

ENERGY ECONOMICS

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Understanding and Interpreting Energy Poverty in China

BY

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Abbreviations

AGECC	UN Secretary General's Advisory Group on Energy and Climate Change
ARPH	Annual Review of Public Health
BERR	UK Department for Business, Enterprise and Regulatory Reform
BMJ	British Medical Journal
CDM	Clean development mechanism
CO ₂	Carbon dioxide
DECC	The Department of Energy and Climate Change, UK
DEFRA	UK Department of Environment, Food, and Rural Affairs
EEA	European Environment Agency
EHP	Environmental health perspectives
EHS	English Housing Survey
GBD	The Global Burden of Disease
IEA	International Energy Agency
JAMA	Journal of the American Medical Association
LWS	Living in Wales Survey
MME	Ministry of Mines and Energy of Brazil
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NEJM	New England Journal of Medicine
NGO	Non-governmental organization
NIHCS	Northern Ireland House Condition Survey
NO _x	Nitrogen oxides
OECD	Organization for Economic Co-operation and Development
PNAS	Proceedings of the National Academy of Sciences
PPP	Purchase power parity
REN21	Renewable Energy Policy Network for the Twenty-first Century
SHCS	Scottish House Condition Survey
SO ₂	Sulfur dioxide
UN	United Nations
WHO	World Health Organization

Preface

In response to the challenges that were posed by energy poverty, a myriad of international organizations, such as the United Nations, the World Bank, and the World Health Organization, are in the process of legislating policies and plans. China, as the largest developing country, is being challenged with more complicated and severer energy poverty problems.

Energy consumption, energy structure, and energy capacity are the three key indicators of energy poverty measurements, which reflect economic development, resident health, and social equity of a specific country or region. There has been a discernible difference among various countries and regions. Most developing countries have a serious problem that their energy consumption per capita is far below the level in developed countries, yet it does not mean that energy poverty has been eliminated in rich areas. Overall, the essential characteristics of energy poverty in those countries are embodied in the following three aspects: (1) lower energy consumption; (2) inferior energy structure; (3) weaker energy capacity.

Energy poverty has considerable, even irreversible consequences for resident health. Over one-third of the global population mainly relies on solid fuels, such as coal and firewood, and one-fifth has no access to electrical services. Besides, inefficient use of traditional biomass results in serious waste of resources. In 2010, more than one million people died of indoor air pollution caused by combustion of solid fuels; this accounts for 12.5% of the total premature deaths.

Human society could hardly proceed without energy. However, a series of problems caused by energy poverty constrain development, affect the social equity, and aggravate the environmental pressure. China has presented itself by structural and regional differences in energy production and consumption. It is of great significance to alleviate, even eradicate, energy poverty for a sustainable development in the long run.

“Energy Economics: China’s Energy Poverty Research,” is a new achievement of CEEP-BIT on the basis of our efforts that have been long devoted to the poverty-related research. We hope that this book serves to call academy and authorities’ attention to energy poverty, and it could provide policy support and decision basis for the government to ultimately eliminate energy poverty. Based on the analytical framework of energy economics, this book discusses crucial perspectives of energy poverty around the following issues:

- (1) The latest progress in energy development in the world and in China has been comprehensively summarized and sorted out.

Analysis of the research shows that: (1) the global economy is heading upwards and the uncertainties in international energy market are decreasing; (2) the global energy pattern is changing profoundly, and the US has taken

substantial steps in seeking energy independence; (3) China is challenged with energy saving and carbon reduction by both total amount control and intensity control; and (4) China is taking great efforts in tackling the increasingly worse air pollution. Furthermore, the world's energy poverty is mainly with the following characteristics: (1) developing countries have a low level of electricity service, which adds more difficulties to addressing global poverty; (2) household energy in developing countries relies on traditional biomass, which causes prominent environment and health problems; and (3) energy poverty population living in developed countries is with a high proportion of energy expenditure, which affects the overall social equity.

- (2) Proper measurement and assessment methods for China have been proposed.

According to the status quo of China's economic and social development as well as the energy supply–demand relationship, along with the international understanding of energy poverty, “energy poverty” in this book is defined as the inaccessibility to modern energy services, especially to those abundant, affordable, high-quality, environmentally friendly energy services. Our research results show that: (1) differences of household energy use in urban and rural areas are notable and the energy poverty in rural area is prominent; (2) geographical differences in rural household energy use are obvious and the energy consumption is dominated by solid fuel; (3) rural energy facilities are inefficiently used, while clean cooking utensils are of low prevalence; and (4) household energy prices are increasing and there are disparities in the proportions of household energy expenditure between urban and rural.

- (3) Energy poverty in different regions of China has been assessed.

Comprehensive regional assessment framework of energy poverty in China is constituted of 11 secondary indicators and 26 tertiary indicators by 4 categories. The assessment results indicate that: (1) overall energy poverty presents itself in a downward trend; (2) energy service availability has been improved; (3) there is no strong tendency toward a cleaner energy consumption structure; (4) Energy management system is not complete; and (5) affordability and high-efficiency in household energy use have been improved. Meanwhile, China's regional energy poverty is characterized by the following features: (1) comprehensive energy poverty situation in middle reaches of Yellow River and Yangtze River is relatively significant; (2) energy service availability of the middle reaches of Yangtze River is weak; (3) middle reaches of Yellow River have not performed well in using clean energy; (4) energy management systems of the eastern coastal and northwestern regions are not complete; and (5) the northeastern and southwestern regions have not performed well in achieving affordability and high efficiency of energy use.

- (4) Impacts of energy poverty on residents' health have been estimated.

Similar to economic poverty, energy poverty has certain influences on residents' health. This book discusses the impacts of energy poverty on urban residents' health and finds that: (1) energy poverty still exists in China's urban areas to some degree, which has negative effects on residents' health;

- (2) solid fuels' combustion, household energy inefficiency, and indoor thermal discomfort are the three critical factors which might influence residents' health in urban areas; and (3) it is crucial to improve energy structure and to induce household energy behavior to eliminate energy poverty.
- (5) Utilization of solid fuels in rural areas and its impacts on rural people are investigated.

Compared to urban areas, China's rural areas are less developed and the situation of energy poverty is prominent. Based on the data of China Health and Nutrition Survey, the characteristics of the consumed energy for cooking in rural areas are investigated as follows: (1) rural people mainly rely on solid fuels; (2) household income has great impact on the choice of energy sources for cooking; (3) great differences occur in the energy consumption for cooking in different rural areas; (4) diversity of rural energy consumption for cooking has been progressively realized; and (5) dependence of rural people on solid fuels is decreasing.

Community health has been affected by solid fuels in rural areas. Toxic gas and inhalable particles, which are from solid fuels combustion in simple cooking stoves, are the primary threats to community health. Women chiefly in charge of cooking are faced with great harm. Besides, the impacts of solid fuels on human health are also usually determined by many other factors such as sanitation of living condition and personal preference.

- (6) Relationship between energy poverty and economic development is analyzed.

Energy poverty is closely related to economic development and poverty. This book takes energy poverty and economy as a unit, discusses the impacts of per capita income, education, climatic condition, and energy price on energy poverty, and confirms the interactions between energy poverty and economic development.

The results demonstrate that: (1) there is an interaction between energy poverty and economic development; (2) the energy structure in developed countries and areas is becoming cleaner; (3) economic development promotes living electricity consumption, and the elasticity of per capita electricity consumption with respect to per capita GDP is 0.95; and (4) economic development is helpful in changing resident energy structure, and if other conditions stay as usual, the share of electricity consumption for living increases by 0.0617% as per capita GDP increases by 1%. Due to the positive correlation and casual relationship between energy poverty and economic development, it is an effective way to further alleviate or even eliminate energy poverty by keeping China's stable and rapid economic development and continuing to improve the living standards of the population.

- (7) Relationship between clean energy development and energy poverty is discussed.

Energy poverty focuses on the availability of modern energy services, which is actually the imbalance in energy development. The results show that (1) wind energy develops fast, which contributes to energy poverty eradication; (2) hydropower is rich, which covers the areas of considerable

energy poverty groups; (3) solar energy is diversely used, which can deal with the energy consumption problem for energy poverty population; (4) biomass energy is effectively utilized, which helps in energy poverty eradication in rural areas; and (5) nuclear power has large potential, which may be a solution to energy poverty.

- (8) Relationship between climate change as well as adaptation strategies and energy poverty is investigated.

Climate change affects energy poverty through availability, that is, it may destroy stable operation of electricity grid, threaten regular energy production, and disturb exploitation of clean energy. According to future climatic scenarios, the vulnerability of China's hydropower keeps growing, especially in the primary hydropower provinces and western poor regions. The impacts of climatic extremes on China and Japan are compared and it is found that the negative effects on China are worse than Japan when the same degree of power failure happens. The reductions in GDP, total output, and employment of China are 2 to 3 times bigger than Japan, and those in resident welfare are 3 to 5 times. On the one hand, the differences in socio-economic vulnerability between China and Japan are mainly caused by the structure factors. On the other hand, climate change adaptation policies have positive effects on energy poverty reduction; the emissions trading policy improves the structure of power generation; the fiscal taxation policy encourages clean power generation; the pricing policy ensures the equity of energy use; and the financial and trade policy allows a better energy consumption structure.

- (9) Policies and actions for energy poverty reduction are summarized.

Governments around the world are concerned about energy poverty and have adopted a series of targeted policies and actions. However, due to the different national conditions and stages of development, the policies and instruments addressing energy poverty are not the same in different countries. China has made great efforts to reduce energy poverty and the achievements are distinguished. It is predicted that China would realize the overall electricity coverage by 2015. Grid infrastructure and distributed generation equipment are developed together to ensure commercial energy supply for most areas where electricity is inaccessible. Different regions use their own measures to exploit energy according to the actual situation. The coverage rate of clean energy such as natural gas, methane, solar energy, and wind energy has been greatly expanded, and residents are able to have an easier access to energy services that leads to cleaner energy consumption patterns. It would provide an adequate scientific basis to justify the energy poverty alleviation policies in China by scrutinizing the policies and instruments of China and other countries in addressing energy poverty.

Energy poverty might restrain economic development, harm human health, and hinder well-being improvement. Currently, China is in a transitional phase of rapid development; China is not only faced with the energy poverty problems

in developing countries, but also characterized by energy poverty features in developed countries. As a result, policymakers should attach great importance to energy poverty and try to eliminate it.

People's living condition in China has been improved significantly since the inauguration of the policy of reform and opening up. The share of poverty group in total population has decreased and energy poverty has been extensively relieved. However, barriers, such as regional imbalance in socioeconomic development, still occur, the continuing trend that energy structure featured by coal, and also risks in environmental and health detriment induced by climate change. Therefore, energy poverty will be remaining as a big challenge to China for a relatively long period.

China should make regional development strategies and new city planning, as well as aim at the equal development of regional and urban–rural economy. Clean energy and renewable energy should be promoted in accordance with the local situations. Meanwhile, it is necessary to advance industrial adjustment and support technical reconstruction in the energy field. Besides, the advanced and new technologies that are specific to certain sector or area should be appropriately introduced into China. Overall, we are determined to spare every effort to address the energy poverty, construct the ecology civilization, and finally realize our China Dream.

In 2006, Professor Yongfa Xu and Professor Keyu Liu from the CNPC Economics & Technology Research Institute and Professor Yiming Wei founded the Center for Energy and Environmental Policy Research (CEEP), and Professor Yiming Wei was appointed as the Director of the CEEP. In 2009, as invited by the Board of Trustees, Professor Yiming Wei joined the Beijing Institute of Technology (BIT) and then the CEEP was affiliated with the School of Management and Economics. CEEP-BIT is always dedicated to scientific research in environmental and energy policy, environmental education, community service, and international collaboration.

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