The Influence of New Environment on the Development of Northeast Electric Power Industry

J K Zhang¹, X Ma¹, P C Ren¹, C S Li¹, J C Liu¹, Z Y Tian¹ and W T Xiong²,*

¹ Northeast branch of State Grid company, Shenyang Hunnan Camp No. 1 North Street, Shenyang 110180, China
² School of Electric and Electronic Engineering, North China Electric Power University, Beijing 102206, China

* 13718899557@163.com

Abstract. Electricity is the foundation of the national economy, and the influence on the social and economic development is self-evident. At the same time, the power industry is also deeply affected by the economy and society. Firstly, this paper introduces the new environment faced by Northeast power industry from four aspects: power system reform, bilateral stochastic system, technological innovation and related policies; then it deeply analyzed the impact of the new environment on the development of the Northeast Power Industry from the above four angle; finally, the opportunities and challenges of the new environment for the future development of the Northeast power industry are summarized. To pave the way for the formulation of Northeast power grid development planning, and it is also helpful to improve and scientificity and accuracy of the Northeast Power Grid Planning.

1. Introduction
In recent years, China's economy, society has entered a new stage, the power industry is also facing a series of new environment. In order to ensure the sustainable development of the power industry and facilitate the timely adjustment of the development direction of the power enterprises, it is necessary to sort out the impact of the new environment and its impact on the power industry.

This paper introduces the new environment faced by the Northeast power industry from five aspects, and analyzed the impact of the new environment on the development of the Northeast power industry, the opportunities and challenges faced by the Northeast power industry are summed up at last, which lays the foundation for the power planning of the Northeast Power Grid.

2. The new environment of northeast electric power industry
This chapter summarized the new environment in Northeast power industry from four aspects like the reformation of electric power system Bilateral stochastic system technical innovation and relevant policies.

2.1. The new environment
During the 12th Five-Year Plan, the world economy is still in a period of profound adjustment after the crisis, showing various characteristics such as low growth and imbalance. The interweaving of this
big-time background and China's "three positions" determines the "new normal" period when China's economy entered a phased decline.

In addition to the typical features of the new normal of the national economy, the economic development in Northeast China also has its own characteristics. In terms of economic growth, economic growth in Northeast China decreased by 2017, showing negative growth and overall weakness. However, in the first half of 2017, the economy in Northeast China rebounded and signs of improvement were evident.

2.2. The reformation of electric power system
In March 15, 2015, the CPC Central Committee issued a document 2015 No. 9 "on the further deepening of power system reform suggestions". The key points and paths of deepening the reform of the electric power system are clearly defined in the document, Orderly release the electricity price in competitive links outside transmission and distribution; Orderly release power distribution and saling business to social capital; orderly release power generation plan beyond public welfare and regulatory. Its core content can be summarized as follows:
- Separately check and ratify the price of electricity transmission and distribution, in order to promote price reform;
- Promote the reform of the electricity trading system, and form a fair and standard market trading platform;
- Steadily promote the reform of the sale side, and orderly release the sale of electricity to the social capital;
- Open grid fair access, establish a new mechanism for the development of distributed power.

2.3. Bilateral stochastic system
In recent years, great efforts have been made to develop clean energy in Northeast China. In 2016, the proportion of solar energy and wind energy installed capacity in Northeast China reached 1.7% and 20.5% respectively, the corresponding power generation increased by 118.4%, 12.6% compared with the same period. In the future, the proportion of renewable energy installation on large scale wind power and solar power will continue to increase in the whole power structure. But because of the existence of output volatility and intermittent, power generation side will no longer be controlled, and be more random.

In addition, Heilongjiang, Jilin and Inner Mongolia are listed as 2015~2020 electric vehicle demonstration and promotion sites. In the future, the electric vehicle industry will be developed rapidly in northeast China. At the same time, the distributed generation will continue to be popular, and the user energy storage technology will be further improved. The randomness of demand side is also increasing gradually, that is to say, the power generation side and demand side of power system have obvious randomness, forming a two-sided stochastic system [1].

2.4. Technical innovation
In recent years, China's energy technology independent innovation ability and equipment localization level improved significantly, some areas reached the international advanced level.

2.4.1. Power Technology. In terms of thermal power, China has completed the world's first million kilowatts ultra supercritical two reheat coal-fired generating units performance test. The generating efficiency of the unit is 47.82%, the power coal consumption is 256.8g/ (kW·h), and the coal consumption of power supply is 266.5g/ (kW·h). All environmental indicators are better than the national ultra-low emission limits [2].

In terms of nuclear power, China's third generation nuclear power technology "Hualong No. 1" first pile demonstration project started construction. While the power generation increases by 5%~10%, the power density in the core is reduced, and the safety of the nuclear power plant is improved [3].
In terms of wind power, the high altitude wind power generation system has also begun to develop, the latest high-altitude wind power is 600 kilowatts.

In terms of energy storage technology, researchers of Peking University have made an important breakthrough in the lithium battery material transport mechanism, which is expected to be used as electric vehicle power battery and be widely used in high temperature.

2.4.2. Grid Technology. In terms of UHV technology, China developed the world's first 1101kV controllable shunt reactor, the world's first 1500 MVA on-site assembled transformer prototype and the first UHV gas insulated transmission line, also developed the ±1100kV DC gas insulated bushing prototype [4], and has broken through the 1100kV /500 A HVDC converter valve and so on.

In terms of flexible DC transmission and DC power grid technology and equipment, our country has completed the world's first 320 thousand volts flexible DC converter transformer development, and has broken through the core technology of 500 thousand V flexible UHVD converter valve.

In terms of micro grid and grid connection technology, China developed the micro electric network voltage control of double layer structure, Flexible switching of main power supply off grid mode, Power environment monitoring system; and developed the prototype of virtual synchronous machine [5].

2.5. Relevant policies

In recent years, China's relevant departments put forward a series of policy that are closely related to the development of the northeast electric power industry from the national level and regional level.

2.5.1. Energy conservation and environmental protection policy. In recent years, the relevant departments have issued a series of energy saving and environmental protection policy, like <Government work report of the State Council in 2016>, <Special program of action for air pollution control in Heilongjiang Province (2016 - 2018)>, <Jilin province 2017 air pollution prevention and control work plan>, <Air pollution prevention regulations of Liaoning province> and so on. In view of the electric power industry, policy requires:

- Complete the ultra low emission transformation of coal-fired generating units, and to control coal power installed.
- Increase efforts to eliminate backward production capacity of high energy consuming industries; Promote the optimization and adjustment of energy structure and replace coal with electricity and gas.
- In key areas of air pollution prevention and control, develop natural gas peak shaving power station orderly; Develop gas steam combined cycle cogeneration moderately combined with heat load demand.
- Promote the adjustment of industrial structure; Speeding up the construction of energy saving and emission reduction projects; Prohibit the direct discharge of toxic and harmful gas.
- Optimize the energy structure and encourage the development of competitive new and renewable energy sources.

2.5.2. A series of policies to revitalize the Northeast. In 2003, <Several opinions on the implementation of Northeast China and other old industrial base strategy etc > was put forward, which marks the formal implementation of the Northeast Revitalization Strategy. In 2007, the <Planning the revitalization of Northeast China> was formulated. In 2014, facing the new situation of global economy, the State Council has put forward <Some opinions on the recent major policy initiatives to support the revitalization of Northeast China>. In 2016, our country launched <The rolling implementation plan for three years to promote the revitalization of the old industrial bases in Northeast China (2016-2018 years)> . In February 2017, the General Administration of Customs has issued< Several measures to support the new round of revitalization of Northeast China >, which aim
is to build the key development and opening platform in Northeast China, and to promote the optimization and upgrading of industrial structure in Northeast China.

2.5.3. "One Belt and One Road" policy. In March 28, 2015, the State Council authorized the three ministries jointly issued<Promote the construction of Silk Road Economic Belt and twenty-first Century Maritime Silk Road vision and action>, which explicitly put forward that we will Strengthen cooperation with countries along the route with the main content of Policy communication, facilities Unicom, trade unimpeded, capital financing, popular communication. In February 2017, Heilongjiang Province issued<Heilongjiang province implementation plan on "the implementation of promoting One Belt and One Road construction science and technology innovation cooperation plan">; In March 17, 2017, the general office of the State Council announced<Scheme for counterpart cooperation between Northeast China and some provinces and cities in the eastern region>, which defines the cooperation program between the northeast and the East; Focus on promoting institutional innovation, and to promote collaborative "One Belt and One Road" construction.

3. The influence of new environment on Northeast Electric Power Industry

The influence of new environment on Northeast Electric Power Industry can be seen in the figure 1 as below:

3.1. The influence of electric power system reform on Northeast Electric Power Industry

The new round of power reform’s core value orientation is to establish a new type of electric power governance system, which is green, low-carbon, energy-saving and emission reduction, more safe and reliable, and realize the comprehensive resource optimization allocation, promote the overall transformation of China's electricity production structure, consumption structure and technical structure. The northeast electric power industry is affected in the following aspects:

- Reform of transmission and distribution price, reshape the positioning of power grid enterprises, change the concept of power grid planning;
- Power market opening increase the competition of northeast electric power market;
• Promote multi direct transaction of electricity;
• The development of distributed power supply and micro grid will change the planning route of power grid enterprise distribution network, and change the relationship between power grid and users;
• The establishment of auxiliary service market mechanism alleviated the development of Northeast Power grid;
• Releasing the business of distributing and saling electricity gradually improved the overall management of power grid enterprises;

3.2. The influence of Bilateral randomness on Northeast Electric Power Industry
The protection of power system is faced with great challenges in the aspects of security and stability due to the randomness of two sides. Which made the real-time supply and demand balance of power system and the system scheduling more difficult [6].

Power planning can make use of the flexibility and controllability of traditional fossil power generation to compensate for the randomness, instability and other defects of renewable energy power generation, and achieve coordinated control of power generation.

At the same time, with the demand side management technology and energy storage technology, the demand side power load actively cooperates with the power generation, so as to form a relatively coordinated "bilateral controllable system".

3.3. "Mutually beneficial" Coordinated development
Power generation technology and power grid technology innovation, can not only promote the Northeast Power Grid towards a diversified, clean development, but also will further safeguard the security of the Northeast power grid operation [7].

The application and popularization of two reheat technology will improve the utilization efficiency of thermal power in Northeast Power Grid; Deep peak shaving technology for thermal storage of thermal power plant increase the flexibility of the unit operation, and lay a foundation for more renewable energy consumption [8].

The development of new energy power generation technology and grid technology, enable the better development and utilization of resources in Northeast china. The new UHV technology enables the Northeast power grid to make full use of its superior geographical position, build cross regional UHV power transmission channel, and achieve two-way power flow with the surrounding areas.

3.4. "Mutually beneficial" Coordinated development
Energy saving and environmental protection, the revitalization of the northeast, "The Belt and Road" policy promote the reform of Northeast power grid system, and promote the development of Northeast power towards clean, green and direction; accelerate the construction of regional networking, strengthen the interconnection of energy; promote renewable energy consumption, improve the industrial structure, lead into advanced science and technology, and promote industrial upgrading.

4. Conclusion
The new environment has brought a series of opportunities and challenges to the development of Northeast Power Grid. On the one hand, technological innovation has promoted the rapid development of power grid; The superior geographical position and the "One Belt and One Road" policy has promoted the wide range of energy cooperation in Northeast Asia countries. On the other hand, Clean power, distributed generation, and the popularity of electric vehicles make the grid be a Bilateral stochastic system, which further aggravate the uncertainty of the development of Northeast Power Grid under the environment of electricity market reform; energy-saving and emission-reduction has brought higher environmental protection requirements to thermal power enterprises.
Acknowledgment
2017 National Grid company Management Consulting Project: Research on coordinated development strategy of Northeast China Power Grid and national energy network under new normal conditions.

References
[1] Ming Z 2016 J. Electr. Power Enterp. Manage. 9 42-5
[2] Song G, Jie Z and Ferdinand H 2017 J. Reheat Chinese Power 50 6-11
[3] Donghai G and Dianyuan Z 2016 J. China Nucl. Ind. 5
[4] The world's first commercial 1000kV site assembly a successful test J. Electr. Trans. Techno. 6 64
[5] State Grid Energy Research Institute 2016 M. China power supply and demand analysis report. China Electr. Power Press
[6] State Grid Energy Research Institute 2016 M. China power generation supply and demand and power supply development report China Electr. Power Press
[7] State Grid Energy Research Institute 2017 M. China power generation supply and demand and power supply development report China Electr. Power Press
[8] Huijuan S, Pengcheng S, Zijie Z and et al. 2016 J. Sci. Techno. Innov. Appli. 16 185