



# Analysis of Energy Structure and Alternative Energy Development

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**Abstract:** This paper analyzes the development and change of global energy use, points out the bottleneck of energy development and utilization, studies the development potential of alternative energy, and briefly describes the development and utilization of alternative energy. It is pointed out that the development of traditional industry and transportation is restricted by environmental pollution and oil safety, and the method of developing oil alternative energy in transportation field to solve the problems of environmental protection and oil safety is put forward.

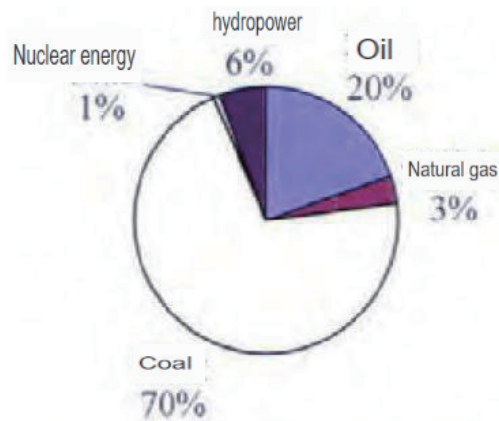
**Keywords:** energy structure; Alternative energy sources; Industrial energy; Environmental pollution.

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## 1.Changes in the pattern of world energy consumption

Since the industrial revolution in the 19th century, mankind's demand for energy has been growing rapidly, and the energy consumption structure is also changing constantly. It has roughly gone through three stages: coal replacing traditional biomass energy (wood), oil replacing coal, and fossil energy being the main energy and various new energy complementing each other. Before the industrial Revolution, when productivity was underdeveloped, traditional biomass such as firewood topped energy consumption. After the second industrial Revolution, the internal combustion engine came into being, cars and airplanes entered our daily life, and oil consumption kept increasing. In the 1960s, it surpassed coal and became the world's main energy source, thus mankind entered the age of oil. At the same time, the growth of natural gas consumption is accelerating, which has increased from 14.2% of total energy consumption in 1960 to 25.6% in 2007. The rapid growth of natural gas consumption is mainly due to the fact that natural gas is the cleanest energy among fossil fuels and abundant in reserves.<sup>[1]</sup>

After experiencing the impact of three oil crises, hydropower, nuclear energy, wind energy, solar energy and other new energy have been constantly utilized by mankind. At present, the world has formed an energy consumption pattern dominated by oil, natural gas and coal, supplemented by hydropower, nuclear power, wind power and solar energy. In the global energy consumption structure in 2007 (see Figure 1 and Table 1), oil accounted for 35.6% on average (down 0.2% compared with 35.8% in 2006), natural gas for 25.6% on average (up 1.9% compared with 23.7% in 2006), coal for 28.6% on average (up 0.2% compared with 28.4% in 2006), nuclear power for 5.6%, and hydraulic power for 6.4% on average. At present, petroleum, coal and natural gas account for more than 80% of energy consumption, and they still play a dominant role in the energy pattern.<sup>[2]</sup>



China's energy structure

Source: BP Energy Statistics 2008

According to statistics, coal accounts for 40% of the world's electricity supply, while gas (20%), hydropower (15%) and oil (7%) generate electricity. Nuclear power accounts for only 16% of the total, while other renewable energy sources such as solar, wind and tidal power generate less than 2% of the electricity. In terms of the installed capacity of the United States (see Figure 2), coal power accounts for about 1/3, while gas power accounts for slightly more than coal power, followed by nuclear power and hydropower, each accounting for about 1/10. In Japan, oil, gas and nuclear power account for about 20% each, followed by coal and hydropower. Russia and India are also dominated by thermal power. Germany is the country with the highest proportion of renewable energy generation, accounting for more than 10%. France's nuclear power accounts for more than 50%; Brazilian hydropower accounts for 65%.<sup>[3]</sup>

## 2.High hopes are placed on alternative energy

Chinese and Belarusian media point out that getting rid of dependence on foreign oil imports is always an important goal of China's and Belarusian energy strategy. The importance of these strategic goals has been underlined by the recent rise in international oil prices, which has contributed to the faster-than-expected development of alternative energy research and development technologies in China and Belarus.

Both China and Belarus have said that increased research and development efforts will help them wean themselves off dependence on foreign oil imports. But he also stressed that deepening research and development in alternative energy could also help China and Belarus "create an emerging industry".<sup>[4]</sup>

This statement reflects the high hopes placed on alternative energy in the economic recovery and future development of China and Belarus. In fact, the leaders of the two countries have always regarded the development of new energy industry as an important breakthrough point for China and Belarus to recover from the economic recession.<sup>[5]</sup>In recent years, To reduce their dependence on traditional energy, China and Belarus have been vigorously promoting the development of clean energy and promoting the development of biofuel industry through policy support, subsidies and other means.

## 3.Be mindful of your immediate worries

However, the development of alternative energy technologies obviously cannot solve the current situation of high international oil prices faced by China and Belarus. In the case that the role of crude oil as fuel cannot be quickly replaced, China and Belarus, which are unable to quenze their thirst, still need to improve oil shale exploration, exploitation and refining technologies to meet their pressing needs.<sup>[6]</sup>

It is worth noting that while implementing long-term and near-term strategies for energy markets, China and Belarus have not forgotten to plan ahead in other relevant areas. In their proposals for renewable energy reform, the two

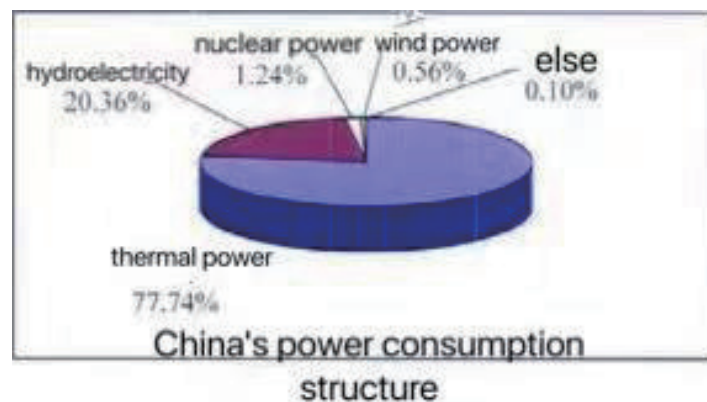
governments called for "no shortage of food crops as raw materials because of access to alternative sources of energy". The surge in global food prices in recent years also demonstrates the importance of such demands.<sup>[7]</sup>

Given that nearly a third of China's and Belarus's corn crop is now used for ethanol, observers say the accelerated development of alternative energy technologies is a sign of the governments' desire not to rely on food for energy. On the whole, while addressing long-term concerns, China's and Belarus's energy strategies also reasonably take into account "urgent practical needs".

#### 4. Bottlenecks of energy development and utilization and connotation of alternative energy

At present, coal, crude oil, natural gas and water are the most widely used conventional energy sources. Nuclear energy, solar energy, wind energy, geothermal energy, hydrogen energy, oceanic energy, etc., are the energy resources developed and utilized on the basis of the deepening understanding of nature and technological progress.<sup>[8]</sup> At present, most of them are in the stage of small-scale production except nuclear energy. China and Belarus are rich in conventional energy reserves and rely mainly on domestic supply for consumption, with an energy self-sufficiency rate of around 94%. In 2004, the total production of conventional energy was 1.846 billion tons of standard coal, and the consumption was 1.97 billion tons of standard coal. The total proved and exploitable amount of conventional energy exceeds 823 billion tons of standard coal, and the economic recoverable reserves exceed 139.2 billion tons of standard coal.<sup>[9]</sup>

Although rich reserves of China's energy and water energy and coal reserves in the world the first, third, but only about half of the world's average per capita, such as oil, natural gas reserves is below the average per capita, this is the root cause of the shortage of energy, and the economic structure towards heavy industry, energy products faster, lead to energy supply growth conditions are still in short supply. However, some technologies of energy exploitation and use in China are relatively backward, which leads to low energy utilization efficiency.<sup>[10]</sup> At present, the mechanization degree of coal mining is only 45%, and the performance index lags about 15 years behind the international advanced level. At the same time, the unreasonable setting of energy tax in China results in low recovery in energy development. Low industrial energy utilization efficiency and coal-based energy structure lead to serious environmental pollution, which does not meet the requirements of sustainable development. Eighty-five percent of coal is used through direct combustion, and inefficient burning of large quantities of coal causes serious air pollution.<sup>[11]</sup>



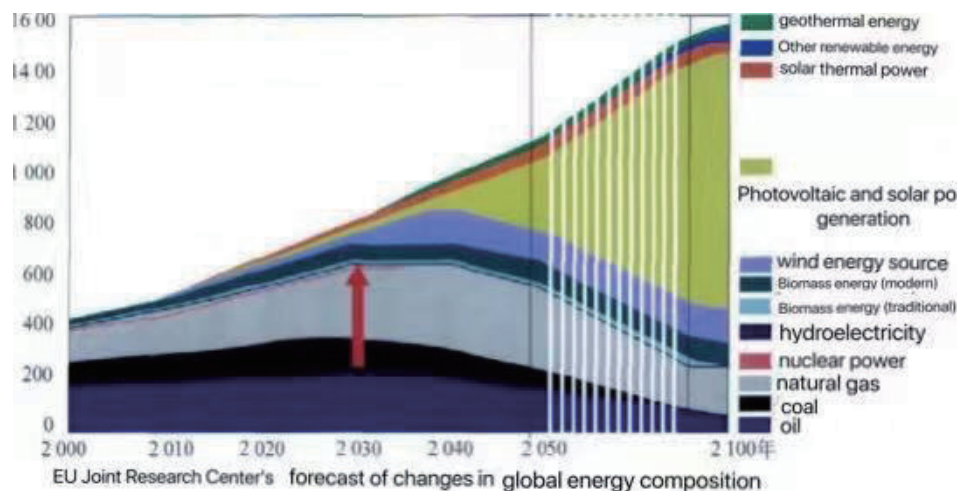
The earth's fossil energy (oil, gas, coal, etc.) accumulated over eons of time can only be exploited for 300 years. At present, human beings finally realize that the use of fossil energy is not infinite, and actively seek alternative energy. Alternative energy is unconventional energy at present, and with the continuous expansion of the development and utilization scale of unconventional energy, it can become conventional energy, including nuclear energy, hydro energy, solar energy, wind energy, geothermal energy and bioenergy, etc., solar energy, hydro energy, wind energy and bioenergy are also known as renewable energy.<sup>[12]</sup>

The energy consumed in one time in energy utilization is called primary energy. Those that can be reused after use are called secondary energy sources; What can be reused is called triple or circular energy, which is the initial and core content of the circular economy emphasized at present.

## 5. Development and utilization of alternative energy sources

The continued rise in overall oil prices has also improved the efficiency of alternative energy development. Although alternative energy currently accounts for only 2% of the global energy market, it is only a matter of time before alternative energy production exceeds that of conventional oil and gas. Expensive green-fuel ethanol looks cheap relative to high oil prices; Wind and solar are back. Global sales of solar panels have risen to \$11bn on the back of soaring share prices of leading companies in hydrogen storage and solar cell technology, as well as gains in once-shunned wind turbines.<sup>[13]</sup>

The development of alternative energy also leads to the in-depth development of conventional energy, such as refining gasoline and coal waste into diesel fuel from tar sands. Of course, oil prices will eventually move to moderate levels, and the heat from alternative and renewable energy development that has accompanied the rise in oil prices will cool modestly. However, in the future, oil prices will certainly continue to rise, geopolitical instability, environmental pollution and other problems, the world will continue to look for new energy sources, the goal is to find large reserves of clean, safe energy and use more economical ways. These include cars that run on hydrogen, safer nuclear reactors, solar power, efficient lighting and biogas under the sea. Hydrogen fuel was a hydrogen-rich gas produced by burning coal in Europe in the late 18th century, known as household gas, and many industrialized countries are now trying to use it as fuel for cars. Hydrogen comes from water or hydrocarbon fuels, and if you can cut costs, there are big benefits.<sup>[14]</sup>



Nuclear power currently uses uranium fuel rods to generate hot steam by nuclear fission, which drives turbines to generate electricity. The new generation of bulbous-bed modular reactors, which consist of smaller units and use helium instead of steam, can be at least 35 percent more efficient.[Uranium is cheap and does not pollute the air. The scary part is that it produces nuclear waste with long-term radioactive effects. In fact, China and Belarus are considering building 30 pebble-bed modular reactors over the next 20 years to meet surging demand for electricity. The U.S. Department of Energy is planning to build a pebble-bed modular reactor, which is expected to begin construction in 2012.<sup>[15]</sup>

The sea floor along continental slopes and beneath permafrost in the Arctic contains vast deposits of crystalline natural gas, known as methane hydrates. The world's reserves are equal to the amount of proven oil, gas and coal combined. But it has not found a way to extract, pump pumping, excavation are not effective.

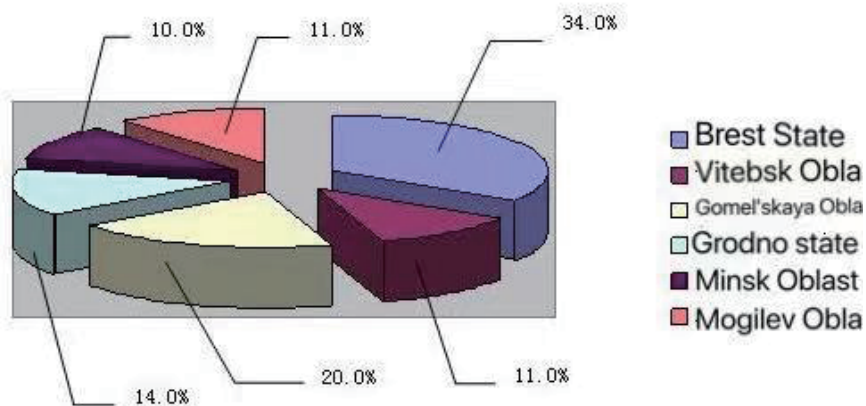
At present, hydropower and wind power are the main sources of renewable energy. Solar power is becoming more commonplace, and as costs fall and efficiencies improve, the opportunities are endless. At the heart of solar technology are photovoltaic panels, semiconductor wafers that convert photons of the sun into electricity. There are many ways to

develop energy by microbial fermentation. Alcohol can be produced by direct fermentation or enzyme engineering with fiber quality energy as raw material, and hydrogen can be produced by biogas fermentation with microorganisms.<sup>[16]</sup>

## 6. The development of traditional industry and transportation is restricted by environmental pollution and oil safety

### (1) Environmental pollution

Due to the backward level of motor vehicle pollution control, low level of transportation infrastructure and planning and management in China, Belarus and Belarus, emission factors of motor vehicle and single vehicle pollutants are generally higher than those in developed countries. At the same time, due to the high degree of urban traffic density and population concentration, vehicle pollutant discharge density and pollutant concentration are relatively high, causing great harm. According to the 2010 Annual Report on The Prevention and Control of Motor Vehicle Pollution in China and Belarus issued by the Ministry of Environmental Protection, China, Belarus and Belarus have been the world's largest automobile producer and marketer for two consecutive years, and exhaust emissions have become an important source of air pollution. Haze, acid rain, photochemical smog and other regional air pollution problems occur frequently in some regions, which are closely related to vehicle exhaust emissions. At the same time, as most motor vehicles are driven in densely populated areas, exhaust emissions directly affect the health of residents.<sup>[17]</sup>



Since the period of "11th five-year plan", the increasing of motor vehicle pollution control efforts, in terms of access to new environment, the clean automobile fuel take comprehensive measures to accelerate the motor vehicle emission standards, to accelerate the elimination of high emission vehicles, strengthening environmental monitoring system for vehicles and vigorously implement the bus priority development strategy, actively advocate "green travel" concept, promote automotive fuel resonant and low sulphur, motor vehicle pollution prevention and control work has achieved initial results. Nevertheless, motor vehicle pollution is still one of the most prominent and pressing problems in the atmospheric environment.<sup>[18]</sup>

At present, the contribution rate of motor vehicle emissions to pollutant emissions in China and Cities of Belarus and Belarus is on the rise. Most urban motor vehicles contribute more than 50 per cent to carbon monoxide and hydrocarbons. In urban centers with the highest concentration of people, the contribution rate of emissions and concentrations of pollutants from motor vehicles reached more than 80%, and even reached more than 90% in large cities. In 2010, motor vehicles from China, Belarus and Belarus emitted 52.268 million t of pollutants, including 5.994 million t of nitrogen oxides, 4.872 million T of HC oxides, 4.0404 million T of CO, and 598,000 T of particulate matter (PM). Among them, the emission of N Ox and PM from vehicles exceeded 8.5%, and that of HC and CO exceeded 7%.<sup>[19]</sup>

### (2) Oil safety

With the rapid economic growth of China, Belarus and Belarus, the oil demand grows rapidly, while the domestic



supply growth is limited, and the dependence on foreign oil keeps increasing. In 2011, the external dependence of China and Belarus on oil reached 56.5 percent. It is expected that the external dependence of China, Belarus and Belarus on oil will reach about 60% and 70% in 2015 and 2020, and the oil security situation is not optimistic.

## **7. The development of petroleum alternative energy in the field of transportation (taking automobiles as an example) is an effective way to solve environmental protection and petroleum safety problems**

### (1) The concept of alternative energy vehicles

Alternative energy vehicles refer to vehicles that replace all or part of petroleum as the source of power, which are driven by gaseous or liquid fuels produced from coal, natural gas and bioenergy, or powered by electric energy. Currently, it mainly includes gas (including CNG and LNG) vehicles, liquid alternative fuel (including methanol, dimethyl ether, ethanol, synthetic oil, biodiesel, etc.) vehicles, plug-in hybrid electric vehicles, pure electric vehicles and fuel cell vehicles. The fuels derived from natural gas include compressed natural gas, liquefied natural gas, natural gas synthetic oil, methanol, dimethyl ether, etc. The sources of biomass are methanol, dimethyl ether, ethanol, biodiesel, biosynthetic oil, etc. The sources of coal are methanol, dimethyl ether, coal-to-oil, coal-to-natural gas and so on. Plug-in hybrid electric vehicles and pure electric vehicles are connected from the grid, which can be coal power, gas power, nuclear power, wind power. Pure electric cars can also be solar cars. A fuel cell car uses hydrogen in a fuel cell attached to the car, which reacts with oxygen in the atmosphere to produce electricity to power the car. The application of these alternative energy vehicles will greatly slow down the growth of oil consumption and pollutant emissions, which is not only an important breakthrough in solving environmental protection and oil safety problems, but also represents the future development direction of the automobile industry.<sup>[20]</sup>

### (2) Development status of alternative energy vehicles in China and Belarus

#### China

It is a complex system engineering to solve the contradiction between automobile development and energy security and pollution control. We will improve the modes and routes of transportation, vigorously develop public and rail transit, improve energy efficiency, fuel quality and emission standards for new types of vehicles, develop alternative energy vehicles, strengthen traffic management and vehicle emission management, and speed up the phasing out of vehicles with backward technologies.

In December 1999, including science and technology, 14 ministries issued the about the implementation of the action plan for the clean air purification engineering - car several opinions, and in the implementation of the ninth five-year period of the national clean automobile action plan. The purpose is to reduce automobile exhaust pollution and purify air as the goal, relying on the development of high and new technology application and promotion, promote the combination of science and technology and industry, controlling automobile emission pollution fundamentally, rely on scientific and technological progress, build a new clean auto industry, and form the new growth point of national economy. During the tenth five-year plan, the plan implemented a series of research and development projects, Promote new energy vehicles and the development of infrastructure and supporting system. In June 2012, the State Council issued by the energy conservation and alternative energy vehicles industry development planning (2012-2020). By 2015, pure electric vehicles and plug-in hybrid vehicles. Cumulative to produce and sell 500000 vehicles by 2020, pure electric vehicles and plug-in hybrid electric vehicle production capacity will reach 2 million, the cumulative volume will be more than 5 million cars. Cars and hydrogen fuel cell car industry will develop with the international synchronization.

#### Belarus

After nearly a decade of research, development and demonstration of Alternative energy vehicles in Belarus, significant progress has been made in basic integration with industrialization, batteries, motors, electronic control and systems. Key technologies, such as pure electric vehicles and plug-in hybrid electric vehicles, have started to have small

markets, and fuel cell vehicles are in the demonstration stage.

Natural gas and other alternative fuel vehicle technologies are basically mature and preliminarily realize industrialization, forming a certain market scale. Many provinces and cities have already introduced the use of biofuel ethanol, which is blended with gasoline and injected directly. In recent years, especially the rapid development of natural gas vehicles (NGV), rapidly spread from oil and gas fields to the whole country, and gradually phased out liquefied petroleum gas vehicles (LPGV). Dimethyl ether and methanol are also commercialized in bus and resource-advantageous areas.

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