



How to develop distributed generation in China: In the context of the reformation of electric power system



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ABSTRACT

One purpose of the reformation of electric power system in China is to enable the power system to absorb a higher proportion of renewable energy. Currently, there are still such problems for China's renewable energy as high cost price, poor power regulating ability and insufficient consumptive space. As an important means of developing renewable energy power generation, distributed generation becomes a highlight in this reformation of electric power system. Under the background of reformation in power system, we describe the current overall market situation of distributed generation and the situation of distributed photovoltaic generation in China and further analyze the future policy environment of distributed generation. At the same time, we also analyze the system, technical and economic obstacles in the development of distributed generation. Market designs are made on various aspects like the objective principle, market types (spot market, futures market, financial market, ancillary service market and retail market) and transaction modes (bilateral contract, multilateral transaction platform and power pool). We also build institutional arrangement for smooth transition mechanism, problem-solving mechanism, independent accounting mechanism in power transition and distribution, full acquisition mechanism and Renewable Portfolio Standard. Discussions on the operation mode for the distributed generation are also shown in this paper based on the policies, regulations of the reformation and technical condition (micro-grid). Through our research, we finally put forward five policy proposals to provide support to the development of distributed generation during the reformation.

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1. Introduction

Jean Tirole, winner of the Prize in Economic Science, implants economic theories into the specialty of power industry in his electricity market theory. His theory includes three major parts: (1) electricity competition and regulation theory, (2) power grid invests and control theory and (3) electricity market theory. Three parts of them all show rich theoretical connotations and policy implications of electricity market and provide advantageous support for the power market reformation in China.

In March 2015, *Several Opinions on Further Deepening the Reform of Power System* (published by General Office of the CPC Central Committee, [2015], *Document 9*) was officially published in full text [1]. Before that, in terms of the direction and major points of the reformation, government departments and social sectors constantly communicated with each other and gave explanations while power industries and medias continued to follow and update. Thus, public attentions on the development of reformation continuously increased. Now, this top-level design document which will objectively direct the power system reformation in the coming years has been decided without doubts.

Document 9 (published by CPC Central Committee, [2015]) covers not only the problems on system and mechanism, but also the overall development of the whole power industry. Many incentive and restrictive policies are in particular clarified. *Document 9* is more like a Big Plan [2] which resolves the problems of market malfunction or temporary vacancy. Strictly speaking, there are quite a few parts that have no direct relationships with the reformation of power system (organization, operation, regulation and system), such as the incentive policies for distributed generation. Neither the preferential access to power grid nor the electricity price policy will function well, unless the costs of those renewable technologies get lower. Government measures and policies are needed to start this price falling process. Otherwise, technologies of this kind cannot enter into the market. This belongs to the category of policy tools eliminating market malfunction.

The followings are some problems about the development of renewable energy:

[Problem 1] Preferential access to power grid in varied renewable energy (distributed generation) and efficient unit [3]: If effective power bidding market is established, then those units featured in lower variable cost will gain precedence in the competitive scheduling system, especially under the circumstance of low shares of variable renewable energy [4]. During the process of market bidding, competition will be fully introduced. If market mechanism functions, the price will return to a rational level. At this point, distributed power generation with lower variable cost will gain a larger profit margin. The scheduling order does not

need location sorting beforehand if infrastructure of power bidding market is completed.

[Problem 2] Achievement of goals and implementation of policies for energy saving and emission reduction [3]: Energy saving solves the problem of energy security while emission reduction solves excessive emission and loss caused by emission. Both problems are part of the market malfunction [5] and additional government policies and measures are needed. Policies like increasing tax are good ways to reflect the real social cost and raising effluent standard to reduce emission. This belongs to the category of correcting market malfunction rather than the self-construction of the market. Notably, the supporting system of preferential stake electrovalence in wind power is also a policy tool to overcome market malfunction.

Here is our question: China's renewable power industry is a policy-based sunrise industry with a huge market development space, but the decision makers of renewable power generation enterprises, especially the decision-making of distributed energy generation enterprises, are lack of enthusiasm. Why is that? Is there something wrong with the power market, or the industry?

2. Status quo

2.1. Market situation

2.1.1. Overviews

At present, China's major distributed generation consists of photovoltaic generation, gas power generation, wind power generation, biomass energy and garbage power in sequence. Benefited from its own advantage and the support of policies, distributed generation has developed a lot in the recent two years [6]. According to the data from the National Energy Administration, as of the end of 2015, China's total installed capacity of photovoltaic power generation reached 43.18 GW, which made China become the world's largest country with photovoltaic power generation capacity. Among them, distributed photovoltaic power generation achieved 6.06 GW, and its annual generating capacity was 39,205 GWh. The proportion of China's distributed power generation is increasing year by year, with an average annual increase of nearly 1% point. By 2020 the installed capacity of distributed power will reach 187 GW, accounting for 9.1% of the national total installed capacity, while by 2030 the installed capacity will reach 505 GW, accounting for 17.3% of the national total installed capacity of the corresponding period [7].

As shown from Tables 1–5, China had reached some achievements in 2013. By the end of March 2013, the number of distributed generation projects of 10 kV and below operated by the State Grid amounted to 759 (Table 1), and installed capacity

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