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Large-scale utilization of wind power in China: Obstacles of conflict between market and planning

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HIGHLIGHTS

- We present the reasons why market is important for utilization of wind power.
- We discuss the current situation of the conflict between planning and market.
- We study the impact of conflict between planning and market on wind power output.
- We argue how to promote coordination between market and planning.

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ABSTRACT

The traditional strict planning system that regulates China's power market dominates power industry operations. However, a series of market-oriented reforms since 1997 call for more decentralized decision-making by individual market participants. Moreover, with the rapid growth of wind power in China, the strict planning system has become one of the significant factors that has curtailed the generation of wind power, which contradicts with the original purpose of using the government's strong control abilities to promote wind power development. In this paper, we first present the reasons why market mechanisms are important for large-scale utilization of wind power by using a case analysis of the Northeast Grid, and then we illustrate the impact of conflicts between strict planning and market mechanisms on large-scale wind power utilization. Last, we explore how to promote coordination between markets and planning to realize large-scale wind power utilization in China. We argue that important measures include implementing flexible power pricing mechanisms instead of the current fixed pricing approach, formulating a more reasonable mechanism for distributing benefits and costs, and designing an appropriate market structure for large-scale wind power utilization to promote market liquidity and to send clear market equilibrium signals.

1. Introduction

Energy consumption in China has grown rapidly since 1953, particularly after 1978 when China launched several economic reforms. China heavily relies on fossil-based energy, which accounts for more than 90 percent of its total energy consumption. Contributing one-third of the world's total CO_2 emissions in 2009, China has become the largest CO_2 emitter (Zhao and Yin, 2011). As a result, promoting renewable energy development, such as wind power, to reduce the consumption of fossil-based energy is an urgent task in China.

China has established an ambitious target for wind power development: by 2015, China's annual electricity generation will reach 180 billion kW h, and wind power capacity is planned to reach 90,000 MW, achieving 3 percent of total electricity generation; by 2020, annual electricity generation will reach 300 billion kW h, and wind power capacity will reach 150 GW, or 4 percent in total electricity generation (Zhang and Lin, 2011). To achieve these objectives, increasing the proportion of wind power generation relative to total power output and improving wind power utilization are critical factors.

Wind power capacity in China has grown rapidly since the 21st century. From 2000 to 2005, Chinese wind power capacity increased 20 percent per annum (Pei et al., 2010). Particularly after the launch of the Renewable Energy Law in 2005, wind power capacity increased from 1260 MW to more than

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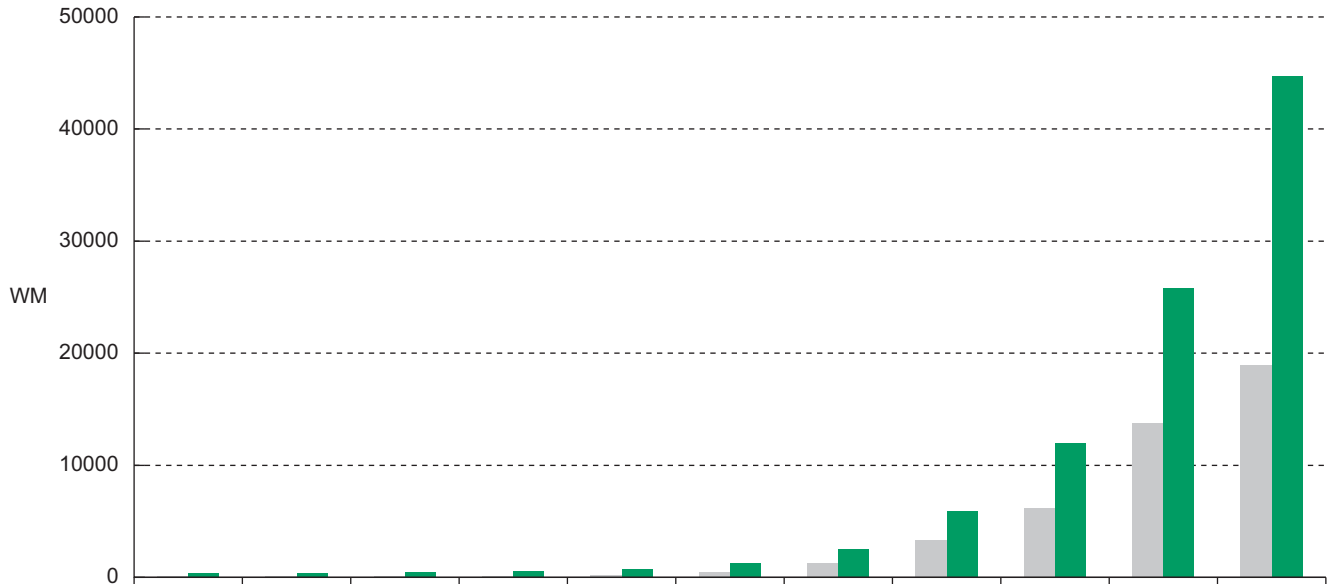

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
new capacity	77.29	57.21	66.31	98.3	196.75	506.91	1287.6	3311.25	6153.73	13785.7	18928
total capacity	341.53	398.74	465.05	563.35	760.1	1267.01	2554.61	5865.86	12019.6	25805.3	44733.3

Fig. 1. New wind power installations and total capacity from 2000 to 2010 in China.
Data source: Wind energy committee, China renewable energy association. The statistics of Chinese wind power installation, 2011, 3, 18.

40,000 MW by 2010, approximately doubling every year with a growth rate higher than the world average growth of wind power capacity (see Fig. 1). In 2008, China's new wind power capacity ranked the second largest in the world and accounted for 22 percent of the world's wind power capacity. In 2009, becoming the fastest-growing wind power country in the world, China became No. 1 in scale in new wind power installations, accounting for 33 percent of new installations globally. In 2010, this trend continued, and China became No. 1 in total wind power capacity.

Although wind power capacity has increased rapidly, wind power utilization is relatively low in China. In 2009, 20 percent of installed wind turbines (in capacity) could not send electricity onto the network (Yu et al., 2011). In 2010, China's grid-connected wind capacity was only 31,000 MW, which means about 30 percent of China's total installed capacity had not been integrated with the grid. According to the State Electricity Regulatory Commission's (SERC) regulatory report, in the first 6 months of 2010, wind curtailment reached as high as 2776 GW h, accounting for about 10 percent of China's total wind power generation.

The ineffective utilization of wind power is more prominent in the Northeast region of China. In 2009, curtailed wind power generation in the Northeast Grid was about 912 million kW h or 9.41 percent[1] of total wind power generation; in 2010, it was approximately 1963 GW h, increasing to 11.33 percent of total wind power generation. A significant challenge to improving the Northeast Grid's wind power utilization is the major reduction in the peak regulation capacity of thermal power during the long winter heating months when the capacity of the combined heat and power (CHP) thermal plants must be utilized to meet heating demands.

To promote large-scale utilization of wind power, the Northeast Electricity Regulatory Authority (NERA) has established a series of market-oriented rules: (1) On 30th September 2010, NERA published "Regulatory Measures on Power Trade Across Provinces in the Northeast Region (Trial)," which established the legal basis for promoting power trade in the Northeast Grid; (2) On 30th September 2010, NERA published "Notice on 'Market Trade of Auxiliary Services and Compensation Monitoring Methods for Power Allocation in Peak Times across Provinces in the Northeast Region' (Trial)," which includes principles of trade pricing, trade organization, information publication, trade implementation and settlements; (3) On 21st December 2010, NERA published two implementation guidelines—"Implementation Guidelines for Connecting Power Plants with the Grid in the Northeast Region" and "Implementation Guidelines for Market Trade of Auxiliary Services for Power Allocation in Peak Times across Provinces in the Northeast Region;" (4) On 18th July 2011, NERA published "Notice on the Formation Principle of Electricity Curves between Provincial Junctors in the Northeast Region," which aims to promote electricity trade across provinces with load differences.

Originally, one of goals of the above policies was to promote wind power utilization. However, these market-oriented policies have had little effect on the promotion of wind power utilization because they conflict with other strict planning control mechanisms on wind power. We will discuss the details of these conflicts in the following sections and demonstrate why such conflicts seriously obstruct the utilization of large-scale wind power in China.

The paper proceeds as follows: the next section reviews the main wind power studies of China. The third section explores why the establishment of trade mechanisms for power resources during peak regulation periods across provinces is important for large-scale wind power utilization in the Northeast Grid. The fourth section introduces obstacles for promoting large-scale wind power utilization pertaining to wind power's strict regulatory environment, which creates conflicts between markets and planning. Section 5 discusses how to resolve conflicts between markets and planning to promote large-scale wind power utilization. The last section concludes with a discussion of policy implications.

[1] Source: Annual report of Northeast Regional Electricity Regulatory (2009). Northeast State Electricity Regulatory Commission Authority.