



The Energy Development Problem Facing China

Qiu Li

University of Nottingham, Nottingham NG7 2RD, U.K.

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Abstract: China is plagued by a large number of energy supply problems because it relies for most of its power on coal and hydrocarbons with the main medium- to long-term threat coming from resource scarcities and environmental disruption. This paper argues that broad-based actions across policies, markets, and technologies are needed to ensure energy security and sustainability. Over the next 30 years, China will take diversified energy supply as a means and transforming the energy structure as its focus in response to challenges such as threats of three linkages for national energy security while ensuring sustainable development. At the same time, we must strengthen our cooperation with relevant international institutions or enterprises around the world and promote more technological innovation. China is a signatory of the Paris Agreement and has pledged to peak carbon emissions before 2030 and achieve a carbon-neutral economy by 2060. Physical deployment of energy efficient and the development of renewable technologies is also required closely followed by enforcing stringent carbon emission policies with an increase in use of low-carbon energy. It is the kind of international cooperation and simultaneously developing technology that will be required under the framework established by the Paris Agreement if we're to meet those ambitious targets.

Keywords: energy consumption, environment, sustainable

1. Introduction

As the world's largest developing country, China faces unprecedented challenges in both energy supply and demand (IEA, 2023)[1]. As China's economy continues to grow rapidly, energy demand is also increasing at an unprecedented rate (National Bureau of Statistics of China, 2023)[2]. Accelerated industrialisation and urbanisation have driven the rapid growth of energy consumption, and the demand for energy for all types of industrial production and residential life has been increasing (Zhang and Chen, 2022)[3]. At the same time, the rapid growth of energy demand also brings many challenges and problems. Firstly, China's energy structure is still dominated by coal, which is not only an important cause of pollution and frequent haze, but also worsens greenhouse gas emissions and has a huge impact on climate change (Wang et al.)[4]. Secondly, with the increase in domestic energy demand, China's dependence on imported energy has been increasing, and imports of oil and natural gas have made the international situation of China's energy security more complex, and the risk of market fluctuations has increase. At the same time, the pressure on environmental protection and sustainable development is increasing. The Chinese government is committed to economic development on the one hand, but on the other hand, it has to face the environmental problems brought about by massive energy consumption. How to achieve energy supply and pollution reduction in green development is an important and self-evident issue for China.

2. Threats to energy supply in the near to medium term (5 years)

2.1 Coal dependence

As a large energy-consuming country, China's energy structure is dominated by coal, which accounts for 60 per cent of total energy consumption. This high dependence on coal has far-reaching implications for the environment and the social life of the population. First, coal combustion is one of the main causes of greenhouse gas emissions and urban haze. The haze produced by coal not only affects the environment but also has an impact on the health of the population, increasing their chances of falling ill, while greenhouse gases contribute to global warming. Moreover, the transport and mining of coal is costly, requires a lot of labor and resources, and causes damage to the ecological environment of the mining area.

To address the above challenges, the Chinese government is also actively promoting the adjustment and optimization of its energy structure and is vigorously developing and promoting clean and renewable energy.

2.2 Oil and gas import dependence.

Although China consumes large quantities of oil and natural gas, more than 70 per cent of its oil consumption comes from imports, and natural gas consumption is around 30 per cent; China's oil self-sufficiency rate is extremely low (IEA,

2023)[5]. This high level of dependence creates many difficulties for China's energy security. Firstly, the fluctuation of international oil prices directly affects the stability of China's economy (Chen, 2022)[6]. High international oil prices and rising import prices have led to higher domestic energy prices and increased costs for industrial production and people's livelihood. At the same time, large fluctuations in international oil prices have increased uncertainty in the energy market, and enterprises face greater risks when deciding on production and investment. Geopolitical tensions, especially the volatile situation in the Middle East, threaten China's energy security. The Middle East is one of the world's key oil and gas producing and supplying regions. Any conflict or political change in the region could lead to disruptions or reductions in energy supplies. Such a situation would not only affect China's energy imports but would also cause a chain reaction in the international energy market, exacerbating the uncertainty of energy supply.

2.3 Bottlenecks in renewable energy development

Although China has been developing sustainable energy and focusing on the development of green energy, the relatively short period of development still has many development bottlenecks that limit the application of renewable energy, especially wind and solar energy, which still suffer from low efficiency and high costs, especially in remote areas of China such as Tibet and Xinjiang.

Secondly, inadequate energy storage facilities are another major bottleneck constraining the development of renewable energy. As wind and solar power generation is intermittent and unstable, how to effectively store and dispatch these energy sources has become a key issue. At present, battery energy storage technology has not yet reached the level of large-scale commercial application, and the problems of high cost, low efficiency and short service life of energy storage still exist. This leads to difficulties in ensuring the reliability of power supply in the absence of wind and light.

3. Threats to energy supply in the long term (30 years)

3.1 Depletion of fossil fuels

Over time, China's fossil fuel resources, such as coal, oil and natural gas, have been dwindling, a trend that poses a significant threat to the country's long-term energy supply. First, as easily extractable resources become increasingly depleted, the remaining resources will become significantly more difficult and costly to extract. Extraction of resources deep underground and in the oceans will require not only more advanced technology, but also higher capital investment, which will undoubtedly push up the cost of energy production and place a burden on the economy.

3.2 Environment and climate change

The extensive use of fossil fuels has led to serious environmental pollution and climate change issues. Extreme weather events caused by climate change, such as droughts and floods, will have a devastating impact on energy infrastructure and supply chains. It will also have a detrimental impact on the health of the population and disrupt the natural ecology.

3.3 Technological and infrastructural backwardness

Although China has made some progress in new energy technologies, overall there are still many shortcomings in the level of technology and infrastructure development. The development of advanced energy technologies such as smart grids, advanced nuclear energy technologies and hydrogen energy is still insufficient to cope with future demand. For example, the development of smart grid technologies is lagging, limiting the effective integration and utilization of renewable energy sources, while the commercial application of hydrogen energy technologies faces many challenges. In addition, the ageing energy infrastructure needs to be urgently upgraded and retrofitted to accommodate future energy demand and supply patterns.

4. Status quo regulation of energy supply and demand

4.1 Policy framework

In response to the energy crisis, the Chinese Government has formulated and introduced a series of policies, including the 13th Five-Year Plan for Energy Development and the Renewable Energy Law, which are of great significance in transforming the energy structure, improving energy utilization efficiency, and accelerating the development of renewable energy (NDRC, 2023)[6]. Firstly, to reduce the dependence of energy on coal, and secondly, to accelerate the development of renewable energy sources, such as wind, solar and hydropower (Li & Wang, 2021)[7]; to promote the use of energy-saving technologies, equipment and applications, and to improve the energy utilization efficiency; research and development of energy technologies and support for the development of energy storage technologies; and construction of safe and stable power

grid systems, oil and gas pipeline systems and energy storage systems. The types of investment in renewable energy projects have been further increased through financial subsidies, tax incentives and market-based reforms. The above policies have facilitated the adjustment of China's energy structure, made China the world's largest producer and consumer of renewable energy, and laid the foundation for a secure, economic, and sustainable energy supply.

4.2 Market regulation

The Chinese Government is gradually promoting energy market reform and establishing a market trading mechanism for electricity, natural gas and other power energy sources. At the same time, it is encouraging enterprises and individuals to save energy and reduce emissions and is endeavoring to trade in carbon emission rights through subsidies and tax incentives.

4.3 Technology Innovation

China has invested so heavily in researching the new technologies regarding energy, mainly in the solar, wind, and nuclear energies. It is also speeding up the advancement of the technology related to storing energy and smart grids to counter uncertainty and volatility in future energy demand.

5. Key Steps to Enhance Energy Security

5.1 Diversify Energy Supply

China will have to diversify sources of energy supply further, including the development of renewable, nuclear, and clean coal technologies. Simultaneously, China should step up domestic oil and gas exploration together with the view of unconventional oil and gas resources to reduce import dependence.

5.2 Promoting the transformation of the energy mix

China is actively promoting a shift in its energy structure from fossil energy to renewable energy to save energy and reduce energy demand. Vigorous efforts are being made to develop renewable energy sources such as wind, solar and hydro-electric power, and to increase their share in energy consumption. At the same time in vigorously promoting the development of green buildings, energy saving and emission reduction to promote the application of new energy.

5.3 Enhance international co-operation

China should continue to strengthen its cooperation with energy-exporting countries and establish stable channels for energy imports, while actively participating in global energy governance. China must endeavor to achieve stability and transparency in the international energy market and actively promote the use of new energy sources.

5.4 Technology Innovation and Application

Increase investments in R&D on energy technologies, particularly regarding energy storage, smart grid, and clean energy technologies. Improve energy supply stability and energy use efficiency through technological innovation.

6. Conclusion

In the long-term, China faces serious energy supply issues, covering coal and hydrocarbon dependence in the near and mid-term while dealing with resource depletion and environmental changes in the future (Xu & Li, 2023)[9]. To address this, China must adopt comprehensive measures in policy, market, and technology. According to experts, China will adequately deal with threats to energy supply security and achieve sustainable energy development in the next 30 years by diversifying its energy supply structure, promoting energy structural transformation, strengthening international cooperation, and accelerating technological innovation (Wang & Zhang, 2022)[10]. Thus, China needs to invest heavily in renewable energy and sustainable technologies to attain carbon neutrality targets and peak carbon emissions as soon as possible.

As a signatory to the Paris Agreement, China aims to achieve global peak carbon emissions before 2030 and attain carbon neutrality by no later than 2060. This will place greater demands and constraints on energy supply, requiring China to achieve its carbon budget by developing more clean energies and reducing fossil fuel use. Under carbon budget constraints, China must balance economic development and carbon emissions, enforce strict carbon emission control policies, and develop green, low-carbon energy sources. Additionally, countries need to strengthen cooperation and share technology under the international framework of the Paris Agreement. For China, implementing energy policy on a global scale is a more challenging task than it was before China entered the international arena (ScienceDirect, 2023)[11].

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