New Energy Formats and Quantitative Methods

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Abstract. The article mainly deduces and summarizes the definition and classification of new energy format based on the concept of energy format, combined with industry consensus and objective description. From the perspective of changes in product types, production methods, and organizational forms, they are divided into five types of new energy formats: energy format with integration of production and consumption, energy format of clean supply, vertically integrated energy format, energy format of Multi-energy complementary and energy format of the integration of information and industrialization. Aiming at the investment and employment of new business forms, construct a data processing method and give a quantitative research basis for new energy formats. It is found that from an overall point of view, the new energy format has shown a good development trend, especially the rapid development of new energy represented by wind power and photovoltaic power generation.

Keywords: Energy New Format, Classification, Quantitative Methods

1 Introduction
This article is based on the concept of energy format, combined with industry consensus and objective description, deduces and summarizes the definition of new energy format. And on this basis, combined with the research of relevant scholars to classify new energy formats from the perspective of changes in product types, production methods, and organizational forms. Finally, the scale calculation methods for five types of new energy formats are provided.

2 Definition of New Format
In response to the new trend of China’s tourism industry transforming from “sightseeing tourism” to “leisure vacation tourism”, Zhang Yunzhong (2008) believes that new tourism formats are based on the evolution of the times and changes in fashion, creating new products that can satisfy tourists’ psychology, emotions, and aesthetics [1]. Li Taiguang, Yu Yuemei, and Jiang Shan (2009) pointed out that the tourism industry has become a major mature industry in the world today. With the maturity of the Chinese market system, the gradual expansion of the industrial scale, the continuous optimization of the industrial structure, and the continuous improvement of industrial energy levels, various new formats of the tourism industry have also begun to emerge in large numbers [2]. Zhang Wenjian (2011) pointed out that the generation mechanism of new tourism formats includes the continuous expansion of market scale, the continuous development of tourism demand, the gradual deepening of
professional division of labor, the development of modern science and technology, the continuous improvement and innovation of government-level policies and regulations [3]. To sum up, it can be seen that new format is essentially market demand-oriented and is affected by evolving factors such as the external environment and internal competition. It is the format that emerged after the traditional format, or the format that has made innovations in product production, operation and management through innovation and learning [4].

3 Definition of New Energy Format

Although the understanding of the energy format in politics, academia and industry is in the exploratory stage, the existence of energy format and the continuous enrichment of new energy industry are indisputable facts.

Nur Baikeli pointed out that "the global pattern of energy supply and demand has changed profoundly, the innovation of energy science and technology is changing rapidly, new modes of energy production and consumption are constantly emerging, and new modes and formats of distributed energy, micro grid and smart energy are developing rapidly". Wang Binghua discussed his understanding of new energy format from the perspective of corporate competition. Zhu Gongshan believes that personal rooftop photovoltaic systems have enabled more and more market players to have the dual identities of energy consumers and producers. This is the new energy format.

Zhang Xiaoliang (2018) believes that new energy formats break industry barriers, and the pattern of deep integration of energy production, transmission, storage and consumption with other industries is gradually forming. Multi-energy complementarity, micro-grid, and "Internet plus" smart energy are all new energy formats [5].Wang Yaohua (2018) pointed out that as multi-energy systems become increasingly connected, other systems such as thermal systems, natural gas systems, and transportation systems are coupled with power systems to achieve coordination and optimization of multiple systems [6].Digital technologies have increasingly integrated into the energy industry and are also reshaping the energy format. Du Xiangwan, an academician of the Chinese Academy of Engineering, pointed out that "the combination of energy technology and information technology is a new format." "Centralized energy technology controlled by producers in one direction will be transformed into a distributed two-way energy system that interacts more with producers and consumers. This is also a new format."

It can be seen from the relevant expressions of industry experts on the new energy format that the new energy format mainly arises from three aspects: the first is the change of production methods, such as integration of production and consumption, from centralized to distributed, and comprehensive utilization of multiple energy; the second is the changes in operating methods, such as micro grids and virtual power plants generated by the integration of informatization and electrification, as well as the vertically integrated photovoltaic cloud network and other platform formats; The third is the trend of cleaner industrial structure, such as the clean utilization of coal, the increase in the proportion of clean energy power generation, and the expanded application of new energy such as hydrogen energy.

Based on the concept of energy format, this article combines the industry consensus and objective description to deduce and summarize the definition of new energy business format. The new energy format is relative to the energy format. Under the background of the new generation information technology revolution, new industrial revolution and the integration of manufacturing industry and the tertiary industry, it is influenced by the evolution factors such as external environment and internal competition, guided by the new market demand for energy products and services, through the innovation of technology, application or mode, or combining the energy industry with other industries Compared with the current energy industry format, there are new breakthroughs, new development, or beyond the traditional energy development mode, which has sustainable growth, can reach a certain scale, and form a relatively stable development trend of industrial form. This definition embodies three key points: breaking the tradition and being different from the past, that is, "new"; having the corresponding economic scale, that is, "industry"; and being in a relatively stable form, that is, "state".
4 Classification of New Energy Formats

Chinese scholars have classified the new formats from different perspectives. Wang Yan (2011) divided the new tourism formats into four categories: brand new tourism format, improved tourism format, generational tourism format, and imitation tourism format. [7] Li Meiping (2010) divided the new formats into new ones caused by the integration of existing industries and the new formats formed by the development of natural resources into new tourism products. Specifically, service form, organizational form, extended form, element form and agglomeration form are used as distinguishing standards and business types to classify [8]. Guo Luan (2011) believes that the composition of new tourism format includes three types: new tourism organization form, new tourism product form, and new tourism operation form[9]. Schumpeter believes that innovation can be attributed to new consumer goods, new production or transportation methods, new markets, and new forms of industrial organization[10].

In summary, new formats can be classified from the perspective of changes in product types, production methods, and organizational forms. Considering the physical characteristics of the basic balance between energy supply and demand, this paper defines new energy formats according to the classification standard of energy formats, the change of the expansion of energy products, energy production mode and the change of energy organization form. Taking into account some recent changes, this article mainly discusses the following five types of new energy formats: due to the expansion of product types and large-scale production methods, new energy formats for large-scale clean energy production have evolved, such as the clean and efficient use of coal, such as centralized wind power plants and centralized photovoltaic power plants; due to the expansion of product types and distributed and customized production methods, new energy formats that integrate production and consumption have evolved, such as distributed photovoltaic and wind power; new energy formats evolved from customized production methods and horizontally integrated organizational forms, such as multi-energy complementary; vertically integrated new energy formats, such as photovoltaic cloud network, evolved from distributed production methods and vertically integrated organizational forms; new energy formats of the integration of information and industrialization, such as virtual power plant and Micro grid, are evolved from distributed production mode and diversified expansion organization form.

5 The Scale Calculation Method of New Energy Format

The statistical data of the energy industry is not comprehensive, and the research on the format has just begun. Therefore, one of the difficulties in this research is the acquisition of energy format data, especially the five new formats mentioned above. This section mainly focuses on the investment and employment of new formats, considering the feasibility, rationality and practicability, constructs data processing methods, and gives the quantitative research basis of new energy formats.

5.1 Calculation Method of Investment Scale of New Format

(1) National data sources and data processing

The proportion of China's five new energy formats is mainly calculated from the perspective of total investment. The total investment in fixed assets of coal mining and washing industry, oil and natural gas exploitation industry, oil, coal and other fuel processing industry and power and heat production and supply industry is taken as the total investment of energy industry. Subsequent calculations of the proportions of various new energy formats are calculated on this basis.

Energy format with integration of production and consumption: First, calculate the total cost of distributed photovoltaics and the total cost of centralized photovoltaics based on the installed capacity and cost of distributed grid-connected photovoltaics and the installed cost of centralized grid-connected photovoltaics; Then, calculate the proportion of the total distributed photovoltaic cost to the total photovoltaic cost; Finally, calculate the investment amount of distributed photovoltaics based on the proportion of distributed photovoltaic costs and the accumulated investment in photovoltaic power supply construction. Use the ratio of the amount of distributed photovoltaic
investment to the amount of completed investment in the energy industry as the proportion of the energy format with integration of production and consumption.

Energy format of clean supply: Clean energy includes hydropower, nuclear power, wind power, solar power, etc. Since hydropower and nuclear power are traditional, so the investment amount of the two is not considered. Specific data processing method: deduct the investment in distributed photovoltaic from the total investment in wind power and solar power construction as the investment in clean supply. The ratio of the investment in the format of clean energy supply to the total investment in the energy industry is taken as the proportion of the new format of clean energy supply.

Vertically integrated energy format: At present, this format has just emerged and the number is relatively small, mainly represented by the photovoltaic cloud network operated by State Grid Corporation. The investment amount of the photovoltaic cloud network is obtained through investigations as the investment amount of the vertically integrated energy format, and the ratio of the investment amount of the vertically integrated energy new format to the total investment in the energy industry is taken as the proportion of the new vertically integrated energy format.

Energy format of Multi-energy complementary: According to the "Implementation Opinions of the National Development and Reform Commission and Energy Administration on Promoting the Construction of Multi-energy Complementary Integration and Optimization Demonstration Projects", multi-energy complementation mainly has two forms: power-side complementation and terminal-oriented complementation. The State Grid Corporation of China has estimated the four major types of integrated energy businesses in 2025. Among them, the clean energy market will be 720 billion Yuan and the multi-energy supply will be 400 billion Yuan, which is basically half of clean energy. Considering the power supply side (new clean energy supply format) and terminal oriented (integrated energy production and consumption and vertical integration energy formats) and the estimated proportion of State Grid Corporation of China, the proportion of energy format of Multi-energy complementary is calculated as half of the sum of the new formats of integrated energy, clean energy supply and vertical integrated energy.

Energy format of the integration of information and industrialization: Judging by expert experience, in the energy-saving service industry currently on the market, projects that rely mainly on informatization and electrification account for about 10% of the market share. Therefore, 10% of the contractual resource management investment in the energy-saving service industry is used as the investment amount of energy format of the integration of information and industrialization, and the ratio of the investment in the new format of the integration of information and industrialization to the total investment in the energy industry is the proportion.

(2) Data sources and data processing in various regions

Energy format with integration of production and consumption: Using the distributed photovoltaic grid-connected data in the operating area of the State Grid Corporation, first calculate the proportion of distributed photovoltaic grid-connected installed capacity in each region to the national distributed photovoltaic grid-connected capacity; Then, according to the proportion of each province, the proportion of the integration of production and consumption in the country is transformed into data for each region.

Energy format of clean supply: Using the national power construction investment completion data (by composition) in the annual report of the China Electricity Council, first calculate the sum of the cumulative investment in wind power construction and the cumulative investment in solar construction in each region. Then calculate the proportion of each region in the country, and finally use this proportion as the weight of each region, combined with the national clean supply scale data to obtain the clean supply scale and proportion data of each province.

Vertically integrated energy format: Using the distributed photovoltaic grid-connected data in the business area of State Grid Corporation, first calculate the proportion of distributed photovoltaic grid-connected installed capacity to the national distributed photovoltaic grid-connected capacity; Then, according to this proportion, the proportion of national vertical integration is transformed into data of various regions.
Energy format of Multi-energy complementary: Multi-energy complementation mainly has two forms: power-side complementation and terminal-oriented complementation. Considering that the multi-energy complementation in the eastern region is limited by resources, mainly distributed energy, so the proportion of distributed energy (light) in each province in the national energy is the weight; The western region has good wind and light resources, and large-scale energy bases are relatively concentrated, so the central energy (light) of each province is the weight of the national energy; The central region is a compromise, taking the proportion of the province's wind power and photovoltaic (distribution + concentration) in the national energy as the weight. Finally, the three proportions are normalized.

Energy format of the integration of information and industrialization: Using the data from the National Bureau of Statistics, first calculate the proportion of each province’s information technology service industry revenue in each province’s GDP, then calculate the proportion of each province in the country, and finally calculate the proportion of each province’s integration of information and industrialization.

(3) Data results and analysis
On the whole, the new energy format has shown a good development trend, especially the rapid development of new energy represented by wind power and photovoltaic power generation. However, in 2016 and 2017, the scale of new energy format has declined, mainly because the development of new energy is facing problems such as insufficient consumption and utilization and uneven regional development. In Severe abandonment of wind and solar has caused a huge waste of clean energy resources. The proportion of electricity rationing in Hami, Jiuquan and other regions is as high as 30%. New energy companies have suffered large-scale losses, which have attracted great attention from the Party Central Committee and the State Council and widespread public concern. The state promptly issued a regulation policy on wind and light investment. In 2016, the National Energy Administration established a wind power investment monitoring and early warning mechanism, and then adjust the scale and layout of development. In 2017, further establish an environmental monitoring and evaluation mechanism for the photovoltaic power generation market, and conduct comprehensive monitoring and evaluation of photovoltaic power station projects. These two policies have effectively optimized the layout of new energy sources, and have also largely alleviated the problems of curtailment of wind and solar. However, it has objectively slowed down the investment in wind power and photovoltaic installations. From 2016 to 2018, the investment in wind power and photovoltaics has experienced negative growth for three consecutive years. The phenomenon of scale expansion occurred in 2018. This is because on July 4, 2016, the National Development and Reform Commission and the National Energy Administration jointly issued the "Implementation Opinions on Promoting the Construction of Multi-energy Complementary and Integrated Optimization Demonstration Projects", "Opinions" show that during the "13th Five-Year Plan" period; more than 20 national terminal integrated energy supply demonstration projects will be built. At the beginning of 2017, the National Energy Administration determined the first batch of 23 projects in the first batch of multi-energy complementary integration and optimization demonstration projects. These policy measures have promoted the expansion of new formats of multi-energy complementary.

5.2 Calculation Method of Employment Scale of New Format
Using coal mining and washing, oil and natural gas mining added value as a proportion of mining industry added value, split the mining industry population data of each province, get each province's "coal mining and washing, oil and gas mining added value employed population". By analogy, according to the above-mentioned methods in the four industries of coal mining and processing, oil and gas extraction, petroleum, coal and other fuel processing industries, and electric power, and heat production and supply industries, the employment data of the entire energy industry is obtained.

Energy format with integration of production and consumption: Use the coefficient of investment in the power industry to stimulate employment, and calculate the number of employees of the format
in each province based on the investment scale of the new format with integration of production and consumption.

Energy format of clean supply: Calculate the employment number of each province in this format according to the investment scale of each province in clean supply using the coefficient of investment in the power industry to stimulate employment.

Vertically integrated energy format: According to the survey results of the photovoltaic cloud network, the current employment is about 100 people. According to the calculation of 1% of the market size, there are a total of 10,000 people in this industry.

Energy format of Multi-energy complementary: According to the survey results of the Marketing Department, the current number of integrated energy service companies in the provinces of State Grid’s business area divided by 4 is used as the number of employees in multi-energy complementary formats. Then calculate the employment situation of each province in this format according to 1% of the market size.

Energy format of the integration of information and industrialization: The proportion of the number of informatization employees in each province to the total number of employees is used as the proportion of the integration of the two in the energy industry, and the employment data is allocated.

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