption.

A number of Sino-Russian cooperation agreements was signed during the Russian Prime Minister Putin's visit in the PRC (12 – 13 October 2009), agreements concerning Far East, East Siberia and North-East PRC cooperation. The agreements between “Rosneft” and Chinese national oil and gas corporation were also recently signed; namely the agreement on oil supply – 15 million tons a year in exchange for US \$ 25 billion credit for construction of pipeline branch from Scovorodino- Daqing to PRC frontier, a cooperation agreement on 70 billion cubic meter a year of national gas delivery from Russia to China.

A question about the effectiveness of such Sino-Russian cooperation for Russia is put in the diverse sections of Russian society, a question whether Russia would become a raw materials-producing appendage of China. By our sight, one may define a problem differently: isn't Russia late with it's energy supply offers for Chinese market and isn't a time for our oil and gas companies to expand of Russian energy supply market to the East? it's necessary to estimate the required energy resources production of China and it's energy resources import capacity for coming to the conclusion.

Today, China is one of the largest energy resource consumers in the world. Total volume of energy production and consummation in China comes to 2 billion tons of standard coal (coal converting). China ranks the second place in the world by total energy production and consumption volume, after USA, and it's share comes to more than 10% of world primary energy consumption. In the period of the 11-th Five-Year Plan China gave primacy to energy saving and it's presumed to reduce specific power intensity by 20% for product unit.

It became clear the necessity to provide corresponding growth of energy supply for the fulfillment of the 11-th Five-Year Plan (2006-2010) and the “small welfare” society creation. But it will be rather difficult to carry out as it became clear since 1990-s the emergency situation of shortages in oil and during the fulfillment the 11-th Five-Year Plan there were also the shortages in coal and natural gas. In 2009 PRC had to import 203,4 million tons of oil, while it's own oil production came to 189 million tons of oil a year, 37,0 million tons of oil products and 125,8 million tons of coal, according to 2009 data bank The share of oil and oil products in the cost of import volume amounts to 10,6%, of coal - to 1,05% a year [1].

According to the central statistical management data at the end of 2007, the size of explored coal reserves in China amounted to 326,1 billion tons, but the share of oil was only 2,832 billion tons and of natural gas was 3,2 trillion cubic meter [2]. But the oil consumption in China notably passed ahead of the production at the beginning of XXI century, and the coal and natural gas consumption was below the production volume. This situation can't last eternally, and the Chinese need in energy resources will increase in near future. This is confirmed not only by oil import growth, but also by the started import of liquefied natural gas import from Australia and gas pipeline import from Turkmenistan. The coal import volume in China exceeded coal export volume in spite of abundant coal supplies from 2007. Consequently, owing to the modern economic development trend, the problem of energy carriers supply is expected to play a very important role in China's energy security.

Although the stocks of energy resources in the country are rather plentiful, its per capita index in China is notably below the statistics of other countries. In particular, there are only 147 tons of explored coal reserves per capita in China, that is only 41,4% of world average level, of explored oil reserves that is - 2,9 tons per head (only 11% of world average level), of explored natural gas reserves – only 4% of world average level [3]. At the same time, the most part of coal reserves is concentrated in the north of China – in Shanxi and Inner Mongolia (57,2% of all coal reserves of PRC), oil reserves are mainly situated to the north-east provinces of China – such as Heilongjiang, Jilin, Liaoning (33,1%) and in the north-west provinces of Xinjiang Shaanxi (21,6%), while the basic part of natural gas reserves is in the west districts of China (the provinces Sichuan, Shaanxi, Qinghai, Xinjiang, Chongqing, Inner Mongolia), altogether that amount to 80,8% of all natural gas reserves of China (look Table I below).

TABLE I. THE MAIN ENERGY CARRIERS RESOURCES AT EVERY PROVINCE OF PRC IN 2007

The provinces of PRC	Coal (billion tons)	Oil (million tons)	Natural gas (billion cubic meter)
<b>PRC</b>	<b>326,1</b>	<b>2832,5</b>	<b>3212,3</b>
Beijing	0,675		
Shanxi	105,6		0,25
Inner Mongolia	80,8	57,6	326,6
Shandong	9,625	341,1	34,8
Henan	11,8	52,2	9,72
Hebei	6,34	250,8	30,3
Hebei	4,34	169,2	20,9
Heilongjiang	7,42	600,7	139,1
Jilin	1,25	166,5	67,0
Guizhou	14,67		0,45
Shaanxi	27,6	199,2	743,5
Sichuan	4,93	3,30	591,6
Xinjiang	12,3	413,9	667,6
Qinghai	2,05	41,6	146,2
Tianjing	0,3	37,7	31,9
Gansu	5,84	94,0	10,7
Jiangsu	1,76	25,2	2,3
Hubei	0,33	12,0	0,38
Anhui	8,1	1,4	
Shanghai			
Jiangsi	0,79		
Zhejiang	0,05		
Fujian	0,44		
Hunan	2,0		

Guangdong	0,19	0,09	0,031
Guangxi	0,85	1,92	0,34
Hainan	0,09	0,29	0,69
Chongqing	2,02	0,06	120,7
Yunnan	7,97	0,12	0,28
Tibet	0,012		
Ningxia	5,9	0,46	0,17
Oceanic shelf		363,4	267,0

Done: Zhongguo tongji nianjian – 2008. Beijing, 2008, p.386

As for distribution of all energy resources among the main six economic regions – North China, North- East China, East China, Centro-South China, South- West China and North-West China, the best situation is observed in North China - 43% of all reserves, South- West China - 28,6% and North- West China - 12,1%. The largest coal reserves are concentrated in

North China - 64%, water resources - in South-West China, while oil and natural gas reserves - in North- East China - 48,3%. Oil and gas resources are distributed more or less evenly between East China – 18,2%, North China - 14,4% and North- West China – 14,1% of all oil and gas reserves (see Table II below).

**TABLE II. DISTRIBUTION OF EXPLORED ENERGY CARRIER RESERVES ACCORDING TO ECONOMIC REGIONS OF CHINA (%)**

Region	Natural resources reserves share			
	Total	Coal	Water supply	Oil and natural gas
North	43,9	64	1,8	14,4
North- East	3,8	3,1	1,8	48,3
East	6	6,5	4,4	18,2
Centro- South	5,6	3,7	9,5	2,5
South- West	28,6	10,7	70	2,5
North-West	12,1	12	12,5	14,1

Sources: Zhongguo nengyuan baipishu Beijing, 1997, p. 124.

Evidently, the main coal resources are accumulated in North China (the provinces Shanxi and Inner Mongolia), while the Southern part of the country (except Guizhou province) is poor of coal. The oil reserves are mainly concentrated in the North- East part of China (the provinces Heilongjiang, Jilin, Liaoning), and also in East China (province Shandong) and in North-West China (Xinjiang); natural gas resources are located in the North-West China (provinces Xinjiang and Shaanxi) and in South- West China (province Sichuan). Although the major part of water storage is situated in the South- West China, the share of developed water resources amounts only to 8%, while this figure reaches

68% in the economically developed East China.

The poor quality of energy carriers has to be noted too. More than 95% oil resources contain high rate of paraffin, the oil easily hardens at the low temperature, and therefore is difficult for transportation and treatment. The major part of coal can't be practically transformed for coke production, and high content of methane in more than 40% coal mines creates heightened danger for the miners during underground mining.

At present, coal takes the principal position in China energy structure (about 70 % of national

total energy consumption), what determines the primary development of coal industry in the PRC, so taking coal as the basic component in a practical requirement. The increased coal consumption causes high level pollution of the environment. The coal as a principal energy component creates certain complications in transfer to the other kinds of energy carriers because of presence of abundant coal reserves on the Chinese territory and the low cost of its production. Nevertheless, from the 1970, after discovery of the Daqing oil deposit in Heilongjiang and Shengli oil deposit in province Shandong the oil share of energy resource consumption increased.

But the oil consumption in China notably passed ahead of its production at the beginning of the 21-st century, and the coal and natural gas consumption was below the production volume. This situation can't last eternally, as the Chinese need in energy carriers will increase in the near future. According to the opinion of experts from the Center of economic security at Chinese Academy of Contemporary International Relations, the energy carriers consumption will increase for the three reasons: 1) living standard growth; 2) escalating of automobilization in the country; 3) crescent urbanization [4].

Consequently, owing to the modern economic development trend, the problem of energy resources supply is expected to play a very important role in China's energy security. In 1990 China provided itself with energy carriers by 104%, but in 1998 – only by 98%, and in 2000 – by 97%. This level of energy supply is above than in USA - 73%, India - 84%, Brazil

- 78%, and much more higher, than in such economically developed countries as Japan – 20% and the Republic of Korea – 17%. At the same time this Chinese index is notably below the level of energy supply of the energy producer countries – such as Russia – 157%, Norway – 878%, Saudi Arabia – 473%, Nigeria – 219%, Venezuela – 381%, Argentina – 132%.

In 2000 the per capita energy carrier consumption in China amounted to 0,9 tons of standard coal while in USA this figure came up to 8,35 tons of standard coal, in Canada - 8,16 tons of standard coal, in Saudi Arabia - 5,08 tons of standard coal, in Russia - 4,22 tons of standard coal, in Japan - 4,12 tons of standard coal. However, this index is much higher in China, than the developing countries have, such countries as Indonesia – 0,69 tons of standard coal, the Philippines - 0,56 tons of standard coal, India - 0,49 tons of standard coal, Algeria – 0,73 tons of standard coal, Nigeria – 0,71 tons of standard coal [5].

China as a whole reached relative balance of home consumption and import of natural gas and coal against net import and net export to consumption, when compared with the balance of import and consumption of fuel-energy resources in the world, but it is difficult to say about oil.

In particular, in 2007 the share of oil import in the consumption volume amounted 49,3% ( practically half of all oil consumption in China) while the share of coal consisted only of 1,7%, and the share of of natural gas was quite negative (-3,0%), as it illustrated in Table III.

TABLE III. IMPORT AND CONSUMPTION OF FUEL-ENERGY RESOURCES IN DIFFERENT PARTS OF THE WORLD

	Ratio of net-import (+) or net- export (-) against consumption (%)		
	Oil	Natural gas	Coal
Eurasia	-1,6	5,1	12,7
Europe	69,5	50,9	43,1
Central Asia (Caspian region)	-393,3	-71,1	-59,5
Russia	-290,3	-38,4	-56,8
the Middle East	-309,5	-18,8	92,2
China	49,3	-3,0	1,7
India	71,0	24,9	13,0
Japan	100	100	99,4
The rest of Asia	68,1	-12,1	18,3

**Sources:** Bushuev V. V. , Gromov A. I. . Global energetic security: Eurasian aspect. The 6-th International Conference , “Energetic Cooperation in Asia: forecasts and reality”, Irkutsk, Russia, 2008, p. 18.

Evidently, according to the figures of net-import and net- export against the consumption of fuel-energy resources China takes much better position than Japan, India and European countries, which are pressed for all kinds of the energy carriers shortage. Although the Middle East countries have black ink of energy carriers such as oil and natural gas consumption, they have negative coal position in energy balance. However, it's not difficult to see, that the problem of energy carriers deficit will become much more aggravated with increase of Chinese peoples leaving standard, growth of automobilization and urbanization of the country. Consequently, owing to the modern economic development trend, the problem of energy carriers supply is expected to play a very important role in China's energy security. Taking into consideration that today China fell into an emergency situation of shortage in oil, the recent focus will be on three main regions - the Middle East, Central Asia (Caspian region), and Russia.

The basic purpose of Chinese energetic development till 2020 is doubling of energy resources production for providing the fulfillment the task of GDP (Gross Domestic Product) augmentation 4 times more in 2020 when compared with 2000. In this case the energy resources necessity in 2020 will come

to 3,0 billions tons of standard coal (coal converting) and 2,1 billions tons of standard coal in 2010. At the same time the share of coal in energy resources consumption should not exceed 60% of total consumption volume in order to reduce the dependence of crude oil import for the country.

The new ‘National Energy Plan,’ promulgated in 2004, for the first time formally gave primacy to energy saving. It was connected with low share of China's energy utilization rate – only 32 %, that is more than 10 % lower than the international advanced level. According to the “energy plan” energy saving and the reduction of energy costs was regarded as an important way to boost the benefits of economic growth. As a result by 2010, the energy cost per 10000 yuans of GDP would decrease from the 2002 level of 2,68 tons of standard coal to 2,25 tons of standard coal, and in 2020 the amount would further drop to 1,54 tons of standard coal. Thus, the energy saving capacity would expand to 400 million tons of standard coal in 2010, and further to 1,4 billion tons of standard coal in 2020, which is equivalent to the reduction of 21 million tons in sulfur dioxide emissions [6].

The crude oil is one of important constituents of the country's energy balance, and it's share

increases every year. China was considered to be poor in oil in 1950-s and its share of energy carriers production not exceeded 2%, but later on – in 1960-s - 1980-s this share was increasing gradually and in 1980 reached 23,8% of energy carriers production. However,

later on, the growth rate of oil exploring and oil production remained behind the country's need of crude oil and oil products, thanks to quick growth of power consumption during the economic reforms. It is illustrated below, Table IV.

TABLE IV. STRUCTURE OF ENERGY CARRIERS PRODUCTION IN CHINA (1957 – 2008)

Year	Energy production (million tons of standard coal)	Coal (%)	Oil (%)	Natural gas (%)	Hydro power, nuclear power , wind power
1957	98,67	94,9	2,1	0,1	2,9
1965	188,24	88,0	8,6	0,8	2,6
1978	627,7	70,3	23,7	2,9	3,1
1980	637,35	69,4	23,8	3,0	3,8
1985	855,46	72,8	20,9	2,0	4,3
1991	1048,44	74,1	19,3	2,0	4,8
1995	1290,34	75,3	16,6	1,9	6,2
2000	1289,78	72,0	18,1	2,8	7,2
2004	1873,41	76,0	13,4	2,9	7,7
2005	2058,76	76,5	12,6	3,2	7,7
2006	2210,56	76,7	11,9	3,5	7,9
2007	2370,00	76,6	11,3	3,9	8,2
2008	2600,00	76,7	10,4	3,9	9,0

*Note:* energy production indices are done in tones of standard coal according to re-count of coal equivalent on base of average coal consumption index at electric power plants annually.

*Sources:* Zhongguo tongji nianjian – 1997. Beijing, 1997, p.215; Zhongguo nengyuan tongji nianjian – 2004 Beijing, 2005, p.33; Zhongguo tongji nianjian – 2006. Beijing, 2006, p.261; Zhongguo tongji nianjian – 2007. Beijing, 2007, p.261; Zhongguo tongji zhaiyao – 2009, 2009, p. 145.

As a result, now the item “coal” occupies the leading place both in energy production balance and in energy consumption in China, as it's illustrated in Table IV and Table V. It becomes clear from the comparison of indices of Table IV and Table V that only crude oil's share is higher in energy consumption structure than in energy production structure. The

situation rests favorable for China among all other positions, as the production of other kinds of energy carries exceeds the consumption. However, this situation can't last eternally, as for the high rate of economic growth support it's necessary keep a balance between the rate of GDP growth and the rate of energy carries production growth.

TABLE V. STRUCTURE OF ENERGY CARRIERS PRODUCTION IN CHINA (1957 – 2008)

Year	Energy production (million tons of standard coal)	Coal (%)	Oil (%)	Natural gas (%)	Hydro power, nuclear power , wind power
1957	96,44	92,3	4,6	0,1	3,0
1965	189,01	86,5	10,3	0,9	3,2
1978	571,44	70,7	22,7	3,2	3,4
1980	602,75	72,2	20,7	3,1	4,0
1985	766,82	75,8	17,1	2,2	4,9
1991	1037,83	76,1	17,1	2,0	4,8
1995	1311,76	74,6	17,5	1,8	6,1
2000	1385,53	67,8	23,2	2,4	6,7
2004	2032,27	68,0	22,3	2,6	7,1

2005	2246,82	69,1	21,0	2,8	7,1
2006	2456,69	69,4	20,4	3,0	7,2
2007	2654,80	69,4	20,0	3,4	7,2
2008	2850,00	68,7	18,7	3,8	8,9

**Note:** energy production indices are done in tones of standard coal according to re-count of coal equivalent on base of average coal consumption index at electric power plants annually.

**Sources:** Zhongguo tongji nianjian – 1997. Beijing, 1997, p.215; Zhongguo nengyuan tongji nianjian – 2004 Beijing, 2005, p. 97; Zhongguo tongji nianjian – 2006. Beijing, 2006, p.261; Zhongguo tongji zhaiyao – 2007 Beijing, 2007, p. 261; ; Zhongguo tongji zhaiyao – 2009 Beijing, 2009, p. 145.

However, from 1992 Chinese energy balance became negative and the consumption visibly overdraws the production owing to the fact that oil consumption notably exceeds its production. In 1990 the energy carriers production exceeded the consumption by 52,19 million tons of standard coal, but in 1992 the consumption already exceeded the production by 19,14 million tons of standard coal. The negative balance between the energy production and the energy consumption was growing especially quickly in the second part of 1990-s - 63,3 million tons of standard coal in 1996 and 95,75 million tons of standard coal in 2000. But for all that the energy carriers consumption was growing only by 14,75 million tons of standard coal (increase 1,1% per year) in 1996-2000 in comparison with 64,95 million tons of standard coal (increase 5,85% per year) in 1991-1995. It is necessary to note that the low growth indices of energy carriers consumption were determined by negative indices of production - on average - 0,01% in 1996 – 2000-s and by elasticity

coefficient of production growth was negative on average -0,001 with regard to GDP, energy resources consumption - was only 0,127 [7]. Later on during the 10-th Five-Year Plan (2001-2005) the deficit of energy carriers continued to grow and in 2005 it already came to 172,5 million tons of standard coal. During the 11-th Five-Year Plan (2006-2010) the deficit of energy carriers continued to grow under conditions of high rate of GDP (Gross Domestic Product) growth as a whole and of high rate industry growth in particular. For example, in 2006 energy carriers consumption exceeded already the energy carriers production by 252 million tons of standard coal, in 2007 this figure was more than by 300 million tons of standard coal. The deficit of energy resources was reduced till 250 million tons of standard coal only in 2008 owing to considerable production increase of renewable energy sources – hydropower, nuclear power, wind energy, solar power and biomass power, as it is illustrated in the Table VI, below.

TABLE VI. ENERGY CARRIERS PRODUCTION AND CONSUMPTION BALANCE IN CHINA 1990-2008 (MILLION TONS OF STANDARD COAL)

Year	Energy carriers production	Energy carriers consumption	Balance
1990	1039,22	987,03	52,19
1991	1048,44	1037,83	10,61
1992	1075,26	1091,70	-19,14
1993	1110,59	1159,93	-49,34
1994	1187,29	1227,37	-40,08
1995	1290,34	1311,76	-21,42
1996	1326,16	1389,48	-63,32
1997	1324,10	1377,98	-53,88
1998	1242,50	1322,14	-79,64
1999	1259,35	1338,31	-78,96
2000	1289,78	1385,53	-95,75
2001	1374,45	1431,99	-57,54

2002	1438,10	1517,97	-79,87
2003	1638,42	1749,90	-111,48
2004	1873,41	2032,27	-158,86
2005	2058,76	2246,82	-188,06
2006	2210,56	2462,70	-252,14
2007	2354,15	2655,83	-301,68
2008	2600,00	2850,00	-250,00

*Sources:* 2007 Zhongguo nengyuan fazhan baogao. Ed. by Wang Jiacheng, ZhaoZhilin, Beijing, Zhongguo Shuili shuidian chubanshe, 2007, p.5-6; Zhongguo tongji zhaiyao - 2009, Beijing, p. 145.

Therefore, the slow rate of oil products production has become an increasingly obvious bottle-neck restricting the country's economic development during the economic reforms in 1980-s.

Although the crude oil production volume was constantly growing: 1980 - 105,95 million tons, 1985 - 124,9 million tons, 1990 - 138,3 million tons, 1995 - 150,0 million tons, 2000 - 163 million tons, 2006 - 184,7 million tons, 2007 - 186,7 million tons, 2008 - 189,7 million tons [8], nevertheless, there was evident shortage oil and it's production growth didn't provide the crescent requirements of the country with the indispensable energy resources. That's why the PRC leadership was obliged to increase extra the coal production and at the same time to increase oil import for energetic problem solution. In the 1980-s oil export significantly exceeded it's import, but oil export began decrease in 1990-s, and oil

import began sharply increase. Since 1993 China became net oil importer. In 1995 net oil import in PRC amounted to 12,2 million tons, in 2000 -to 65,4 million tons, in 2005 - already to 142,8 million tons. Accordingly, Chinese scientists appreciated the level of oil dependence of the country: in 1995 - 7,6%, in 2000 - 33,8%, in 2005 - 43,9%, and in 2010 - 50% [9]. In 2000 total oil import volume came to about 97,5 million tons (59,8% of annual crude oil production), in 2005 - to 171,6 million tons (about 94,6%), and in 2008 -to already 180 million tons.

As it is predicted, in 2010 net oil import in China will increase to 200 million tons and in 2020 - to 250 million tons. Still in 1990-s of the 20-th century the energy resources consumption volume in China exceeded already the volume of energy resources production, and such tendency will be remaining for decades ahead (Table VII).

TABLE VII. ENERGY RESOURCES CONSUMPTION BALANCE IN CHINA (MILLION TONS OF STANDARD COAL)

	1985	1990	1995	2000	2005	2006	2007
<b>Total energy resources volume</b>	<b>776,0</b>	<b>961,4</b>	<b>1295</b>	<b>1365</b>	<b>2232</b>	<b>2439</b>	<b>2611</b>
Volume of producible energy resources	885,0	1039	1290	1289	2059	2211	2354
Import	3,4	13,1	54,6	143,3	269,5	310,6	349,0
Export (-0)	57,7	58,7	67,8	96,3	114,5	109,3	103,0
Volume of stock resources at the end of year	-25,1	-32,2	-4,9	11,0	-10,1	-1,7	-19,8
Energy resources renewal			23,1	17,6	28,4	29,0	30,6
<b>Overall energy resources consumption</b>	<b>766,8</b>	<b>987,0</b>	<b>1312</b>	<b>1385</b>	<b>2247</b>	<b>2463</b>	<b>2656</b>
<b>Consumption balance</b>	<b>+9,2</b>	<b>-25,7</b>	<b>-17</b>	<b>-20</b>	<b>-15</b>	<b>-24</b>	<b>-45</b>

*Sources:* Zhongguo tongji nianjian - 2001. Beijing, 2001, p. 230; Zhongguo tongji nianjian - 2008. Beijing, 2008, p. 244.



Evidently, the energy resources deficit in China amounted to more than 20 million tons of standard coal at the end of XX century and in 2008 – 45 million tons of standard coal, what is connected first of all with shortage of oil. In 1990-s one of the main problems for national economy was the lack of energy resources in the country. According to the energy consumption balance data the main reason of the energy resources deficit in PRC was lack of petroleum-refining products, such as benzene, kerosene, diesel oil, mazut. The rate of petroleum-refining products production is low and is notably retarded from oil consumption requirement. The gap between the needs of oil products for quickly developing national economy of PRC and possibility of it's production is deepening every year.

During the 11-th Five-Year-Plan (2006-2010) energy resources consumption growth with the elasticity coefficient between GDP growth and primary energy resources consumption at the level 0,5 will be not less than 3,5% a year, on conditions that planned growth rate of GDP will be 7% a year. Under the actual oil consumption volume of 224 million tons in 2000 it's easy to calculate that in 2020 it will be necessary to have not less than 500 million tons of oil for satisfaction of PRC oil needs, that notably exceeds the potential possibilities of oil production. As a result, the Chinese oil import dependence is increasing. Energy Institute of the State Committee on development and reforms estimates this dependence on oil import at the level of 46-52% in 2010 , 59-62% in 2020 r., IEA estimates – at 61% in 2010 and at 77% in 2020 and EIA estimates – at 54% in 2010 and 72% in 2020 [10].

There are three alternates of energy problem solution: 1) working out and exploitation oil and gas deposits in existence which are situated in the west of the country; 2) partial replacement of oil with coal, natural gas, hydroelectric power and with different alternative energy sources in the energy balance of the country; 3) augmentation of oil import.

**First: Working out and exploitation oil and gas deposits in existence which are situated**

**in the west part of the country.** Tarim Basin (Xinjiang Uyghur Autonomous Region), middle stream of the Hwang Ho river (provinces Shaanxi, Gansu and Ningxia Hui Autonomous Region, Qaidam Basin (province Qinghai), provinces Sichuan, Xinjiang (natural gas) are among this deposits. This measure will provide increase of energy resources reserves in the country, by means of which regulation the energy carrier prices at the Chinese home market and guarantee of the necessary oil consumption balance on a national scale will be realized .

For the first time a necessity of creation of national strategic energy carriers reserve system was posed as an essential problem in China at the beginning of 21-st century, as it is in existence in certain countries in case of crisis, in particular, in USA, Japan, Brazil, India, South African Republic. The creation of spare capacities in China was begun relatively not long ago. Now at the disposal of oil and petrochemical Chinese companies there are the storages of total capacity 21,07 million cubic meters, all of them are used for industrial purposes, working life of oil products not exceed 21,6 days. Till recently oil storages and gas-holders for energy resources storing with a strategic view were practically absent, there were only the storages for oil and gas keeping for 2-5 days for the oil-pipe line and gas pipeline delivery and keeping for 15-25 days for oil and gas railway delivery [11].

In 2004, China for the first time set up a national strategic oil reserve system, and marked out a total of four reserve bases in three provinces: Zhenhai District, Ningbo, Zhejiang Province; Daishan County, Zhoushan, Zhejiang Province; Huangdao District, Qingdao, Shandong Province and Xingang District, Dalian, Liaoning Province. Recently one more reserve crude oil base was put into operation at the deposit in Shanshang District (SUAR) [12]. The first phase of national strategic oil reserve system construction received 6 billion yuan of government appropriation, creating a crude oil reserve capacity of 14 days. According to estimates, 2008 will see strategic oil reserves reach a capacity of over 35 days.

The certain changes were made in the state legislation in connection with all preceding. In particular, in December 2006 Ministry of Commerce accepted two legislative definitions: "About the oil products market management" and "About the crude oil market management", by means of which monopolistic system of united oil products distribution in the country was blown up. The oil products market was formed, where large competitive oil companies, transnational corporations and different enterprises are operating [13].

**Second: Partial oil substitution for coal, natural gas and hydroelectric power in country energy balance.** This is connected with the fact, that China disposes of tremendous forecasted coal and natural gas reserves and also of hydroelectric resources in the west part of the country – the Chang Jiang river, the Hwang Ho river and others. In December 2006 the State Committee of PRC reform's development made a decision about the liberalization of coal prices since 2007. In compliance with this decision long time operating throughout the country system of coal purchase conferences was called off, that was the system when during negotiations between the coal producers and consumers of heat and power plants the coal prices were established. Since 1993 for establishing a price for hydroelectric power the State determined the coal prices for large state electric power stations, that formed "double-track" price system – coal prices for large state electric power stations ("planned" coal) and coal prices for other aims ("market" coal). the gap between prices for "planned" coal and "market" coal was enlarging annually as a result of the coal purchase conferences decisions. That's why since 2007 the system of coal purchase conferences was canceled and coal market was created, on basis of it All-Chinese coal stock exchange with regional stock exchanges began operate. It was presumed, that coal price liberalization will allow to liberate the prices for electric power – it's production, delivery and distribution. However, to the Chinese experts' opinion, this measure have to be coordinated with price liberalization for freight services, which, to a

great extent, influence on 1 coal ton price, moreover the carrier companies monopolized coal delivery on a national scale [14]. As a result there was a notable coal price increase and it didn't stop even in autumn 2008 at the height of the financial crisis when prices decreased for almost all kinds of production. Coal price increase continues even nowadays as a consequence of country's energy resources need growth and constant oil import share increase in it's consummation capacity. In this case coal serves as a kind of oil substitute and coal consumption share in energy resources consumption volume will hardly be reduced especially under the circumstances of world oil and natural gas prices growth.

However, during the latest years China notably realizes the full development of different types of energy including wind and solar energy, small hydroelectric power stations, hydrothermal energy, see flow energy and other new energies. With development of a new and renewable types of energy, their share in the country's energy resources structure should be notably increased by 2010, according to the program, accepted in 1995 by three departments - State Planning Committee of PRC, State Committee on Science and Technology of PRC and State Committee on Trade and Economy of PRC. In 1997 "PRC law about energy saving" was passed, the law, where there was declared a strategy of "support of electric power stations on base of coal with intensification of exploring of oil fields and gas fields". At the same time it was underlined the necessity of development of wind energy, small hydroelectric power stations, hydrothermal power, solar power, biomass power [15].

According to the PRC State Council's energy resources development plan the renewable energy resources production volume has amount to 13,0 million tons of standard coal in 2005 and it's share of total energy resources production volume has to amount to 0,7% , in 2010 - 25 million tons of standard coal (or 1,25%), in 2015 – 43 million tons of standard coal (or 2%) [16].

China has become the first user of renewable energy resources production volume in the world.

The renewable energy resources investments, large hydroelectric power stations are excluded, increased by 91% when compared with 2006 and amounted to US \$10,8 billion.

In 2007 PRC became the second in the world after Germany in total investments in all establishments reproducing energy resources; in 2009 PRC planned to be the first in the world in this kind of investments [17].

The PRC government has raised the significance of the renewable energy resources problem to a considerable height because of quick price growth for traditional energy carries - oil, natural gas, and because of the difficulties with traditional energy carries delivery by seaway through Straights of Malacca with simultaneous increase of oil import dependence share by 50% in 2010 and by 60-70% in 2020. Under the influence of the circumstances PRC government set a problem to increase the renewable energy resources share in energy resources consumption volume up to 10% in 2010 and to 15% in 2020 [18].

As a whole China can be considered to be a country with reach renewable energy resources to satisfy a country want at the efficient use.

However, renewable energy resources use depends on local conditions as they located nonuniform along Chinese territory. It's more profitable for certain provinces to use solar power, for the others – wind power or biomass power, geothermal energy resources, sea and ocean power.

in future, the possibilities of renewable energy resources use are connected, to a considerable degree, with scientific and technological progress and development of innovation economy in the country, with the creation of new hi-tech industry's zones and with state expenditures increase for science and technology development.

**Third: Oil import increase.** At present the most part of Chinese oil import comes from different countries of the world. In 2004 Saudi Arabia was the first in oil import to China - 17,24 million tons, then Oman followed - 16,34 million tons, Angola - 16,2 million tons, Iran - 13,2 million tons and Russia - 10,77 million tons. Two years after – in 2006 - Saudi Arabia continued to take the first place in oil import to China - 23,87 million tons, Angola was the second - 23,45 million tons, Iran was the third - 16,77 million tons, Russia was the fourth - 15,97 million tons and Oman was the fifth - 13,18 million tons, as it is illustrated in Table VIII (see below).

TABLE VIII. OIL IMPORT IN CHINA 1998 - 2006 (MILLION TONS)

Страны	1998	1999	2000	2001	2002	2003	2004	2005	2006
Iran	3,62	3,95	7,00	10,84	10,63	12,39	13,24	14,27	16,77
Saudi Arabia	1,81	2,50	5,73	8,78	11,39	15,18	17,24	22,18	23,87
Oman	0,57	5,02	15,66	8,14	8,05	9,28	16,34	10,83	13,18
Yemen	4,04	4,13	3,61	2,29	2,26	6,97	4,91		
Kuwait	0,28	0,33	0,43	1,46	1,07	0,91	1,25		
the United Arab Emirates	0,51	-	0,43	0,65		0,86	1,34		
Qatar	-	-	1,60	1,33	0,46	0,68	0,14		
Iraq	0,61	0,97	3,18	0,37	0,54		1,31		
<b>the Middle East (total)</b>	<b>16,67</b>	<b>16,90</b>	<b>37,65</b>	<b>33,86</b>	<b>34,39</b>	<b>46,29</b>	<b>55,79</b>	<b>59,99</b>	<b>65,60</b>
Sudan	-	0,27	3,31	4,97	6,43	6,26	5,77		
Angola	1,10	2,88	8,64	3,80	5,71	10,10	16,21	17,46	23,45
Equatorial Guinea	0,24	0,81	0,92	2,15	1,78	1,46	3,49		
Cameroon	-	0,25	0,43	0,82		0,24	...		
Nigeria	0,12	1,37	1,19	0,77	0,49	0,12	1,49		
Congo	0,38	0,38	1,45	0,64	1,05	3,39	4,77		
Libya	0,14	0,13	0,13	0,25		0,12	1,34		

Gabon	-	0,65	0,46	0,14		0,28	0,55		
<b>Africa (total)</b>	<b>2,20</b>	<b>7,25</b>	<b>16,95</b>	<b>13,55</b>	<b>15,44</b>	<b>22,44</b>	<b>35,30</b>	<b>38,47</b>	<b>45,79</b>
Vietnam	0,87	1,51	3,16	3,36	3,54	3,51	5,35		
Indonesia	3,42	3,95	4,64	2,65	3,24	3,33	3,43		
Malaysia	0,45	0,25	0,74	0,90	1,65	2,03	1,69		
Brunei	-	-	0,28	0,75	1,29	1,36	0,88		
Australia	0,35	0,90	1,11	0,80	1,16	1,78	1,51		
Thailand	0,13	-	0,28	0,23	0,74	1,61	0,92		
Papua New Guinea	0,07	0,15	0,39	0,07	0,16	0,08	...		
<b>Asia and Australia (total)</b>	<b>5,47</b>	<b>6,83</b>	<b>10,61</b>	<b>8,68</b>	<b>12,85</b>	<b>13,91</b>	<b>14,03</b>	<b>9,68</b>	<b>5,16</b>
Russia	0,14	0,57	1,48	1,77	3,03	5,25	10,78	12,78	15,97
Norway	0,49	2,01	1,48	0,92	2,11	0,93	2,01		
Kazakhstan	0,41	0,49	0,72	0,65		1,20	1,29		
Great Britain	-	2,20	1,04	0,50	1,22	0,20	0,16		
Brazil	...	...	...	...	...	0,12	1,58		
Argentina	...	...	...	...	...	0,13	0,71		
Ecuador	...	...	...	...	...	0,14	0,28		
Venezuela	...	...	...	...	...	0,44	0,33		
<b>Europe and Western Hemisphere countries</b>	<b>3,00</b>	<b>5,63</b>	<b>5,05</b>	<b>4,17</b>	<b>6,36</b>	<b>8,42</b>	<b>17,14</b>	<b>19,93</b>	<b>28,65</b>
<b>Organization of Petroleum Exporting Countries, OPEC</b>						<b>34,17</b>	<b>41,79</b>		
<b>Import (total)</b>	<b>27,32</b>	<b>36,61</b>	<b>70,27</b>	<b>60,26</b>	<b>69,41</b>	<b>91,12</b>	<b>122,8</b>	<b>128,1</b>	<b>145,2</b>

**Compile on:** Zhongguo nengyuan kechiqui fazhan zhanliue. Zhuanti yanjiu (Strategic Research Report on China's Sustainable Energy Development). Ed. by Peng Shenghu, Qian Yuifen, Bu Xin. Beijing, Kexue chubanshe, www.sciencep.com, 2006, c.25-26; Zhongguo nengyuan kechiqui fazhan zhanliue. Zhuanti yanjiu (Strategic Research Report on China's Sustainable Energy Development). Ed. by Peng Shenghu, Qian Yuifen, Bu Xin. Beijing, Kexue chubanshe, www.sciencep.com, 2006, c.25-26; Zhongguo nengyuan fazhang baogao. Ed. By Cui Minxuan, Beijing, Shehui kexue wenxian chubanshe, 2007, p.178.

However, there were the remarkable changes in the Chinese oil import structure in comparison with 1998. In 1998 Iran, Yemen and Indonesia were the principal oil importers of China, in 2001 – only Iran rested of this group, but Saudi Arabia and Oman came to the leading group of Chinese oil suppliers, and in 2004 Angola and Russia joined these leading three countries group, the latter increased remarkably their oil supplies volume. At that, the Middle East continued to play the leading role in Chinese oil import structure, its oil import share was 61% in 1998, 56,2% in 2001, 45,4% in 2004 and 45,2% in 2006. At the same time the Chinese oil import volume increased sharply owing to oil supplies from Africa, especially from Angola whose total oil import increased from 1,1 till 23,45 million tons and the oil

import share to China accordingly increased from 4,0% till 16,2% in the period 1998 – 2006. The share of Asia and Australia was gradually decreasing from 20,0% in 1998 to 11,4% in 2004 and to 3,6% in 2006; the reason was sharp oil import drop from Indonesia and Malaysia. The oil import volume from Asia and Australia decreased by 46,7% during one year since 2005 to 2006. At the same time a remarkable increase of oil import share from Europe and Western Hemisphere countries to PRC occurred thanks to oil import from Russia and Venezuela. In 1998 this share amounted to only 0,5% of total import, in 2004 it was already - 8,8%, and in 2006 – 19,7 % (look Table IX below).

TABLE IX. OIL IMPORT STRUCTURE IN CHINA FROM WORLD COUNTRIES IN 1998-2006 (%)

Countries	1998	1999	2000	2001	2002	2003	2004	2005	2006
<b>Import (total)</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Organization of Petroleum Exporting Countries, OPEC</b>						<b>37,5</b>	<b>34,0</b>		
<b>the Middle East (total)</b>	<b>61,0</b>	<b>46,2</b>	<b>53,6</b>	<b>56,2</b>	<b>49,6</b>	<b>50,8</b>	<b>45,4</b>	<b>40,5</b>	<b>45,2</b>
Including:									
Saudi Arabia	6,6	6,8	8,2	14,6	16,4	16,7	14,0	17,3	16,4
Oman	2,1	13,7	22,3	13,5	11,6	10,2	13,3	8,5	9,1
Yemen	14,8	11,3	5,1	3,8	3,3	7,6	4,0		
Iran	13,3	10,8	10,0	18,0	15,3	13,6	10,8	11,2	11,6
<b>Africa (total)</b>	<b>8,0</b>	<b>19,8</b>	<b>24,1</b>	<b>22,5</b>	<b>22,2</b>	<b>24,6</b>	<b>28,7</b>	<b>30,0</b>	<b>31,5</b>
Including:									
Sudan	-	0,7	8,8	8,2	9,3	6,9	4,7		
Angola	4,0	7,9	12,3	6,3	8,2	11,1	13,2	13,6	16,2
Equatorial Guinea	0,9	2,2	1,3	3,6	2,6	1,6	2,8		
Congo	1,4	1,0	2,1	1,1	1,5	3,7	3,9		
<b>Asia and Australia (total)</b>	<b>20,0</b>	<b>18,7</b>	<b>15,1</b>	<b>14,4</b>	<b>18,5</b>	<b>15,3</b>	<b>11,4</b>	<b>7,6</b>	<b>3,60</b>
Including:									
Vietnam	3,2	4,1	4,5	5,6	5,1	3,9	4,4		
Indonesia	12,5	10,8	6,6	4,4	4,7	3,7	2,8		
Australia	1,3	2,5	1,6	1,3	1,7	1,9	1,2		
<b>Europe and Western Hemisphere countries</b>	<b>11,0</b>	<b>15,3</b>	<b>7,2</b>	<b>6,9</b>	<b>9,7</b>	<b>9,3</b>	<b>14,5</b>	<b>15,6</b>	<b>19,7</b>
Russia	0,5	1,6	2,1	2,9	4,4	5,8	8,8	10,0	11,0
Norway	1,8	5,5	2,1	1,5	3,0	1,0	1,6		
Kazakhstan	1,5	1,3	1,0	1,1		1,3	1,1		

Estimated on the basis of Table VIII above

According to the forecast of the US RAND Corporation, the ideal future oil security strategy for China should be to obtain by one-third of its oil from each of the Middle East, Russia and Central Asia. That view doesn't take into account Africa and South America. At present a quarter of China's oil imports are from Africa, China has teamed up productively with Sudan and Angola, and also Gabon, Algeria, Nigeria, Cameroon, Equatorial Guinea and others. Four countries in south America have been in close negotiations with China over energy investment. China has promised to invest US \$ 5 billion in oil and gas projects in Argentina over the next five years, and invest US \$ 8.5 billion in infrastructure and mining in Brazil. There are the negotiations with Venezuela and Colombia about the plans to build an oil pipeline through Colombia to the Pacific Ocean for easier oil transportation to China. Based on data from the Ministry of Commerce, the major Chinese oil companies CNPC (Chinese national oil company),

Sinopec (Chinese petrochemical company) and CNOOC (Chinese company offshore oil and gas exploitation) have been involved in 65 oil and gas exploration and exploitation projects in more

Than 30 countries, having invested US \$ 7 billion in total and in return, having obtained 60 million tons of "shareholding oil"[19].

In our opinion, China is capable to get by with existent energy carries reserves on it's territory taking into consideration the tremendous coal reserves and other energy carries, the program of energy resources saving of 2006, development of renewable energy sources for secure high level economic development. Moreover, China has already prevalent sources of oil import from the Middle East, Russia, Central Asia and Latin America countries. Thereupon it becomes evident, that China will possess the necessary energy sources to provide high level economic growth. At the same time, it is necessary to note that the high level of GDP growth in China will need

additional energy production increase for creation of “small welfare “ society, that can be ensured not only by oil import, but also by coal and natural gas import. In that case if Russia

doesn't pay much attention to east route of energy resources export it should be surpassed by other countries in the competitive struggle for Chinese energy resources market.

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