

Coordination between clean energy generation and thermal power generation under the policy of “direct power-purchase for large users” in China



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ABSTRACT

The inefficient utilization of clean energy and distorted pricing mechanism are the most critical problems that have hampered the reform of China's electric power industry for many years. A large number of clean energy generators have recently been constructed, but water spillage at hydroelectric facilities and wind curtailment persist due to integration challenges. The adjustment of electricity price has relied on executive orders of the Chinese government and the National Development and Reform Commission (NDRC). Distorted prices that are not derived from a market economy have seriously hampered the development of China's electricity market. Therefore, in recent years, the Chinese government has issued a number of reform measures concerning “direct power-purchase for large users”. The main idea of this pricing mechanism is to form direct negotiations between large users and generators to determine the electricity price. To a certain extent, this pricing mechanism is conducive to the electricity market reform in China. However, the coordination between clean energy generation and thermal power generation under the policy of “direct power-purchase for large users” has become the key issue in China's electric power industry. This paper summarizes the policies of “direct power-purchase for large users” in different provinces in China. The electricity market in Yunnan, for which the contradiction between thermal power generation and hydropower generation is increasingly severe, is the focus of the research. At last, a feasible electricity market scheme has been derived to coordinate thermal power generation and hydropower generation. This scheme has considerable theoretical and practical significance to the future of China's electricity market reform.

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1. Introduction

During the past decades, the pricing mechanism of China's electric power industry was seriously distorted. Specifically, the grid enterprises buy power from generators at on-grid price and sell them to the users at the sale price of electricity (Pazheri et al., 2014; Omar et al., 2014; Ming et al., 2014a, b; Wang and Chen, 2012). The price of electricity is separated into different categories (for agricultural users, industrial users and so on) by the government. Different kinds of users (including residential users, agricultural users, industrial users and so on) will buy electricity from the grid enterprises at the price of electricity separately.

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Among those, both on-grid price and the price of electricity were determined by the NDRC (short for National Development and Reform Commission) according to the fixed cost and variable cost of generators and grid enterprises, as shown in Fig. 1. Under this pricing mechanism, which is not market-oriented and objective, the price signal has lost its important guiding role in the market and has hindered electricity market reform in China for quite a long time (Bao and Fang, 2013; Zeng et al., 2014; Sovacool, 2009).

The Chinese government has started to carry out policies about DPLU (“direct power-purchase for large users”) since 2002 in order to solve this problem in a more market-oriented way (Zhao et al., 2012). This policy, which will form direct negotiations between large users and generators to determine the electricity price, has made some progress in promoting the market-oriented reform in China. At the same time, the problems of water spillage at hydroelectric facilities and the need for wind curtailment were becoming

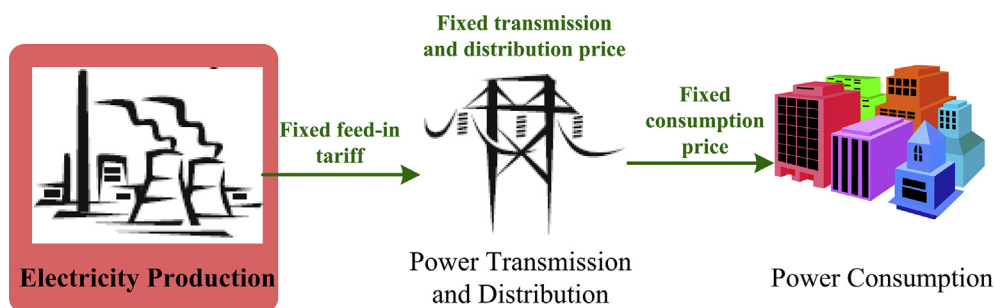


Fig. 1. The pricing mechanism of China's electric power industry.
Source: Authors' own elaboration.

severe due to the blind expansion of clean generation without proper integration (Lion et al., 2015; Zheng et al., 2011; The Central People's Government of The People's Republic of China (2013)). However, the present market operation of DPLU is still not quite conducive to the utilization of clean energy (Karami et al., 2013; Mark et al., 2014; Lejeune and Hui, 2012).

In the next few years, it is acknowledged that DPLU will be the key to electricity market reform in China. The utilization of clean energy as well as the coordination between thermal power generation and clean energy generation should be deliberately considered during the establishment of electricity market and power system operation (Zhao et al., 2014a; Pereira et al., 2014; Hirth, 2013). This paper focuses on Yunnan province as a case example, where the contradiction between thermal power generation and hydropower generation has significantly hindered the operation of the electricity market. The second part of the article will address the status of implementation of DPLU and summarize the DPLU policies in different provinces. The development status, characteristics, and challenges of Yunnan's electric power industry will be analyzed in the third section. The fourth part will give feasible recommendations. This article will end with some conclusions about the development of China's clean energy generation and electricity market reform.

2. The policy of DPLU

2.1. History of DPLU

The concept of DPLU was first proposed by NEA (National Energy Administration) in 2002. However, during 2002–2010, the implementation of DPLU was not successful and has been hampered for various reasons (Ngan, 2010). With the rapid growth of China's demand for electricity and development of the electric power industry, the drawbacks of existing pricing mechanisms drew the attention of the government. In 2013, DPLU was once more proposed as a possible way to form a market-oriented pricing mechanism. After the formation of the new NEA, a large number of DPLU arrangements were carried out by the Central government and NEA (Wu et al., 2014; Wang et al., 2014; Jin et al., 2014). This policy has become an important component of China's electricity market reform. Overall, the history of DPLU (shown in Fig. 2) can be separated into four stages.

(1) Stage 1: Concept formation

In 2002, the State Council issued *The Electric Power Industry Reform Planning* (The Central People's Government of The People's Republic of China (2002)). This government document stated that the all provincial governments should promote DPLU and change dominance of the market by grid enterprises (Ming et al., 2013a,

2013b; Xuegong et al., 2013; Liu et al., 2013a, b). At the same time, the electricity price should be determined by both sides: the generators and the large users. This is the first time the concept of DPLU was put forward.

In 2004, the former SERC (State Electricity Regulatory Commission) and the NDRC issued *Interim Measures for Direct power-purchase for large users* (NEA, 2004; Xuegong et al., 2013). The guiding ideology, purposes and principles of DPLU were covered in this government document.

(2) Stage 2: Initial implementation

In 2005, Jilin Electric Power Supply Company, Jilin Carbon Company and Jilin Longhua Thermal Power Company signed contracts that first implemented DPLU. In 2006, a large number of DPLU contracts were signed in the Guangdong province.

In June 2009, *Notice on Improving the Implementation of Direct power-purchase for large users* was carried out by the former SERC, NDRC, and NEA, which laid the foundation of policies and regulations for DPLU. Under the guidance of this government document, several DPLU contracts between Chalco Fushun Aluminum Company and Huaneng Yimin Generation Company were made (Valentine, 2014; Du et al., 2013; Liu et al., 2013a, b).

(3) Stage 3: Rapid promotion

During 2010–2012, DPLU was hindered from different aspects. In 2013, the government realized that the traditional price mechanism has seriously hindered the process of China's electricity market reform. Since then, DPLU again became an important component of the reform of China's electric power industry.

In May 2013, the NDRC issued *Deepening Economic Reform in 2013*, which listed DPLU as one of the key ways to promote the reform of the energy sector (Xinhuanet, 2013; Zhao et al., 2012). In August, NEA issued *Notice on Relative Factors of Direct power-purchase for large users*, which first promoted the idea that market should be the critical factor in the allocation of resources.

In October 2013, NEA issued *Regulations on Direct power-purchase for large users*, which further described the rights and obligations of participants of DPLU (Netease, 2013; Wu et al., 2014). Since DPLU has become fully market-oriented, the administrative approval of transactions of DPLU is no longer necessary.

(4) Stage 4: Large-scale implementation

As of November 2013, DPLU has been implemented in 11 provinces, including Yunnan, Jilin, Guangdong, Shandong, Henan, Anhui, Jiangsu, Hunan, Sichuan, Shanxi, and Gansu.

In 2014, the volume of DPLU for Guangdong reached 210 million kWh. In addition, a large number of users will participate in the

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