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Research on the energy security and future development of China

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Abstract. Nowadays, with the increase in carbon dioxide emissions, the global temperature is also increasing. Therefore, energy conservation and carbon emission reduction have been very hot topics in recent years. Nowadays, the best way to save energy and reduce emissions is to carry out energy transition. However, in the process of reducing carbon emissions and accelerating the energy transition, people often ignore some of these problems: First, in the process of rapid energy transition, energy supply is difficult to take care of and energy security is also difficult to guarantee, however, in most energy development studies, these points are easily ignored. The research theme of this study is energy supply guarantee, new energy security and the future development of energy. This research will take China as the entry point. The object of the research is the development of fossil fuels and clean energy, and the method of research is to search the literature and integrate the content. At present, the requirements for an energy transition are very urgent, but a too fast transition may encounter an insufficient energy supply and unguaranteed energy security. So, the government needs to build a new energy system as soon as possible and develop the technologies that are related to it.

Keywords: carbon emission, energy supply guarantee, energy security, energy transition.

1. Introduction

People are paying more and more attention to carbon emission reduction and the use of new energy. However, the rapid development of energy may lead to problems with energy supply guarantees and energy security.

The research topic of this study is the problem of energy supply guarantee and how to ensure energy security in the rapid energy transition, and China is the entry point for research.

This study divides the research into several themes: the security risks faced by China's energy transition under the carbon neutral goal, and the countermeasures and suggestions for China's energy transition and energy security under the carbon neutral goal. In these two topics, the study lists two sub-topics, respectively: the difficulty of energy supply under the requirement of carbon reduction, the difficulty of energy security under the trend of accelerating energy transition, the acceleration of the construction of a new energy system, and the acceleration of energy science and technology innovation.

Nowadays, with the rapid energy transition, more and more attentions have been paid to the efficiency of new energy and carbon emission reduction. Therefore, energy security is very important for the development of a country's low-carbon economy. This study hopes to sort out the methods to ensure energy security and the future development of energy.

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2. The security risks faced by China's energy transition under the carbon neutral goal

2.1. The difficulty of energy supply under the requirement of carbon reduction

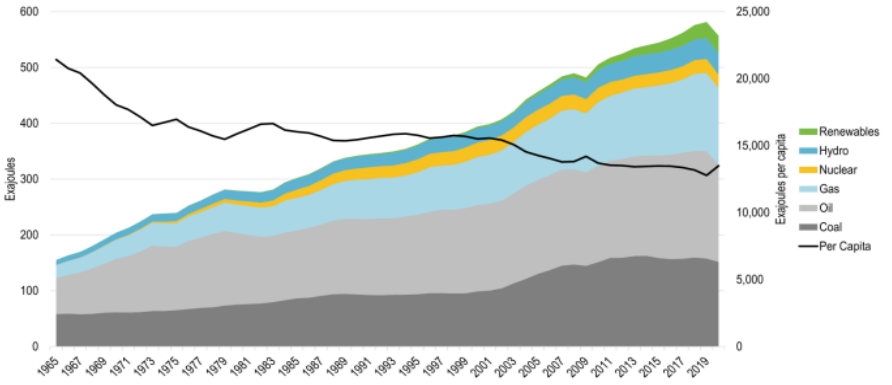

Figure 1. The geography of transport systems world energy consumption, 1965-2020.

As can be seen from Figure 1, since 1965, people's annual energy consumption has been increasing continuously. Despite the continuous development of clean energy, the use of fossil energy has still been increasing, and human beings still rely mainly on coal and oil. This long-term excavation of fossil fuels has reduced the Earth's fossil energy reserves. At the same time, due to the demand for carbon emission reduction and the decreasing amount of fossil energy, the energy transition needs to happen immediately, which means that people urgently need to use clean energy to replace fossil energy. This makes the existing energy supply problem deteriorated. In recent years, the lack of energy has been reflected in all countries. In 2021 and 2022, the lack of coal and electricity has caused widespread power shortages in India [1-2]. The obstruction of natural gas imports has strained Mexico's electricity supply and demand [3]. Similarly, since 2021, Europe has faced an energy shortage, which is not only due to external factors such as weather change, economic recession, and the Russia-Ukraine conflict, but more importantly, due to the rapid low-carbon energy transition and radical energy policies [4]. Therefore, in today's complex political environment, the requirements of carbon reduction undoubtedly increase the difficulty of energy security. In addition, according to the 2021 Global Wind Farm Report, the annual electricity generation is 1,591.2 TWh, but today the world uses 1.5 trillion KWH of electricity throughout the year, so wind power can only meet a tiny fraction of the electricity needed. According to IEA statistics, renewable energy accounts for only about 20% in the use of power generation, and energy with low carbon emissions accounts for less than 20%, while fossil energy still accounts for more than 60% in the use of power generation [5]. Therefore, people's reliance on fossil fuels cannot be quickly replaced by clean energy, which means that rapid carbon emission reduction requirements will bring energy security problems for the world.

2.2. The difficulty of energy security under the trend of accelerating energy transition

There are several definitions of energy security. One of those definitions is the security of energy supply, that is, the availability of energy, which can be understood as not being energy dependent on the oil of some oil-producing countries or oil-producing areas only, and can also refer to the country or region with sufficient energy reserves and safe production and supply [6]. Second, energy security is closely linked to climate changes and environmental security issues. The dilemma of today's climate change and environmental politics lies in the way energy is produced and consumed. Energy saving and carbon emission reduction, low-carbon economy, and clean energy development have become the main trends of energy technology revolution and global energy structure change[7]. It is important to note that energy security is not limited to oil supply and oil price security.

As the world's energy reserves decline, the availability of fossil fuels is declining, and with it energy security. However, even if the speed of the energy transition is accelerated and the use of fossil fuels is reduced, energy security cannot be improved and will become more difficult to ensure. The first reason

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is that it has become harder to get energy. Under the trend of rapid energy transition, the number of wind turbines is also increasing, so the demand for raw materials for wind turbines is becoming higher as well. Second, a very important element in the wind generator is copper. However, if copper is used in the equivalent speed nowadays, and no more copper is developed, the copper will be depleted in 20 years. This will cause problems for the manufacturing of wind turbines, which will lead to problems in the energy transition. In addition, power generation facilities are also vulnerable to damage, such as the wave power station near the city of Bergen and the Wave power station of the Bell-channel Trap Reservoir, which were damaged during a severe storm in December 1988, and the steel structure was partially thrown into the sea, which was never repaired [8]. Therefore, how to guarantee the energy security of new energy is an urgent problem to be solved.

It is also needed to be known that the energy utilization rate of new energy is too low, and the electricity generated by new energy accounts for only about 15% at present. Therefore, abandoning the use of fossil fuels too quickly will lead to energy shortage. How to balance the speed of the energy transition with the demand for energy supply is what needs attention today.

3. The countermeasures and suggestions

3.1. The acceleration of the construction of a new energy system

It can be seen from this literature that the use of non-fossil energy in China's energy consumption structure gradually increased from 2012 to 2019. According to preliminary calculations, coal consumption accounted for about 58% of total energy consumption in 2019, about 10% lower than in 2012; Clean energy consumption accounted for about 23% of total energy consumption, an increase of about 9% over 2012. Non-fossil fuels accounted for about 15% of total energy consumption, about 6% more than in 2012 [9]. According to IEA statistics, in 2017, the number of pure electric vehicles and plug-in hybrid passenger vehicles in China reached 1,227,800, accounting for 40% of the global electric passenger car population. Among them, the number of pure electric passenger vehicles is 951,200, accounting for 77.47%[10]. The total installed capacity of wind power and solar power will reach more than 1.2 billion kilowatts [11].

It can be seen that China is making efforts to accelerate the construction of a new energy system, and the acceleration of the construction of a new energy system must be carried out under the condition of ensuring energy supply and energy security, so the process will be very difficult.

3.2. The acceleration of energy science and technology innovation

As China needs to achieve carbon neutrality in 2060, an energy transition is very necessary, but due to the low utilization rate of new energy and low power generation efficiency, scientific and technological innovation in related aspects is essential. Innovations in environmentally friendly energy include, but are not limited to, higher solar photovoltaic (PV) module efficiency, more advanced wind turbines, and innovations in ultra-supercritical power generation (USC) technology, integrated coal gasification combined cycle power generation systems (IGCC), combined heat and power generation (CHP), and CCUS [12]. Only through scientific and technological innovation can we promote energy transformation and achieve carbon neutrality.

China's investment in solar photovoltaic panel manufacturing in recent years also proves that China has paid increasing attention to new energy development and innovation in recent years, and has made continuous efforts to achieve carbon neutrality by 2060. According to the IEA's Total investment in solar PV manufacturing capacity by country and region, China's investment in the sector is increasing. It is forecast to reach $90 billion in 2022-2027 [13].

4. Conclusion

In the case of the energy transition, it is difficult to ensure energy security. Although the use of new energy is increasing year by year, people still cannot leave their dependence on fossil energy. However, the need for carbon emissions caused by fossil energy and the reduction of fossil energy make people

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have to carry out an energy transition, so it is inevitable to encounter insufficient supply and difficulty in ensuring energy security.

In order to solve these problems, China needs to quickly and reasonably build a new energy system and try to use new energy instead of fossil fuels while ensuring energy supply guarantees and energy security. Of course, investing in research and development is another very important approach. When it comes to scientific and technological innovation, China must focus on how to improve energy efficiency, minimize carbon emissions in the manufacturing process, ensure that the finished product can have higher power generation capacity, replace more fossil fuels, carry out environmentally friendly development, and reach carbon neutrality by 2060. Of course, this research also has some shortcomings. This research does not include the content of low-carbon economy, does not mention the manufacturing process of new energy, and some parts are directly rough. In the subsequent research, should be placed on how to rapidly develop new energy and build a new energy system under the low-carbon economy.

References

[1] Qian Xiaoyan. 2022-05-13, India's Heat Wave Coupled with Electricity Shortages "Rush for Coal" Around the World. https://kns.cnki.net/kcms2/article/abstract?v=3uoqIhG8C45iO2vZ0jWu7b6KLB8DnSLplp8mG7lp0l4QgjWd01dUlcwIRn0Y2Rq3BhKYzOfmKDFRZSdyydLhw28RE8v4Srxvl9BkKM4e3xA%3d&uniplatform=NZKPT

[2] Liu Lingling. 2021-11-02, Coal shortage leads to severe power crisis in India. https://kns.cnki.net/kcms2/article/abstract?v=3uoqIhG8C45iO2vZ0jWu7b6KLB8DnSLp_d5sIu2ONyRGO5X-zva9ICe2nb6n6POB5ui1zlKLGPpMDX6lC8XbvsRk54PWyW8Kb-PgRL6k07Y%3d&uniplatform=NZKPT

[3] Li Jin. (2021). Mexican president calls on people to conserve energy amid energy shortages. Petroleum and Petrochemical Energy Conservation (05),3.

[4] Shan, Baoguo, Ji, Xingpei, Xu, Chuanlong & Liu, Zhilin. 2011 A new species of the genus Pseudopelagicus (Hymenoptera, Braconidae, Pelaginae) from China. (2022). Analysis of the recent global energy supply and demand situation and China's energy and power supply strategy. China Power (10), 1-13.

[5] IEA, Shares of global electricity generation by source in the Net Zero Scenario, 2000-2030, IEA, Paris

[6] YANG Yu, YU Hongyuan, LU Gang, WANG Limao, ZHAO Yuan, HAO Lisa... & Cai, G. T.. (2020). A century of change in world energy and national energy security. Journal of Natural Resources (11), 2803-2820.

[7] Baidu, 2023, Energy Security https://baike.baidu.com/item/%E8%83%BD%E6%BA%90%E5%AE%89%E5%85%A8/53418?fr=ge_ala

[8] Yu, C.. (1996). Research on wave energy in Norway. Ocean Engineering (04).

[9] Information Office of the State Council of the People's Republic of China. 2022. China's Energy Development in the New Era. https://kns.cnki.net/kcms2/article/abstract?v=3uoqIhG8C45iO2vZ0jWu7b6KLB8DnSLpvEMyZWnWRX709lG6r56CZJ_MPbTT92CNyDBDqsqU_7X_NEN4mskQn44Yv8Wipl3ngFX9gYx2aW0%3d&uniplatform=NZKPT

[10] IEA. Global EV outlook 2018[R/OL]. (2018-05). www.iea.org /gevo2018/.

[11] Xi Jinping. (2020). Following the past, starting a new journey of global response to climate change - Speech at the Climate Ambition Summit. China Environmental Monitor (12), 9.

[12] Zhang, Shoshu & Ma, Bo Yong. (2019). World Energy Development Trends and Future Direction of China's Energy. China Land Resources Economics (10), 20-27+33.

[13] IEA, Total investment in solar PV manufacturing capacity by country and region, 2016-2027, IEA, Paris