Research on Coordinated Development Strategy of Northeast Power Grid and National Energy Grid

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Abstract. In the new era, the Northeast power grid is facing a series of opportunities and challenges. In this paper, the strategy of “complementary”, “transmission” and “mutual benefit” coordinated development of Northeast China Power Grid and national energy grid is formulated based on the relevant national policy planning; considering the difference of unique geographical location, natural resources, human resources, technology and other factors of the northeast and other areas; taking into account the development situation and future development needs of all regions, formed a coordinated development strategy layout, covering the unified planning, new energy development, peaking capacity construction, power substitution and talent support. It is beneficial to improve the efficiency of the national energy allocation and utilization, and to solve the practical problems faced by the power grid, so as to realize the coordinated development of the Northeast Power Grid and the national energy grid.

1. Introduction

Under the new environment, the rapid development of China's economy, the continuous progress of technology, the expansion of the scope of cooperation and the new round of electricity market reform have brought a series of opportunities and challenges for the development of Northeast Power Grid. Judging the role orientation of Northeast Power Grid in the future energy grid reasonably and scientifically is the foundation to ensure the sustainable development of Northeast Power Grid. According to the Northeast power grid’s development conditions and external challenges and opportunities, the Northeast power grid is positioned as the future power hub in Northeast Asia Energy Internet. And the coordinated development strategy of Northeast Power Grid and national energy grid is put forward, which can provide reference for the future planning of Northeast power grid, and ensure the power grid science and sustainable development.

2. Power grid positioning of Northeast China Power Grid

2.1. Geographical advantage brings up the hub position of Northeast Power Grid

From the domestic point of view, the northeast is located in the northernmost part of China, the southwest connects to the North China, and the south is adjacent to the Bo Sea and the Yellow Sea; from an international point of view, the northeast is located in the central region of Northeast Asia,
adjacent to North Korea, Russia and Mongolia, and across the sea from Japan and Korea. Therefore, Northeast China will become the hub of interconnection between China's power grid and Northeast Asia Power Grid.

2.2. Energy situation promotes northeast power grid to pivot positioning transformation
With the growing depletion of fossil energy, the development of renewable energy has become the focus of development. Northeast China has a large amount of wind resources and light resources, which can be used as renewable energy sources in the future [1]. According to the seasonal variation of renewable energy, the remaining renewable energy power generation is transported to the surrounding areas or neighbouring countries through UHV transmission lines, and when renewable energy output is insufficient, it can receive electricity from other countries.

2.3. Unbalance of power supply and demand makes northeast power grid develop to hub
In terms of electricity supply and demand, the power supply in the Northeast Power Grid is concentrated in the north with the load concentrated in the south, presenting the pattern of sending electricity from the west to the east and sending it to the north.

In recent years, the northeast region load growth slowly, and the scale of clean energy development is gradually expanding, the scale of local consumption ability is insufficient, leading to widespread abandoned wind, nuclear phenomena. In addition, due to the randomness of renewable energy output, it may not be able to meet the demand of local and electric power delivery, In the future, the northeast can be connected with the Northeast Asia grid to meet the power demand of itself and other parts of the country.

2.4. "One Belt and One Road" policy to promote the formation of the Northeast Power Grid hub location
"One Belt and One Road" series of policy clear program of cooperation in Northeast China and the eastern region, and support the eastern region in Northeast China to jointly promote the Mongolia and Russia economic corridor construction, carried out jointly for open cooperation in Northeast Asia, which provided significant opportunities for the interconnection of Northeast China Power Grid and Northeast power grid [2].

3. Constructing concentric circles of coordinated development
The coordinated development strategy originated in Northeast China, to expand the domestic Chinese and other regions, and then extended to the Northeast Asian countries, the Northeast Power Grid and the national energy network influence the coordinated development of "concentric circles" such as water waves ripple across.

3.1. "Complementary" coordinated development
The Northeast Power Grid concentrated in the north, the load concentrated in the south, showing the power transmission from east to west and North to the South. In addition, the total energy resources in Northeast China are rich, but unevenly distributed. And the provinces in the region have obvious differences in economic development, technological innovation, institutional mechanisms, talent reserves and so on. Therefore, for the protection of the northeast region of power balance, to optimize the allocation of various energy resources, and to increase network efficiency, should further optimize the internal power structure of three provinces and one district, and realize the coordinated development of the complementary between the northeast provinces.

3.2. "Transfer type" coordinated development
At the national level, due to geographical constraints, the northeast is only directly connected with the North China. Northeast China and Northwest China are rich in energy resources, but are lack of consumptive ability, and the development is relatively backward [3]; Beijing Tianjin Hebei region has
a large number of talents, but the problem of environmental pollution is serious; in East China, the economic development is faster, the technology level is higher, and the management mechanism is perfect. Therefore, in order to realize the comprehensive and coordinated development of Northeast China Power Grid and national energy grid, it is necessary to give full play to the unique advantages of each region and to achieve coordinated development across the country.

3.3. "Mutually beneficial" Coordinated development
In Northeast Asia, Russia and Mongolia have abundant energy resources, but their consumptive ability is limited [4]. Japan and South Korea’s demand for energy resources is relatively large, while their own energy resources are relatively scarce. And Northeast China has a good market potential and geographical advantages. Due to the time difference and climate difference, the load peak periods of different countries in Northeast Asia are different. Therefore, Northeast China should give full play to the role of the hub to achieve interoperability with Russia, Mongolia, South Korea, and Japan. Give full play to the advantages of all countries, cooperation and sharing, so as to achieve mutually beneficial coordinated development between the two sides.

4. Strategic focus of coordinated development

4.1. In the unified planning: "power grid load" coordination

4.1.1. Coordinated planning between power grids. According to the idea of national unified planning, considering the power supply and load situation of each district, the planning of power grid and the planning of liaison line among regions are formulated [5]. To further expand the construction of inter regional power grid interconnection, to break the balance of power with the principle of "balancing the provinces, districts and districts", and to improve the inter provincial power grid inter regulating capacity [6].

4.1.2. Coordinated planning between multiple power sources. The key to the coordinated development of multiple sources in Northeast China is the peak load regulation of the system. It is necessary to reasonably increase the proportion of peak load power supply and flexible regulation power supply in the power installation, and solve the problem of system peaking caused by the large-scale development of the wind power TV University. Therefore, we should speed up the construction of pumped storage power station and gas station, to improve the renewable energy consumptive capacity of Northeast Power Grid.

4.1.3. Coordinated planning of power grid and power supply. In order to ensure the optimal allocation of energy resources, it is necessary to ensure the scale and speed of power construction match the grid construction. In view of the situation in Northeast China, the wind power planning can be integrated into the unified planning of energy and electricity, and the speed of wind power project construction and grid construction should be synchronized to achieve the overall planning and coordinated development of wind power and power grid.

4.2. In the development of new energy: "renewable energy centralized power generation and distributed generation coordination and complementation"

4.2.1. Vigorously develop renewable energy distributed generation. The northeast is rich in solar and wind energy resources. Distributed photovoltaic power generation and distributed wind power generation should be developed according to local conditions to provide useful supplement for power supply of large power grid [7], which can not only meet the heating demand in some remote areas, saving the cost of construction of power grids, but also can realize the local consumption of solar and wind resources, so as to achieve the comprehensive and coordinated development of the Power Grid.
4.2.2. Construct the intelligent microgrid based on distributed generation system. Smart microgrid can meet the access and consumption of Distributed Renewable Energy of high penetration, can meet the special requirements of the power quality and reliability of users. Therefore, the Northeast power grid should do a good job in supporting the construction of intelligent microgrid, combine the production and consumption of distributed energy to supply energy directly to users, and the remaining power should be integrated into the power grid through smart microgrid, which can effectively improve the reliability and flexibility of power system, and reduce power loss.

4.3. In the aspect of peaking capacity construction, "Measures should be taken to improve peak shaving capacity from Power side load side of grid side"

4.3.1. Construct Pumped Storage Power Station to peak shaving. The pumped storage power station has dual functions of peak shaving and valley filling. The peak shaving range is large and environmental friendly and economical, which can ensure the power grid to meet the real-time power demand of the user side. At the same time, the stability of the output is guaranteed by the lower power generation cost and the environmental burden. In Northeast China the construction of large pumped storage power stations should be accelerated.

4.3.2. Construct gas fired power plant and import flexible thermal power technology to peak shaving. Gas power generation has good regulation ability and peak shaving performance. Facing the severe peak shaving problem, the northeast region should develop a certain scale of gas-fired power generation, mainly as peaking power supply. In addition, it is necessary to build coal power unit peaking capacity improvement project, to learn from the experience of other regions and foreign countries [8], and to speed up thermal storage reform of thermal power units and flexibility transformation of pure condensing unit in Northeast China so as to speed up the thermal power response and deep peak shaving capacity.

4.3.3. Develop energy storage technology and thermal power generation peak shaving system. In the future, Northeast China power grid should accelerate the development of energy storage battery, cold storage, heat storage and other energy storage methods, adhere to the centralized and distributed energy storage as a whole, and improve the energy density of the Northeast power grid energy storage device through the application of large capacity, long life, low cost, high safety new energy storage technology to meet the large-scale energy storage demand of power system, and to improve the peak load capacity of Northeast Power Grid. In addition, vigorously develop solar thermal power industry, give full play to its advantages of heat storage and energy storage, controllable output and adjustable output, to improve the absorptive capacity of wind power.

4.3.4. Strengthen power demand side management and tap demand side response to peak shaving capacity. The Northeast power grid should adopt a comprehensive and interactive demand side management approach. The demand side management should be established in the market to improve the price incentive policy to ease the tension situation of Northeast Power Grid peaking. At the same time, guiding users to change the way of electricity consumption, develop the valley power market, realize peak load shifting, improve the load rate of the grid, and ensure the continuous growth of power supply throughout the year.

4.4. In terms of electric energy substitution, "substituting electricity for coal, substituting electricity for oil, electricity comes from afar."

In the operating area of Northeast Power Grid, it started the substitution work of electric energy in an all-round way. In response to the national electric energy alternative strategy and the advantages of convenient, safe, clean and efficient electric power, the Company started from the areas of heating, industrial production, transportation, service and agriculture, Actively advocating a new mode of
energy consumption "substituting electricity with coal, replacing oil with electricity, and electricity from afar", the proportion of electricity consumed in terminal energy consumption has been continuously raised.

4.4.1. Replacing coal with electricity. Replacing coal with electricity in terminal consumption to reduce the environmental damage caused by coal use. In the city central heating, commercial, industrial and agricultural production field, vigorously promote the heat pump, electric heating, electric boiler, double storage alternative energy technology to promote electricity instead of direct consumption of coal, and guide the whole society to change the habit of useful energy [9].

4.4.2. Replacing oil with electricity. Speeding up commercial application of electric vehicles, to promote port power, airport operation vehicle oil to electricity according to local conditions. fossil fuel vehicles will be gradually replaced with electric vehicles. Accelerate the construction of intelligent transportation system, fully realize the "electricity instead of oil", so as to promote the efficient use of energy in the transportation industry and reduce environmental pollution.

4.4.3. Electricity comes from afar. Construct UHV network, the thermal power, wind power and solar power in the West and north of the northeast will be transported to the southern load center of China to achieve large-scale and comprehensive energy substitution in Northeast China.

4.5. In terms of talent support: "adapt to the networking needs, improve the talent training mechanism."

4.5.1. Establish the talent training mechanism in Northeast Power Grid. According to the transformation from northeast power grid to northeast Asia power hub, the paper analyzes in depth the trend of talent demand in the future power grid, formulates a new training mechanism for talents, adapts to the future development of networking in Northeast Asia, and reserves talents for operation and management of Northeast Power Grid.

4.5.2. Establish the Northeast Power Grid think tank. It is necessary to set up the Northeast Power Grid and the National and Northeast Asia Energy Internet Strategy Research Fund to guide the study of major issues in Mongolia, Russia, Japan and South Korea to establish a high-end think tank for energy internet in Northeast Asia. In view of the Northeast Power Grid and the National Energy Network, Northeast Asia Internet development regularly released research report to ensure the coordinated development of the Northeast Power Grid and the National Energy Network.

5. Conclusion
This paper positioned Northeast power grid as the hub of power network in Northeast Asia in the future, and put forward the "concentric circle" macro strategy of coordinated development between Northeast Power Grid and national energy grid, which will realize the "complementary", "Transfer type" and "mutually beneficial" coordinated development of the Northeast China Power Grid and the national energy grid. At the same time, it put forward the coordinated development strategic layout, which covers five aspects: unified planning, new energy development, peak regulation capacity construction, power substitution and talent support, provided a reference for the coordinated development of Northeast China Power Grid and national energy grid, which is of great significance to the sustainable development of power grid Science.

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