

Problems and prospects of rural energy transformation in China

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Abstract. In recent years, China's rural energy supply security capacity has been enhanced, and the adjustment of energy structure has achieved remarkable results, but there are still some problems: The low utilization rate of waste energy in rural areas restricts the comprehensive utilization of resources and environmental protection, the level of rural energy consumption is always in the stage of development, and the lagging construction of rural energy socialized service system restricts the development of rural energy. In view of the problems and challenges faced by China's rural energy development, focus on rural energy consumption. This paper analyzes the basic situation of energy development in China's rural areas (taking Lantian County of Shaanxi Province as an example). Under the special premise of China's national conditions, the specific characteristics of different development in different regions are integrated, and the traditional fossil energy is gradually replaced by the storage and utilization of rural waste and new energy. The key issues such as the construction of rural energy service system and policy guidance are studied, and the measures and suggestions for promoting the scientific development of rural energy in China are put forward.

Keywords: rural energy, sustainable development, rural revitalization, green energy, environment

1. Introduction

China is the largest developing country in the world, with nearly half of the population living in rural areas [1]. Energy plays an important role in human society and economic development [2]. Unreasonable use of energy leads to environmental pollution and unsustainable development [3]. In China, with the rapid development of the economy and the improvement of living standards, the proportion of household energy consumption and total household energy consumption has been increasing rapidly [4]. How to improve the energy efficiency and reduce energy consumption of rural households is an important policy issue in China. Existing studies have found that the current energy problems in rural areas are mainly characterized by the traditional energy problems in townships and the energy transition in townships. However, rural areas are still in the stage of energy transition, and there is a big gap between them and urban development. Natural gas has become an important transitional energy, and fossil energy and new energy will be used in township areas [5]. Western countries entered the post-industrial era, the development of rural revitalization. After the development of characteristic rural industries, the formation of a huge scale and the promotion of special production methods, while improving their own

market competitiveness, but this agricultural model can only be used for reference for such small countries and countries with special geographical locations. Therefore, this paper aims to discuss the best solutions and subsequent development in the context of carbon neutrality in China, to help improve the supply capacity of clean energy in rural areas, optimize and adjust the consumption structure, improve the energy utilization efficiency and adjust the energy utilization structure. In addition, it can reduce environmental pollution, ensure the safety and health of residents in their work and life, build beautiful rural areas and achieve rural revitalization.

2. The Necessity of Energy Transformation

In 2018, China's rural energy consumption was about 562 million tons of standard coal, of which production energy and domestic energy accounted for 44% and 56%, respectively. In rural production energy, commodity energy accounted for 98%, of which coal, refined oil and electricity accounted for 42.8%, 24.5% and 19.3%, respectively. Non-commodity energy accounts for 35.1% of rural domestic energy consumption [6].

On the whole, there is not much difference in rural energy consumption of China's domestic energy production energy, both of which are dominated by commodity energy, but the proportion of non-commodity energy consumption in domestic energy consumption is still large. The proportion of non-commercial energy in rural domestic energy is the highest in fuelwood, followed by straw, solar energy and biogas.

3. The Problems Faced by Energy Transformation

During the period of reform and opening up from 1949 to the early days of the founding of New China, the economy gradually developed, the energy infrastructure was weak, and the efficiency of stoves was relatively low, mainly in fuelwood and straw, while the problem of fuel shortage gradually emerged, and commodity energy accounted for a relatively large proportion of the living energy of rural residents. From 1980 to the beginning of the 21st century, China continued to improve the rural energy supply problem, aiming to solve the energy shortage, but the biggest difficulty is still that the demand is far greater than the supply. In 1998, the State Council made a major decision to keep the power grid price in urban and rural areas at the same level, so that rural residents have greatly increased the opportunity to use coal and electricity. Has been greatly improved. In the early 21st century, China's rural coal consumption showed a trend of first rising and then decreasing, which was closely related to the expenditure budget and the habit preference of rural residents in their energy choices. For example, many rural residents at the time chose to use free biomass energy rather than coal, or the tradeoff between advanced renewable energy and backward solid fuels. This shows the limitations of the time, as well as the backward development of the countryside, and the infrastructure construction is very inadequate. From 2000 to 2015, China vigorously carried out a sustainable development strategy, the guardian of the only earth, to retain resources from being overexploited, and the use of coal was greatly reduced. However, coal still dominates rural energy consumption, which is related to the form of urban and rural housing and the efficiency of rural residents' stoves. In 2015, rural residents gradually began to use renewable solar power generation and solar stoves, which shows that rural residents are gradually moving towards electrification and modernization. Reflecting the improvement of the housing and health conditions of rural residents, China still needs to make efforts in the complete transformation of rural energy, and policies still need to provide guidance so that the market can further provide technical supply and market supply.

Nowadays, the "rural energy revolution" is an integral part of the overall layout of China's energy revolution. Accelerating the use of clean energy, replacing biomass energy from aquaculture waste, and making better use of resources is related to the daily life of more than 600 million rural residents in China, neither blindly replacing traditional fossil energy with new energy, nor unlimited use of fossil energy and burning straw and firewood.

From the "Northern Winter Clean Heating Plan" in 2017 to the "Rural Construction Action Implementation Plan" in 2022, it can be seen that under the call of "strengthening the clean use of coal

and gradually using clean energy to replace coal in rural areas”, the role and utilization of coal in China’s energy utilization need us to re-examine. At the same time, it is also necessary to weigh the residents’ own choices and personal habits. China has a vast territory and abundant resources, and it is also necessary to judge the types and ways of energy use in different geographical environments.

Additionally, coal burning brings a series of problems, such as serious environmental pollution, does not meet the requirements of rural green development. In 2018, nearly 180 million tons of straw and firewood were used in direct combustion in many areas, resulting in serious environmental pollution and low energy utilization efficiency, resulting in dirty and poor living environment. The total utilization of inferior loose coal is large [7]. In 2018, the consumption of loose coal for heating in winter was nearly 150 million tons. Yin et al. estimated that in 2017, 271,100 people (on average) died from indoor air pollution caused by solid combustion in China, mainly in rural areas, especially in rural areas with poor infrastructure such as Yunnan, Gansu, Guizhou and Qinghai [8]. In Lantian County, Shaanxi Province, households heating with traditional stoves (no exhaust system) had 2.6 times of PM_{2.5} than households heating with new stoves (with a secondary air distribution system). Among rural residents in China, the elderly have a relatively low level of education, less disposable income, and are more dependent on traditional fossil fuels or biomass energy [9]. However, this data cannot be used as direct data. There are various causes of diseases, including uncontrollable factors such as living habits, which are also closely related to the physical conditions of rural residents. For example, suffering from chronic diseases or cardiovascular and cerebrovascular diseases, etc., may induce death.

4. The Measures and Proposals for Future Development

In view of the problem of energy utilization of rural waste, it is necessary to improve the secondary utilization of straw, livestock and poultry manure and related systems of collection, storage and treatment, and strengthen the application of emerging technologies such as biological natural gas. In view of the application of rural energy electrification, it is necessary to make full use of the abundant natural resources such as wind energy, solar energy and water energy in rural areas, and accelerate the construction of a power-centered, efficient and environmentally friendly rural clean energy supply system. On the supply side, relevant departments should strengthen research on clean energy such as electricity, implement comprehensive electrification projects in rural areas, promote residents to take green and low-carbon transportation, and use clean energy for heating. For the construction of rural energy service system, the responsibilities of rural governments and local enterprises should be considered, and a number of comprehensive and supporting rural energy service systems with wide coverage should be cultivated. In addition, to promote the healthy, green, scientific and sustainable development of clean energy in rural China.

The following suggestions are put forward in terms of policy management and institutional mechanisms:

The organization and management of rural energy work should be strengthened. The construction of new rural energy sources and the development of rural energy should be integrated into the overall layout plan, taking into account the socio-economic development.

A clean energy development path suitable for rural China should be opened up, drawing on the advanced technologies and successful experiences of other countries, and based on agricultural food production and biomass waste treatment. Taking high efficiency and cleanliness as the starting point, aiming at clean energy and solar photovoltaic and wind power generation, integrating agricultural cultivation, ecological environmental management and green energy, rural industrial parks should be developed to realize the common prosperity of China’s urban and rural areas.

Rural areas should be rationally planned, the most appropriate energy development model should be selected, and the construction of rural energy infrastructure should also be considered in the construction process, so that clean energy is not blindly applied without considering its own characteristics and whether it is applicable in the region. At the same time, rural energy development must be compatible with the economic and social needs of energy development.

The capacity for independent development of rural energy should be improved. Rural counterpart

energy operations and services should be promoted and developed, and rural residents should be strongly encouraged to invest and participate in the construction of new rural energy projects. At the same time, it is also necessary to improve rural energy management and strengthen human capacity building. For example, energy technology training and related knowledge lectures should be held in rural schools and enterprises to speed up the cultivation of high-quality, highly skilled rural energy professionals of a composite type, and to make rural energy construction a part of the national talent training program.

Rural demonstration sites should be developed to promote a comprehensive rural energy revolution. Priority should be given to provinces in urgent need of energy renovation and large-scale agriculture. Carry out pilot demonstration work on rural energy development. Make full use of rural energy resources, carry out relevant work and apply relevant technologies in accordance with local conditions.

5. Conclusion

While working towards poverty eradication and building a moderately prosperous society, China is also prioritizing the energy revolution. Combining some successful experiences at home and abroad, China has conducted experiments in the region and promoted the whole country to achieve energy conservation and environmental protection in the true sense and improve the living environment of residents. However, there are still some shortcomings in development, such as the government's insufficient planning and the shortage of corresponding talents. China is a traditional agricultural country, and the ideas of many farmers have not been completely changed, so the implementation and development of policies are quite difficult and slow. At the same time, the living conditions in remote areas are poor and the infrastructure is not perfect, and this paper mainly focuses on Lantian County in Shaanxi Province, which has certain limitations and cannot be extended to rural areas in the whole country. In the future research, more comprehensive research and the most appropriate technology can be carried out for rural areas with different terrain to adapt to the various living habits of people in different areas.

References

- [1] Liu W, Spaargaren G, Heerink N (2013) Energy consumption practices of rural households in north China: basic characteristics and potential for low carbon development. *Energy Policy* 55:128–138
- [2] San V, Sriv T, Spoann V, Var S, Seak S (2012) Economic and environmental costs of rural household energy consumption structures in sameakki meanchey district, Kampong Chhnang province, Cambodia. *Energy* 48(1):484–491
- [3] Guo Z, Zhou K, Zhang C, Lu X, Chen W, Yang S (2018) Residential electricity consumption behavior: influencing factors, related theories and intervention strategies. *Renew Sust Energ Rev* 81:399–412
- [4] Ding Z, Wang G, Liu Z (2017) Research on differences in the factors influencing the energy-saving behavior of urban and rural residents in China—a case study of Jiangsu Province. *Energy Policy* 100:252–259
- [5] SUN Ruonan, YANG Man, SU Juan, et al. Current situation of rural energy development and its development and utilization modes in China[J]. *Journal of China Agricultural University*, 2020, 25(8):163–173
- [6] Lin, B. (2019) *China energy Outlook 2018*. Peking University Press, Beijing.
- [7] HONG Bowen, FENG Kaihui, MU Yunfei, et al. Discussion of distributed energy resources utility mode and its application in rural areas of China[J]. *Electric Power*, 2020, 53(2): 99–104.
- [8] YIN P, BKAUER M, COHEN A J, et al. The effect of air pollution on deaths, disease burden, and life expectancy across China and its provinces. 1990—2017: An analysis for the global burden of disease study 2017m. *Lancet Planet Health*, 2020, 4(9): e386—e398
- [9] HE Kailai, LI Yaqi, XU Hongmei, et al. Characteristics of PM_{2.5} emission from domestic fuel combustion and its effect on lung function: a case study of Lantian County, Shaanxi Province[J]. *Chinese Journal of Environmental Chemistry*, 2020, 39(2): 552—565