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Using System Dynamics to Inform Integrated Decision-Making for China's Fight against Energy Poverty

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Abstract

To make informed decisions and maximise China's efforts to reduce energy poverty, a simulation model for energy poverty policy is created. The model investigates the time-varying behaviour of the energy poverty system across time using system dynamic modelling, and scenario analysis is performed to evaluate and identify the most effective scenario. The findings indicate that from 2021 to 2030, there will be a gradual improvement of energy poverty. In 2030, the energy poverty index in scenarios I through VI will drop by 47.98%, 62.08%, 43.19%, 53.31%, 62.22%, and 88.42%, respectively, compared to 2011. While energy structure adjustment has a dual role in reducing energy poverty, it also has a considerable positive impact on employment and financial spending. China could attain its goals most effectively through a combination strategy.

Keywords: Energy poverty • Alleviation • Renewable energy

Introduction

Energy neediness has been difficult for the entire world. Because energy poverty and the issues that go along with it, like diseases, heating, and climate change, make it hard for people to live better lives, reducing energy poverty has always been a goal. In 2021, China won the war on poverty on a global scale and eradicated extreme poverty. Nevertheless, China, the largest developing nation, continues to face severe energy poverty. In 2014, the Chinese Family Tracking Survey (CFPS) reveals that traditional biomass energy is still used by 41% of rural Chinese families for cooking, heating, and lighting. At the moment, the coronavirus pandemic and the conflict between Russia and Ukraine have a significant negative impact on energy supplies and prices, which has made energy poverty worse. The Communist Party of China's 20th National Congress emphasized expanding progress toward universal prosperity. Governments place a high priority on reducing energy poverty and ensuring that the residential sector has access to affordable energy [1,2].

Description

Energy poverty alleviation has gained prominence in academic debates and attracted a growing amount of attention. A number of studies are mostly conducted from four points of view. First, a lot of academics agree that expanding access to renewable energy sources is essential. Yadav and co. recommended establishing enabling policy frameworks and establishing a collaborative ecosystem to facilitate the successful transition of rural and remote communities to off-grid solar-based regimes. Ground source heating on brownfield land could be used to combat heat poverty in social housing. Gilbert and Bazilian demonstrated that the ongoing distributed energy revolution could be complemented and accelerated by distributed nuclear power. Second, some academics advocate developing new technologies for increasing energy efficiency. Bienvenue-Huertas and others simulated a common type of social housing in ten Spanish cities that represent the various climates, and discovered that the mixed-mode is effective in reducing energy poverty. Micro-grides were an appealing alternative for rural communities to access clean energy, and they examined the sustainability of micro-grides by analyzing their resilience. Thirdly, some academics suggest that households with limited access to modern energy should consider investing their money. A stronger emphasis on home insulation and other significant investments might be a better and more transformative policy option for addressing fuel poverty in the United States. Goldthau came to the conclusion that the governance of the energy infrastructure was crucial to the fight against energy poverty. According to Koomson and Danquah the greatest reduction in energy poverty will likely be seen among employees if financial inclusion is improved. Fourthly, according to other researchers, households' financial burden is reduced and energy costs are made more affordable as a result of social assistance. Barrella and co evaluated the impact of heating allowances on the reduction of energy poverty during the winter in Spain. Karásek and Pojar analyzed arrangement of help for energy unfortunate families in the Czech Republic and in the Unified Kingdome and drafted potential measures to limit the effect of energy neediness. Bukari and co. suggested that remittances and health insurance were the most important means of reducing the negative impact that energy poverty has on household health care costs [3,4].

Renewable energy development, technological innovation, financial investment, and social assistance are the focus of the existing literature on energy poverty alleviation. Systemic research on employment and financial assistance, which also play a significant role in reducing energy poverty, is lacking. Additionally, China must address energy poverty, which is a significant component of relative poverty, after overcoming extreme poverty. Therefore, this study looks at how employment and government spending affect energy poverty in light of this context [5].

Energy poverty alleviation is a dynamically complex system due to the influence of a variety of components and their interactions. These interactions are connected to the system's feedback loops by system dynamics theories. The effects of these interactions and feedback loops on energy poverty over time could be studied using system dynamic modeling. In a complex environment, this aids in the development of energy poverty alleviation policies. However, little research has been done using system dynamic modeling to alleviate energy poverty. This study uses the case of China's energy poverty alleviation to propose a system dynamics-based energy poverty policy simulation model to fill this void. The collaborations and criticism circles among work, monetary help and energy neediness are examined exhaustively; The research that has been done on this subject is looked at and shown to people who have to make decisions about energy poverty policy design. Additionally,

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this research demonstrates that China has the potential to achieve the United Nations Sustainable Development Goal (SDG) 7 and eradicate energy poverty by 2031. Energy poverty has long been a global problem. Because energy poverty and the issues that go along with it, like diseases, heating, and climate change, make it hard for people to live better lives, reducing energy poverty has always been a goal. In 2021, China won the war on poverty on a global scale and eradicated extreme poverty. Nevertheless, China, the largest developing nation, continues to face severe energy poverty. In 2014, the Chinese Family Tracking Survey (CFPS) reveals that traditional biomass energy is still used by 41% of rural Chinese families for cooking, heating, and lighting. At present, Covid pandemic and Russian-Ukrainian clash adversely affect energy supplies and energy cost, which has prompted an expansion in energy destitution. The Communist Party of China's 20th National Congress emphasized expanding progress toward universal prosperity. Governments place a high priority on reducing energy poverty and ensuring that the residential sector has access to affordable energy [6,7].

Energy poverty alleviation has gained prominence in academic debates and attracted a growing amount of attention. A number of studies are mostly conducted from four points of view. First, a lot of academics agree that expanding access to renewable energy sources is essential. Yadav and co. recommended establishing enabling policy frameworks and establishing a collaborative ecosystem to facilitate the successful transition of rural and remote communities to off-grid solar-based regimes. Ground source heating on brownfield land could be used to combat heat poverty in social housing, according to Donaldson and Lord. Gilbert and Bazilian demonstrated that the ongoing distributed energy revolution could be complemented and accelerated by distributed nuclear power. Second, some academics advocate developing new technologies for increasing energy efficiency. Bienvenue-Huertas and others mimicked a typical typology of social dwelling in 10 urban communities illustrative of the different environments of Spain and observed that the blended mode is powerful in energy destitution mitigation. According to Valencia & Billi, micro-grides were an appealing alternative for rural communities to access clean energy, and they examined the sustainability of micro-grides by analyzing their resilience. Thirdly, some academics suggest that households with limited access to modern energy should consider investing their money. A stronger emphasis on home insulation and other significant investments might be a better and more transformative policy option for addressing fuel poverty in the United States. Goldthau came to the conclusion that the governance of the energy infrastructure was crucial to the fight against energy poverty. The greatest reduction in energy poverty will likely be seen among employees if financial inclusion is improved [8-10].

Conclusion

According to other researchers, households' financial burden is reduced and energy costs are made more affordable as a result of social assistance. Barrella and co evaluated the impact of heating allowances on the reduction of energy poverty during the winter in Spain. Compared the support systems for energy-poor households in the Czech Republic and the United Kingdom and drafted potential measures to lessen energy poverty's impact. Existing literary works on energy neediness mitigation are dedicated to sustainable power advancement, mechanical development, monetary venture and social help. Systemic research on employment and financial assistance, which also play a significant role in reducing energy poverty, is lacking. Additionally, China must address energy poverty, which is a significant component of relative poverty, after overcoming extreme poverty. Therefore, this study looks at how employment and government spending affect energy poverty in light of this context.

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