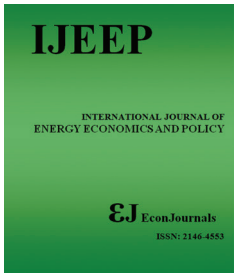

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The Problems of China as a Major Consumer of Energy Resources

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ABSTRACT

The high rates of development in China are increasingly indicated the insufficiency of their own energy resources to maintain the positive dynamics of the growth of the national economy. In the absence of structural changes in the Chinese energy industry, exacerbation of the environmental problem is likely to reduce the inflow of foreign direct investment, on which the PRC economy is also mainly dependent. It is justified that with the rapid growth of the Chinese economy, the problems are growing as the obstacle to the further economic development of the country; it is growing the interdependence of the Chinese and world economies, which is a hidden threat to the stability and well-being of the global economy represented by the PRC.

Keywords: GDP Growth Rates, Export, Import, Living Standards, Energy Resources, Energy Consumption
JEL Classifications: Q4, O3

1. INTRODUCTION

China is one of the leaders of the modern world economy. Due to its competitive advantages and competent economic policy of the last decades, it managed to turn from a backward agrarian country into one of the most dynamically developing and having a huge influence of the economies of the world. We entered a new stage in the development of the world economic system, the success of which will be determined by the readiness to respond to the Great challenges of our time. Each national system will increasingly surpass from its development if it cannot anticipate and adapt to the qualitative changes dictated by the Great challenges. Modern challenges associated with global economic processes, global political risks and changes in the international security situation force resource-insufficient states to look for ways to stabilize their energy supplies. This task has reached one of the priority places in the PRC's foreign policy during the past 10-15 years.

Over the past 40 years, China has shown rapid and significant economic growth, passed the way from agrarian to industrial economy: Its GDP increased by an average of 9.8% per year, which represents dynamic economic growth, which is currently making China the second largest economy in the world for nominal GDP after the USA.

The purpose of this research is to assess the achievements and problems of the energy sector of the PRC. In this research, we look at the energy problems of China. We prove that the depth of the problems with an increase in energy consumption, is determined by the extremely low rates of growth in the efficiency of Chinese energy, which involves a number of other economic and social problems.

The high rates of development in China are increasingly indicated the insufficiency of their own energy resources to maintain the positive dynamics of the growth of the national economy. However, the high rates of the Chinese economy were not ensured by the corresponding development of the fuel and energy complex, which is a problem for the further development of China. The RPC

is increasingly moving into the category of net energy importers. The structure of the Chinese energy entails negative consequences it is the real obstacles to the development of the Chinese economy. In the absence of structural changes in the Chinese energy industry, exacerbation of the environmental problem is likely to reduce the inflow of foreign direct investment, on which the PRC economy is also mainly dependent.

2. THE MAIN PROBLEMS OF CHINA ENERGY INDUSTRY

2.1. Problem 1: Insufficiency of Own Sources of Energy

According to international estimates, in 2017, the explored sources of oil in the PRC are enough to satisfy the current level of consumption over 10 years, natural gas - 25, coal - 30 years (BP Statistical Review of World Energy, 2017). However, it should not be overestimated the role of the "Chinese factor" in the world oil market: this country's share in world fuel imports is still relatively modest, as evidenced by the data in Table 1 on the PRC's share in world fossil fuel reserves.

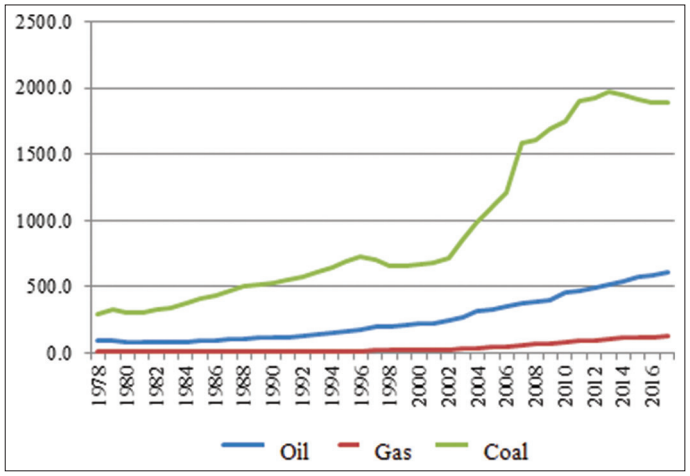
Moreover, since 2009, China is the leader in terms of primary energy consumption in the world. In 2007, this indicator amounted to 23.2% of all primary energy consumed in the world economy. The main source of energy in China is coal, as can be seen from the dynamics of primary energy consumption in China (Figure 1).

According to the data in Figure 2, the USA and the PRC are the world leaders in terms of energy consumption. However, the Chinese economy is characterized by fairly large volumes of oil and oil products imports, which is also one of the main signs of the high degree of dependence of the Chinese economy on the international energy market. It is not only a growing problem of the Chinese economy, but also a significant problem for the global economy. Figure 3 demonstrates that the total energy consumption in China is increasing, while in the USA it is decreasing. But this confirms that developed countries are on the path to reducing energy costs, and an increase in the rate of growth in energy consumption is not automatically a sign of a growing economy.

According to Figure 4, over the past decade the energy production and energy consumption in the PRC has grown rapidly, however, energy consumption has also increased in excess of energy consumption. In this connection, the volumes of the energy balance of trade has increased.

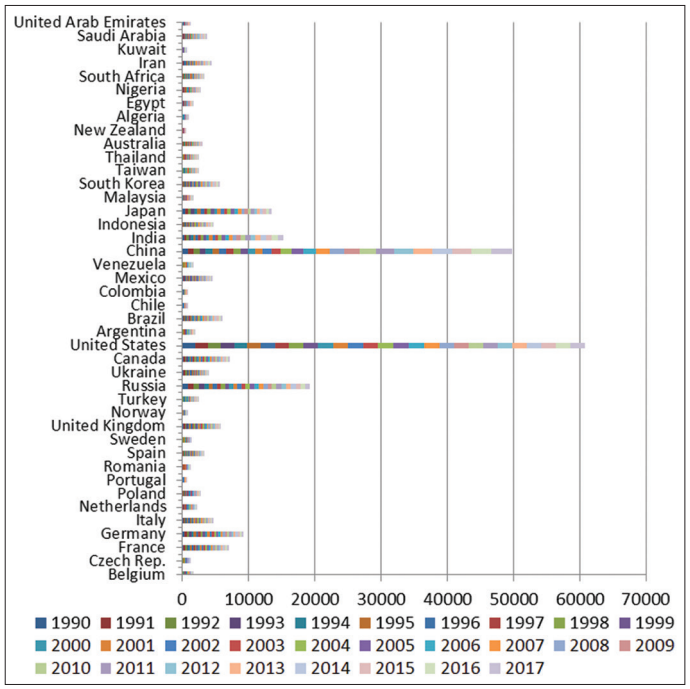
At the same time, it is important to note that during the analyzed time period (1990-2017) (Figure 5), there was a periodic decline in the share of energy imports in total energy consumption. The shortage of energy resources in China actualizes the problem of energy saving, both in everyday life and in production, which is very energy-intensive.

Figure 1: Dynamics of primary energy consumption in the PRC in 2000-2017, mln



Source: Share of Renewable Energy in Power Generation, 2018

Figure 2: Total energy consumption by country (Total energy consumption (Mtoe)



Source: Share of Renewable Energy in Power Generation, 2018; Global Energy Internet Development Cooperation, 2017

Table 1: The PRC's share of the world's fossil fuel reserves

Year	Coal		Oil		Natural gas	
	Stocks, billion tons	Share, %	Stocks, billion tons	Share, %	Stocks, trillion cc m	Share, %
2000	114.5	11.6	3.3	2.3	1.4	0.9
2010	114.5	13.3	2.0	1.1	2.8	1.5
2016	114.5	12.8	2.5	1.1	3.8	2.1

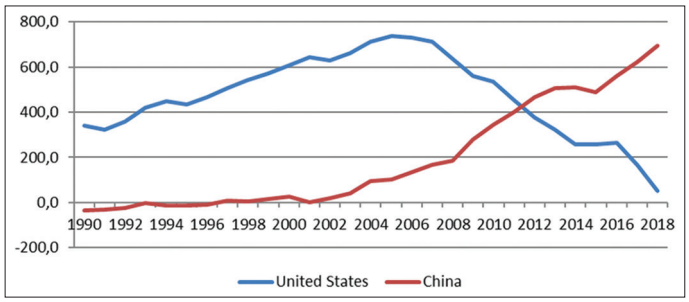
Source: Calculated according to the National Statistical Office of China

Thus, the volumes of energy production do not correspond to the growth rates of energy consumption.

2.2. Problem 2: Unbalanced Structure of Energy Supply and Energy Consumption

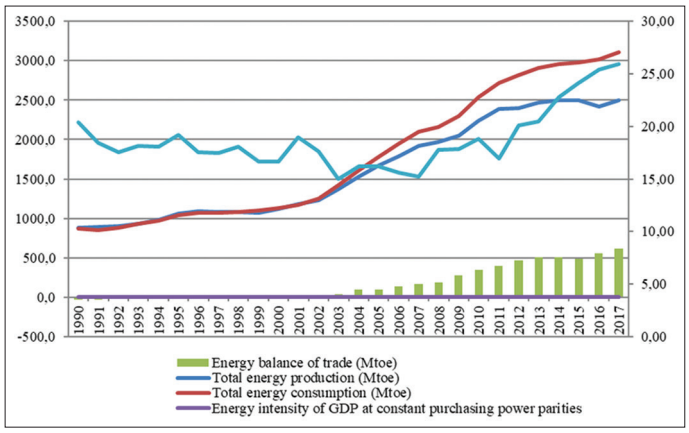
According to Table 2, the main source of energy in China in 2017 is coal, its share in the country's energy balance is 64%, oil takes the second place - 19%.

Figure 3: The total energy consumption of China and the US Energy balance of trade (Mtoe)



Source: Share of Renewable Energy in Power Generation, 2018

Figure 4: Comparison of energy production, energy consumption, energy trade balance, energy intensity and renewable energy sources



Source: Share of Renewable Energy in Power Generation, 2018

Crude oil is also an important component of the country's energy balance, and gradually its share increases. If in the 1950s it was considered that China has low level of oil reserves, and its share in energy production did not exceed 2%, then in the 1960-80s its share gradually grew and reached 23.8% in 1980. However, later, due to the rapid growth of energy consumption during the economic reform, the rate of oil exploration and oil production began to noticeably lag from the country's requirements for crude oil and oil products. Since 1992, the energy balance in the PRC has become negative, and consumption has become significantly higher than production. Then, the energy deficit continued to grow, and in 2005 it has already amounted to 172.5 mln. During the 11th Five-Year Plan (2006-2010), the energy deficit continued to grow in the conditions of high GDP growth rates in general and in the manufacturing in particular. Since 2007, the volume of energy consumption exceeded the production volume by more than 300 million tons of equivalent fuel.

The specific feature of China is a significant difference in the structure of energy consumption from other countries. The coal energy has historically developed in this country. The structure of energy consumption in the PRC is presented in Table 3.

2.3. Problem 3: Critical Level of Environmental Pollution

The country, possessing large reserves of uranium and great potential in hydro, solar and wind power (Boqiang and Chunping, 2013), is gradually reducing the share of coal and intends to increase the share of alternative energy to 15% in the country's total energy balance by 2020. Although it is justified from a resource point of view, many negative consequences of the preferential use of coal (primarily environmental) are becoming catastrophic: nowadays, China is on the verge of an ecological disaster.

According to Figure 6, CO_2 emissions from fossil fuels in China from 1978 to 2017 increased almost 6.5 times, and the average growth rate was 17%. In 2017, the growth rate of emissions in China was transferred to a positive growth zone (growth in CO_2 volumes in 2017 was + 1.3% after - 0.5% in 2015 and 2016).

Table 2: The structure of the modern energy balance of the PRC in 2012 and 2017

Types of resources	Indicators	Quantity		Share of world (%)		The structure of the energy balance, 2017 (%)	
		2012	2017	2012	2017	2012	2017
Total primary energy	Consumption (million tons)	2613.55	3014.43	21.3	22.9	100	100
Oil	Stocks (million tons)	2000	2500	0.9	1.1	17.67	18.58
	Production (million tons)	203.6	215	5.1	4.9		
	Consumption (million tons)	461.8	560	11.4	12.9		
Natural gas	Stocks (billion cubic meters)	3100	3800	1.5	2.1	4.48	5.87
	Production (billion cubic meters)	102.5	138.0	3.1	4.8		
	Consumption (billion cubic meters/million tonnes of oil equivalent)	131/117	197/177	4.0	4.7		
Coal	Stocks (million tons)	114500	114500	13.3	12.8	70.38	63.69
	Production (million tons e.)	1956	1827	49.5	47.7		
Nuclear energy	Consumption (million tons e.)	1839.4	1920	49.4	50		
	Consumption (million tons e.)	19.5	38	3.3	6.6	0.75	1.26
Hydro-electric power	Consumption (million tons e.)	157	255	19.8	28.5	6.00	8.46
Renewable energy	Biofuels (million tons e.)	1.149	2.43	2.0	3.2	0.72	2.14
	Other species (million tons e.)	17.7	62	9.1	17.2		

Source: Calculated using BP Statistical review of world energy 2012; 2017

Table 3: The structure of energy consumption in the PRC

Year	Total energy consumption (million tons of ne.)	Coal (%)	Oil (%)	Natural gas (%)
1957	96.44	92.3	4.6	0.1
1962	165.4	89.2	6.6	0.9
1965	189.0	86.5	10.3	0.9
1970	292.9	80.9	14.7	0.9
1975	454.3	71.9	21.1	2.5
1980	602.8	72.2	20.7	3.1
1985	766.8	75.8	17.1	2.2
1990	987.0	76.2	16.6	2.1
1999	1220.0	67.1	23.4	2.8
2003	1204.2	69.3	22.1	2.4
2006	1729.8	70.2	20.4	2.9
2011	2432.2	70.5	17.6	4.0
2013	2735.2	68.5	17.7	4.7
2014	2903.9	67.3	17.7	5.1
2015	2970.3	65.6	17.7	5.7
2016	3014.0	63.7	18.6	5.9

Source: National Statistical Office of the People's Republic of China, 2013-2017

Since 2005, China has been the largest emitter of carbon dioxide in the world, in 2017, China produced 27.6% of its total emissions, but by the end of this year, China has reduced CO_2 emissions per unit of GDP by 46% compared to 2005, fulfilling its commitment taken in the framework of the Paris Climate Agreement (2015), to reduce the intensity of CO_2 emissions by 40-45% from the 2005 level by 2020 (Boqiang and Chunping, 2013).

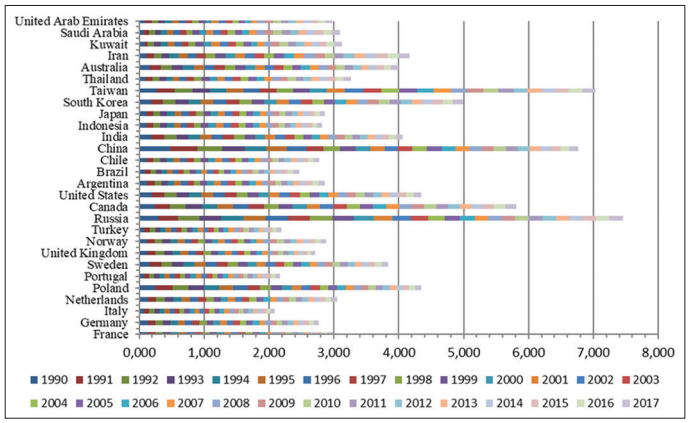
2.4. Problem 4: Irregular Territorial Distribution of Energy Resources

It should be noted another problem of the PRC. The macroregions of China differ significantly from each other in the provision of energy resources. The distribution of energy takes place according to the scheme - coal in the north, electricity in the south, oil in the east, gas in the west. If you allocate energy reserves in China to six major economic regions, then the North China will be most energy-secured - 43% of all energy reserves, the South-West China - 28.6% and the North-West China - 12.1%. The largest reserves of coal are concentrated in the North China (64%), hydro resources - in the South-West (70%), and oil and natural gas - in the North East China (48.3%) (Gao and Dong, 2007). Thus, almost all natural gas is produced in the western regions far from the main sources of consumption, which makes it extremely difficult to use as one of the main energy sources (Aristova, 2014). The absolute increase in its production in the 2000s was concentrated mainly in the east of the country (Table 4).

Guangdong and Jiangsu provinces were also major consumers of domestic gas, and in total in China 170 million citizens had access to domestic natural gas in 2010. The most developed regions of the country use the clear energy. At the same time, the growth of natural gas consumption was fairly evenly distributed in almost all regions of China.

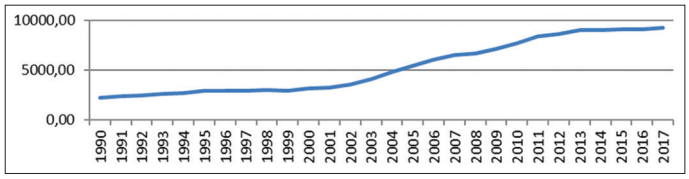
In connection with the differentiation of the economies of the Chinese provinces, we calculated the integral indicator (province development ratio).

Figure 5: Energy intensity per unit of GDP at constant purchasing power parity (PPP) (GDP energy intensity at constant purchasing power parities (thous. USD/USD) (Energy intensity of GDP at constant purchasing power parities (koe/$2015p)



Source: Share of renewable energy in power generation, 2018

Figure 6: CO_2 emissions from fuel combustion ($MtCO_2$)



Source: National Statistical Office of the People's Republic of China, 2013-2017

The formula for calculating the development rate is following:

$$CED = \frac{\sum\left(\frac{1}{3SPI};\frac{1}{2SSI}\right);STI}{100} \quad (1)$$

CED - Development rate;
SPI - Share of extractive industry in GRP;
SSI - Share of manufacturing in GRP;
STI - Share of service sector in GRP.

We received the following results.

The most part of the Chinese provinces are characterized by a lower degree of development of the economy with a development coefficient in the range of 0.61-0.68. Eight provinces are characterized by a higher level of economic development, however, with a relatively low development rate in the range from 0.681 to 0.75. It is also noteworthy that most of the Chinese provinces of this group are located in the coastal zone or closer to the southern border of the PRC. The next range of development rates from 0.751 to 0.82 included only one territorial entity of China - Shanghai. This subject is located in the coastal zone of the PRC and, as noted before, it is characterized by a high share of the service sector in the GRP, which influenced the level of development coefficient (Table 5).

The last range of the most developed provinces of China, characterized by a development rate in the range of 0.821-0.89, includes only two territorial subjects of the PRC - Beijing and Taiwan.

Thereby, the territorial entities of China located in the coastal zone or closer to the southern border of the country are characterized by a higher level of economic development than other provinces. It is also important to note that the share of provinces with a relatively more developed economy is substantially small.

Table 4: Production and consumption of electricity in the regions of China, billion kWh

Region/Year	Production		Consumption	
	2000	2011	2000	2011
North (Beijing, Tianjin, Hebei, ARM, Shanxi)	226	652	219	624
Northeast	139	243	150	269
West (Shanghai, Anhui, Jiangsu, Jiangxi, Fujian, Shandong, Zhejiang)	406	1184	423	1266
Center-South (Henan, Hubei, Hunan, Guangdong, Hainan, GCHAR)	323	873	333	929
Southwest (Sichuan, Yunnan, Guizhou, TAR, Chongqing)	138	462	142	354
Northwest (Shaanxi, Gansu, NHAR, XUAR, Qinghai)	98	301	102	280

Source: Calculated by Statistical Yearbook of China Energy, 2010

2.5. Problem 5: The High Level of Dependence on Hydrocarbon Imports, Especially Oil

The largest share in the consumption of petroleum products accounts for industry and transport. The share of consumption of petroleum products in the transport sector is constantly growing.

From 2013, the share of transport began to exceed the share of industry in the structure of consumption of petroleum products of China (in 2014, the share of industry - 35%, transport - 38%), while in 1990 the transport sector of the economy consumed 4 times less products oil refining than in the industrial sector (industry's share - 64%, transport - 15%) (China Statistical Yearbook, 2016).

According to the researches of B. Lin, GDP growth in China is directly dependent on the growth of oil consumption in the transport sector of the economy (Boqiang and Chunping, 2013). Whereas, motorization of China is at a relatively beginning stage of development, it can be assumed that oil imports will continue to increase (Figure 7).

As a result of the analytical review, the main economic factors were identified, and the research hypothesis is that there is the influence between these factors and oil consumption in the PRC. To solve this problem, within the framework of the hypothesis

Table 5: Data of the sectoral structure of the economy and the calculated coefficient of development of the provinces of the PRC

Province of China	Share of extractive industry in GRP (%)	Share of manufacturing in GRP (%)	Share of service sector in GRP (%)	Development rate
Henan	14.1	57.3	28.6	0.6195
Xinjiang Uygur	19.8	47.7	32.5	0.6295
Jiangxi	12.8	54.2	33	0.643667
Anhui	14	52.1	33.9	0.646167
Guangxi Zhuang	17.5	47.1	35.4	0.647833
Sichuan	14.4	50.5	35.1	0.6515
Hebei	12.8	52	35.2	0.654667
Qinghai	10	55.1	34.9	0.657833
Jilin	12.1	52	35.9	0.659333
Gansu	14.5	48.2	37.3	0.662333
Inner Mongolia	9.4	54.5	36.1	0.664833
Heilongjiang	12.6	50.2	37.2	0.665
Shaanxi	9.8	53.8	36.4	0.665667
Hubei	13.4	48.7	37.9	0.667167
Chongqing	8.6	55	36.4	0.667667
Shandong	9.2	54.2	36.6	0.667667
Yunnan	15.3	44.6	40	0.674
Hunan	14.5	45.8	39.7	0.674333
Shanxi	6	56.9	37.1	0.6755
Liaoning	9.3	52	38.7	0.678
Fujian	9.3	51	39.7	0.683
Hainan	26.2	27.7	46.2	0.687833
Ningxia Hui	9.4	49	41.6	0.692333
Jiangsu	6.1	52.5	41.4	0.696833
Zhejiang	4.9	51.6	43.5	0.709333
Guizhou	13.6	39.1	47.3	0.713833
Guangdong	5	50	45	0.716667
Tianjin	1.6	52.4	46	0.727333
Tibetan	13.5	32.3	54.2	0.7485
Shanghai	0.7	42.1	57.3	0.785833
Taiwan	1.6	31.1	67.2	0.832833
Beijin	0.9	24	75.1	0.874

Source: Calculated by China Provinces and Cities-HKTDC

on the composition of the causal block of influencing factors on oil consumption by the country, the econometric analysis of the statistical data set was carried out.

To construct the regression equations, it was collected the annual data for 45 years (1971-2015) from statistical sources in accordance with the results of the analytical review. The oil consumption in the transportation industry indirectly characterizes factors X_2 and X_3; the oil consumption in the energy sector - factor X_4; in production - factor X_5.

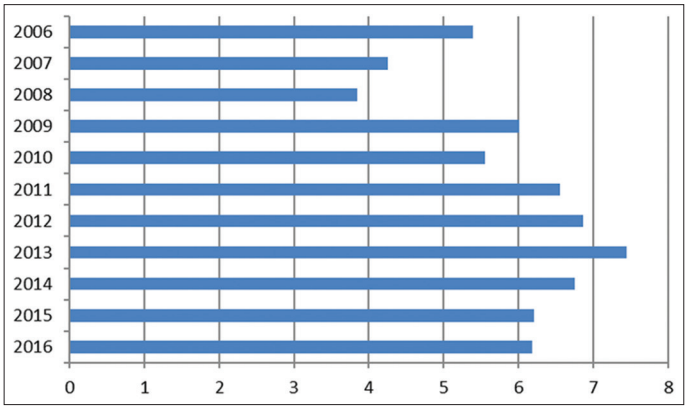
The main factors hypothetically affecting oil consumption in the country was listed below:

Y - Oil consumption million barrels per day;

x_1 - Total population, million people;

x_2 - Energy consumption in the road sector, mln toe;

Figure 7: Imports of electricity (billion kilowatt hours)



Source: International Energy Data, 2018

x_3 - Air transportation of passengers registered in the country, mln.;

x_4 - Electricity production on the basis of oil and petroleum products, billion kW/h.;

x_5 - GVA in "production," in 2010 prices of 10 billion USD;

x_6 - Gross output, billion USD, 2010 prices.

Calculations are made by (World Development Indicators, 2017; BP Statistical Review of World Energy, 2017). To solve the problems, associated with the occurrence of false correlation and heteroscedasticity, the regression equations were constructed for stationary series, for which the indicators were converted into growth rates. The econometric analysis was carried out in two successive stages. Firstly, the hypothesis about the effect of the dynamics of GDP (factor x6) on the growth rate of oil consumption was tested. The constructed regression equations allowed us to accept the hypothesis of a positive relationship between the dynamics of oil consumption and GDP. Moreover, for the PRC, as a result of its energy saving policy, in the absence of GDP growth, the rate of oil consumption will decline.

The regression equation between the growth rate of oil consumption and the growth rate of GDP:

$$y_t=-0.001+0.65x_{7t}+e_t$$

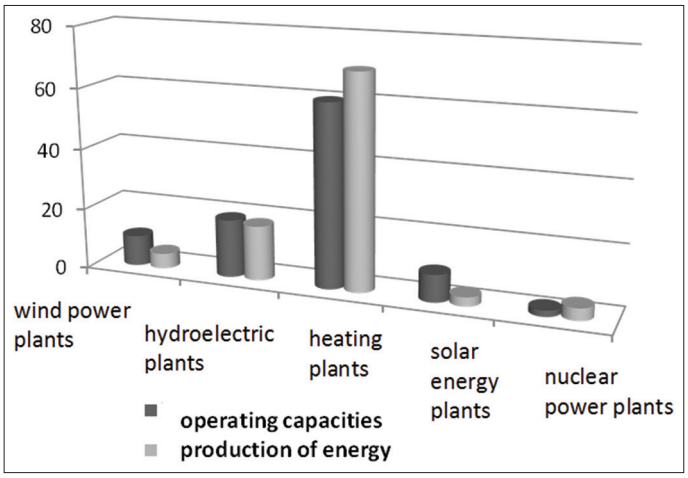
$$(0.02)R^2=14\%$$

At the second stage of calculations, in order to understand the impact of the causal complex, GDP was replaced with components and the share of influence of each factor on oil consumption in the country was revealed. To solve the problem of multicollinearity, the regression analysis was performed using the step-by-step method.

Figure 8: Map of nuclear power plants in China

Source: China statistical yearbook, 2016

Figure 9: Structure of installed generating capacity and power generation, 2018



Source: International Energy Data, 2018

To determine the degree of influence of each factor, the regression equations were based on the analysis of partial correlations.

There is the construction of multiple regression equation:

$$y=-0.04+0.34x_{2t}+0.09x_{5t}+e_t$$

$$(0.003)(0.003)$$

$$R^2 = 35\%$$

As a result, for the PRC, priority factors were identified that affect oil consumption in the country. The calculations showed that the growth of oil consumption is associated with the growing needs of the national transport for energy resources, and with the growing demand for electricity. In modern technological and economic conditions, oil remains one of the key resources for energy supply.

3. DIRECTIONS OF CHINA ENERGY DEVELOPMENT

3.1. Direction 1: Creation a Single Unified Energy Grid

The network complex of China is characterized by the fact that there is no single energy grid in the country. Six regional grid systems are in operation, which increases the risk of local power shortages: for example, the hydro potential of the western part cannot be used to its fullest to supply the southern coastal provinces, so an important task for the Chinese government is to create a unified energy grid. According to plans, by the end of 2020, China will build 15 large high-voltage transmission lines (800-1000 kV). Most of the technologies in the network complex of China are Western. Equipment is usually produced in local factories. The main suppliers of technological solutions in terms of high-voltage DC networks for China are the Swedish concern ABB and German Siemens.

3.2. Direction 2: Changes in Energy Sources

China encourages the development of clean technologies for the development of deposits and the use of coal, stimulates the development of advanced technologies, coal gasification, for example, integrated gasification combined cycle - IGCC, continuous coking in the fluidized bed - CFB, nuclear reactors of the third generation with water - PWR and gas cooled high-temperature reactors - HTGR.

Table 6: Installed wind power capacity by country, 2016 (MW)

Country	Total installed power	Growth in 2016
China	148000	32970
USA	74347	8598
Germany	45192	4919
India	24759	2294
Spain	22987	0
Great Britain	13614	1174

Source: World Wind Energy Association, 2016

At present, the consumption of such types of energy as nuclear power plants and renewable energy sources, as well as small hydroelectric power stations, hydrothermal energy, energy of tides and seas has significantly increased.

However, for 20-30 years there are no obvious structural changes in the energy consumption of electricity. Coal dominates with about 85% and after the hydroelectric station in 5-7%. It can be observed that in China, since 2004, new segments have appeared in the production of electricity from alternative sources and fuels like the sun, wind, tides, biofuels. In the general structure, they are completely invisible, but there is significant growth. We don't consider that it will somehow affect the energy balance in the next 10 years, because their growth is not comparable with the necessities of the economy and the net annual increment in energy production.

Nowadays, the 35 nuclear power units are in operation in China and another 21 are under construction. Every year, the PRC plans to commission 6-8 power units, by 2030 its number will exceed 110 (Figure 8).

CNNC and CGN are Chinese and French reactor technologies, but the American "denial" of the melt trap has moved into the "Dragon-1" project. And, since the projects of all three Chinese atomic energy companies use the same heat removal technology in case of alleged accidents, let's look at the details of this solution. The purely subjective opinion is obvious: we do not see any logic in rejecting the trap, because this technology is not so complicated, but it is completely reliable. But decisions on this issue, of course, takes by the regulatory and supervisory authorities of the countries with which the Chinese experts are negotiating. Here is a brief description of the so-called "IVR strategy" - retention of damaged or molten fuel inside the reactor vessel; the melt trap is not provided for in the project.

In recent years, China has remained the undisputed leader in the development of renewable energy in terms of the installed generating capacity of hydropower plants (352 GW), wind farms (184 GW) and SES (175 GW). Solar energy has long overtaken the goal set out in the five-year plan for 2020 at

110 GW. In June 2018, in China it was decided to stop issuing subsidies for the construction of new SES, phased reduction of "green" tariffs and encouraging projects that do not require government subsidies.

In order to reduce the share of coal-fired power plants in China, nuclear and renewable energy is actively developing. As of March 2019, there are 45 nuclear reactors with a capacity of 44.6 GW in China, about 15 units are under construction. By 2020, the installed capacity of nuclear power plants should increase to 58 GW, and by 2030 - to 150 GW. However, nowadays the situation is far from the forecast (Figure 9).

The obvious disproportion is an extremely low proportion of a power plant that uses gas (about 2%) and nuclear power plants (no more than 3%). In the middle 1990s there were no gas stations in China at all, 10 years ago it began to appear. Since then, the growth is five or more times, but China's energy intensity and energy demand is so great that this growth has little effect on the energy structure (REN21, 2015; Renewable Energy Policy Network for the 21st Century, 2018).

Since 2008, the large-scale development of wind energy has begun. The report of the International Organization for the Support of Renewable Energy REN21, published on June 1, 2016, states that in 2015, China invested 102.9 billion USD (1/3 of the world) in the construction of renewable energy facilities) (Cautious Europe Cuts Renewable Energy Investments, 2018).

Nowadays, in China, there are 12 thousand megawatts of capacity, generating electricity using wind (Table 6). For the most part these are 50- and 100-megawatt farms, as well as many medium-sized farms under construction. In addition, according to the Wind Base program, six megacomplexes are created, each with a capacity of at least 10 gigawatts. These complexes are located in the provinces of Gansu (15 gigawatts), western Inner Mongolia (20 gigawatts), eastern Inner Mongolia (30 gigawatts), Hebei (10 gigawatts), Xinjiang (20 gigawatts) and along the coast north of Shanghai in Jiangsu province (10 gigawatts).

In Table 7, we can see insufficient development of renewable energy sources.

3.3. Direction 3: Reducing the Intensity of Energy Use

China recorded a significant decrease in energy use intensity, although it was slower than in 2016, as energy consumption accelerated in 2017. China's high energy intensity is mainly due to the predominance of energy-intensive industries, the export-oriented economy and low energy consumption. energy prices, which is not conducive to improving energy efficiency.

In the next 15 years, China predicts a decrease in the average annual growth rate of energy consumption from 8% in 2000-2014 to 3% in 2015-2030, which is caused by a slowdown in economic growth, the development of the services sector and a course for improving energy efficiency. At the same time, the potential for growth in energy consumption depends on the growth of urbanization and infrastructure projects to stimulate the economy and maintain employment.

3.4. Direction 4: Energy Reform

With the growth of the economy and the aggravation of the problems of shortage of energy resources, an energy reform is unfolding (Table 8).

Only for 2008-2010 China is actively encroaching on world energy markets and it was quite successfully. The total amount of transactions in 2008 amounted to 24,530 million USD; in 2009 - 39,670 million USD; for 2010 - 25,110 million USD (Salijanova, 2011). The geography of transactions are Canada, Brazil, Indonesia, USA, Argentina, Ecuador, Russia, Venezuela, Syria, Argentina, Australia, Mongolia, Qatar, England, Australia, Cameroon, Singapore, Kazakhstan, Iraq, Switzerland, Iran, Yemen, France, England, Nigeria, Norway, Myanmar.

From the second half of the XX century to the present, China has been actively developing its hydropower complex, it remains for several years the world leader in the production and consumption of hydropower. In November 2016, the Ministry of Energy of China announced the Plan for the development of the electric power industry in the "13 five-year period" and for the future until 2025. In perspective, the government of the PRC plans to increase the total capacity of all hydroelectric power plants to 350 GW by 2020 and to 510 GW by 2050 (Zakharov, 2016).

According to the latest statistics from the National Energy Administration (NEA), China is currently the largest market for solar photovoltaic (PV) technologies in the world - with a total installed capacity of 43.2 GW (2016). China has the first place in the world in this indicator, got ahead of the former undisputed leader - Germany. It should also be noted that China's photovoltaic solar power has increased about 13 times since 2011. In addition, most installed solar panels are not yet fully utilized. Thus, approximately 30% of installations in 2015 were not fully involved in Gansu province, and 26% in Xinjiang (according to NEA) (Lindon, 2016).

Table 7: Dynamics of production of renewable energy sources (billion kilowat)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net generation of traditional thermal power	2560	2623	3132.67	3132.67	3589.98	3648.24	3956.68	3984.92	4008.18	4157.28
Net geothermal power generation	0.12	0.14	0.15	0.16	0.13	0.13	0.13	0.13	0.13	0.13
Net nuclear power generation	59.3	65.33	65.71	70.96	82.57	92.65	110.71	123.81	161.2	197.83
Net hydropower generation	480.41	579.34	609.48	704.27	681.17	854.17	900.52	1 040.63	1103.33	1150.95
Net wind power generation	5.71	14.8	26.9	44.62	70.33	95.98	141.2	156.08	185.77	237.07
Net power generation	3108.03	3297.47	3527.34	3984.02	4461.71	4735.54	5170.66	5387.91	5562.48	5882.94

Source: Statistical Review of World Energy, 2012-2017

Table 8: The main stages of the energy reform in China

Year	Directions of reform	Purpose
1997	It was established state power corporation, SPC	To separate commercial activity from the sphere of administrative regulation
2001	Strategy "go beyond boundary"	Opening the way to Chinese investment companies in overseas oil projects
2002	It was launched Electricity reform It was established State Energy Administration The State Energy Corporation has been reorganized, dividing into seven generating companies and two grid companies (State Grid Corporation of China, China Southern Power Grid)	These companies currently produce more than 50% of electricity and own the entire network infrastructure
2004	The State Council of China adopted a program for the development of alternative energy for the medium and long term (2004-2020) Pilot projects of electricity markets launched in the west and north-west of China	Investment in the industry for a total of 2 trillion Yuan (about 300 billion USD)
2005	It was adopted a law on renewable energy	A legal framework has been created for the development of alternative energy in the country, sources of financing have been identified, and relations between renewable energy producers and owners of power grids in China have been regulated.
2006	The State Committee for the Development of Reform of the People's Republic of China has decided to liberalize the price of coal since 2007	A coal market has been created, based on the All-China Coal Stock Exchange with regional stock markets.
2007	"China Energy Development Report 2007" (the so-called Blue Book) and "White Paper on China's Energy Situation and Policy"	It is declared that the energy policy is an integral part of the long-term comprehensive program of modernization of the PRC.
2008	The law "On energy saving"	
2010	The law "On renewable energy"	
2014	The decree, in which it was noticed that in China it is necessary to increase the share of renewable energy by 2030 in the structure of energy consumption to 30%	To do this, it is necessary to increase the production of electricity from renewable energy sources by 800 GW (Zakharov, 2016)
2015	Document No. 9 of the State Council on the Further Strengthening of the Institutional Reform of the Electric Power Industry and Six Documents Implementing the Provisions of the Document	The pricing mechanism on the wholesale electricity market, electricity trading, load distribution schemes, electricity distribution, retail market liberalization, management of coal-fired thermal power plants for own needs were painted
2016	Geothermal Energy Development Plan (Prospects and Problems of Geothermal Energy, 2015)	Introduced into the program of the 13th five-year plan (2016-2020)
2017	"Plan for the development of the gas industry in the period of the 13th five-year plan" (2016-2020)	In this plan, as a "indicative" indicator of gas supplies to the Chinese market in 2020, a value of 360 billion cubic meters is given

About 79% of companies, located in Tibet, work on solar energy. In the area of Mount Chomolungma at the altitude of 5200, 5820 and 6500 meters above sea level, China Mobile's solar energy bases also operate, which cover the climbing routes with a signal, which makes them more convenient and safe for tourists.

Despite the fact that China has reached the first position in the world in terms of the development of solar energy, there are still a number of important problems in the country. According to opinion of the head of the Solar Energy Division of the China Electromechanical Production and Commercial Company Sun Guangbin, there are many problems that impede the development of China's solar power. He says: "At present, the core technologies and equipment, market demand and the main raw materials necessary for the full development of solar energy in the country still rely on foreign countries, which is a significant barrier to the further development of the solar industry in China. Nowadays, almost all core technologies and equipment are borrowed from abroad, more than 90% of raw materials are imported and 98% of sales go to meet the demand of foreign consumers". Thus, Sun Guangbin noted that China's solar power industry has not yet developed a system for self-development and implementation of new products (Shaw, 2010; Jian, 2018).

Environmental specialist from Beijing, Zhang Junfeng, is confident that hydroelectric power plants adversely affect the country's environment. In his opinion, the new power plants will in fact not help China, except for the official figure of GDP. He notes that "hydroelectric power sources are mainly located in mountainous areas, which in China are the weakest from a geological point of view. The construction will undoubtedly entail a change in the local geosystem. It can be a cause of earthquakes, landslides, soil and water conservation, as well as a cause of other problems. However, China has grand plans to build new hydropower plants and increase the energy capacity of the country (Yukun, 2016).

The problem of renewable resources is in its unpredictability and uncontrollability. You get electricity not when you need it, but when the appropriate environmental conditions come together. It is an obvious disadvantage compared to the traditional generation. And here we wisely will not touch the extremely large-scale issue of maneuvering of capacities. At the beginning of 2017, Germany was already confronted with large-scale outages due to cloudy, windless weather. And yet they are not the only ones who have suffered from such misfortune. The state of South Australia in the second half of 2016 abandoned from

the coal. And if on average in Australia, according to Fortune, the share of renewable energy is 7%, then South Australia has brought it to 45.6% (31.2% is wind energy, 14.4% is solar energy).

Natural gas in this region provides 49.1% of electricity generation. With the transition to renewable energy sources, South Australia has experienced a twofold increase in wholesale electricity prices and frequent outages.

So far, all renewable energy relies on traditional energy storage technologies, which have reached the threshold of its development. Germany, Australia or any other region – it does not matter. If this region decides to create drives to support renewable energy, then the first thing it does is to load the mining industry. Then - the chemical production. And at the end of the operating cycle, there will be a necessity for safety and extremely costly disposal.

Although, renewable energy has become a mass phenomenon on a global scale; but it cannot function completely without the support of traditional generation. At the same time, nowadays, with the current level of technology development, it would be a fatal mistake to thoughtlessly and uncontrollably expand the renewable energy sector.

4. CONCLUSION

As a conclusion, for China, as an economic leader not only in regional scale, but also in global scale, energy problems become extremely urgent and even strategically important.

The following energy problems remain in China: low energy consumption per capita; lack of own energy reserves; low quality of existing deposits; low energy efficiency of the economy; uneven territorial distribution of energy resources; unbalanced structure of energy supply and energy consumption; high dependence on imported hydrocarbons, especially oil. At the same time achieving new economic goals, China moved to a leading position in the field of environmental pollution.

Energy issues are of interest to all Asian countries, but for China the energy problem has become a big challenge. China will base its strategy of resolving the issue of tension with energy supply, based on its own resources, while certain imports will be saved to meet the growing demand for energy. Nowadays, the Chinese government pays great attention to the development of an effective domestic energy strategy. The relevant departments are taking active measures to optimize the fuel and energy complex, to introduce new technologies for the production of electricity, to develop technologies for "clean" coal, to increase the share of the usage of natural gas, hydroelectric power plants, nuclear power plants, wind energy and other alternative sources of energy. The Chinese government in these areas has achieved significant success; however, to maintain the current pace of economic development of the country, these measures are not enough. In this situation, China has to develop, in addition to its national energy policy, an external energy strategy.

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