Renewable and Sustainable Energy Reviews 82 (2018) 156–167

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Analysis and recommendations for onshore wind power policies in China

Lingyue Li[a,b], Xiaoqing Ren[c], Yanli Yang[a], Peidong Zhang[d,*], Xiao Chen[a,*]

[a] Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences, Qingdao 266101, China
[b] School of Mathematical Sciences, University of Chinese Academy of Sciences, Beijing 100049, China
[c] College of Environmental Science and Engineering, Nankai University, Tianjin 210093, China
[d] College of Environment and Safety Engineering, Qingdao University of Science & Technology, Qingdao 266042, China

ARTICLE INFO

Keywords:
Wind power
Energy policy
China

ABSTRACT

Recently China's wind power industry is challenged by many problems such as wind power integration and wind curtailment, which seriously hinders the development of onshore wind power. Since China's policy has a direct and significant influence on wind power industry, it is vital to analyze and evaluate published policies. This paper explores in detail 134 China's onshore wind power policies from 2005 to 2015 so as to provide analytical support for future formulation and implementation of wind power policy. Based on policy summary from equipment manufacturing industry, wind farms and power grid industry, this paper evaluates the policies from the perspective of overall plan, support policy and policy implementation using fitting method, game theory and empirical analysis. The results indicate that China's wind policy is gradually becoming perfected, for example, there are more reasonable objectives and improved support policies. However, many problems remain to be solved, like unreasonable planning, imperfect support policies, immature trading systems and uncoordinated actions among interest related parties. Furthermore, combined with international experiences, suggestions on improving China's wind power policy are proposed from seven aspects.

1. Introduction

With the increasing severity of global environmental and energetic problems, new energy and renewable energy development have received more and more attention [1]. Due to the advantages of abundant resources, relatively mature technologies, relatively low cost and non-pollution, the use of wind power has become a main trend of countries around the world [2]. By the end of 2016, the global cumulative installed wind capacity is 486.7 GW [3], which brings wind power to the fourth-largest source of electricity after thermal power, nuclear power, and hydropower. Meanwhile, wind power technology has been improved significantly [4,5], and the cost of wind power has been declining gradually. Such rapid development of global wind power industry is inseparable from the policy support of all countries. The United States, Denmark, Spain, Germany and other countries have issued series of policies to promote the development of wind power [6], such as fixed price, investment subsidies, tariff incentives, tax exemption, domestic rate requirements, export assistance programs, research and development (R & D) support, green electricity, renewable energy quota system, concession policy and certification policy.

China has issued numbers of wind power policies to support the development of wind power industry, which has made great progress in wind power industry. By the end of 2016, the total cumulative installed capacity of wind power in China has achieved 168.7 GW, which accounts for 34.7% of global installed capacity and ranks first around the world [3]. However, although wind policy in China has achieved installed capacity growth, technical level improvement, wind power cost reduction and development of other aspects, there are still exist other problems like wind power integration and wind curtailment [7]. Furthermore, many problems are worth studying, for example, how policies affect behaviors of subjects in wind power industry, what is the variation trend of policies, whether these policies are reasonable and which aspects still need to be improved.

Recently, many articles about Chinese wind power are published every year and many of these studies involve policy. However, most of the studies concentrate on wind power's status, only regarded policy as an aspect of reasons for wind power development and did not carry out a detailed and comprehensive analysis. In this sense, the researches about analysis and evaluation of the overall policy for the whole industry chain are still relatively few. These researches include the comparison of wind power policy at home and abroad [8–12] and the analysis and evaluation on the analysis of published wind power

Abbreviations: R & D, research and development; NDRC, National Development and Reform Commission; MIIT, Ministry of Industry and Information Technology; NEA, National Energy Administration; MOST, Ministry of Science and Technology; VAT, value-added tax; CECRE, Renewable Energy Power Control Center

* Corresponding authors.
E-mail addresses: eeesc@163.com (P. Zhang), chenxiao@qibebt.ac.cn (X. Chen).

http://dx.doi.org/10.1016/j.rser.2017.06.114
Received 13 December 2016; Received in revised form 26 June 2017; Accepted 26 June 2017

Table 1
Main literatures on the analysis and evaluation of Chinese wind power policies.

Literature	Published time	Method	Policy time	Policy scope	Policy classification
The analysis of the promotion policies in wind energy industry [13]	2009	Game theory	1986–2008	–	Classification by period
wind power development and policies in china [14]	2010	Empirical analysis	1994–2008	Incentive policies	Regulatory and mandatory policies, financial incentive policies, research and development policies
Effective policies for renewable energy-the example of China's wind power-lessons for China's photovoltaic power [15]	2010	Empirical analysis	1994–2008	Main renewable energy policies	–
Cost Analysis and Pricing Policy of Wind Power in China [16]	2011	Inflation-adapted model	1986–2008	Price policies	The initial stage, the incremental stage and the coordinated stage
Study on policy of the wind power grid in China [17]	2011	Game theory	1996–2008	Some special policies	–
China's wind power industry: Policy support, technological achievements, and emerging challenges [18]	2012	Empirical analysis	2005–2010	Some special policies	The national renewable energy law and national-level regulations
Large scale wind power integration in China: Analysis from a policy perspective [19]	2012	Empirical analysis	2005–2009	Some special policies	–
Review on wind power development and relevant policies in China during the 11th Five-Year-Plan period [20]	2012	Empirical analysis	2005–2010	Some special policies	Classification by year
Development policy for non-grid-connected wind power in China: An analysis based on institutional change [21]	2012	Empirical analysis	2005–2006	Some special policies	Mandatory institutional change and induced institutional change
Potential and policy issues for sustainable development of wind power in China [22]	2013	Empirical analysis	2005–2012	Some special policies	–
Political and institutional analysis of the successes and failures of China's wind power policy [23]	2013	Empirical analysis	2005–2011	Some special policies	–
Review of wind power tariff policies in China [24]	2013	Empirical analysis	2002–2011	Tariff policies	–
The study of Chinese wind power integration problem based on game theory [25]	2013	Game theory	–	Some special policies	–
Analysis on the policies of wind power generation industry in China-in the perspective of externality theory [26]	2014	Empirical analysis	2001–2009	Some special policies	Environment-type policy, supply-type policy and demand-type policy
A large amount of idle capacity under rapid expansion: Policy analysis on the dilemma of wind power utilization in China [27]	2014	Typical Nash strategy	2005–2010	Some special policies	–
China's policy initiatives for the development of wind energy technology [28]	2014	Empirical analysis	1986–2012	Policy initiatives for technology	Demonstration period, Early development period, Market boom phase, Plateau period
The economics of wind power in China and policy implications [29]	2015	Empirical analysis	2006–2010	Some special policies	–
System dynamics simulation of large-scale generation system for designing wind power policy in China [30]	2015	System dynamics method	–	Some special policies	–
The industrial performance of wind power industry in China [31]	2015	Empirical analysis	1994–2013	Price policies	Classification by period
Incentive policy research on the excess profit allocation in wind power projects based on DEA game [32]	2015	DEA game theory	–	Fiscal policies	–
The effectiveness of China's wind power policy: an empirical analysis [33]	2016	Regression method	1994–2012	Some special policies	Price policy and non-price policy
The evolution of wind energy policies in China (1995–2014): an analysis based on policy instruments [34]	2016	Content analysis	1995–2014	72 relevant policies	Environment-type policy, supply-type policy and demand-type policy
Wind power development in China: an assessment of provincial policies [35]	2016	Fixed-effect regression model	2001–2012	Provincial policies	–
Wind curtailment of China's wind power operation: Evolution, causes and solutions [36]	2016	Empirical analysis	2006–2013	–	Planning and management, policy incentives