Research on the Development Status, Existing Problems and Countermeasures of Shandong Energy Storage Technology

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Abstract—New energy storage is an important technology and basic equipment for building a new power system. What's more, it is an important support for achieving the goal of carbon peak and carbon neutralization. Among them, the focus of scientific and technological research is to develop energy storage technology, accelerate the demonstration and application of new energy storage, improve the consumption capacity of new energy, establish a new energy supply system, innovate technologies such as power generation, energy storage, transformation, transmission and consumption, and ensure stable supply. It is urgent for energy storage technology to support the transformation of energy consumption, and also we should develop the relevant technology system vigorously. Due to the high proportion of non fossil energy in Shandong, the proportion of non fossil energy consumption in Shandong will be around 15% by 2027, but there is a big gap from the requirement of the Party Central Committee and the State Council that the proportion of non fossil energy consumption should reach about 25% by 2030[1~3]. The time of Shandong energy storage technology development is tight and the task is heavy. This research adopted the patent analysis method to find out the development status of Shandong energy storage technology, sort out the existing problems, put forward countermeasures and suggestions, and provide decision-making and support for the government.

Keywords—Shandong, Energy storage technology, Development status, Patent analysis

1. Introduction

Shandong's carbon emission ranks first in China, accounting for about 10% of China's. The task of "carbon reduction" is heavy and difficult [4]. It was pro-posed at the 12th provincial Party Congress that "the proportion of non fossil energy consumption will increase by more than 1 percentage point per year in the next five years". The focus of promoting the "double carbon" task in the next five years is on increasing the proportion of non fossil energy consumption in energy consumption and reducing the proportion of fossil energy consumption [5]. The important way to realize the change of energy consumption structure is to develop energy storage technology. Shandong energy storage technology has a tight time and heavy

ICICA 2022, December 02-04, Chongqing, People's Republic of China

DOI 10.4108/eai.2-12-2022.2328069

task. Therefore, it is very necessary to find out the development status of Shandong energy storage technology, sort out the existing problems, and put forward targeted countermeasures and suggestions.

In this study, the patent database incoPat was used to summarize Shandong's advantages by finding out Shandong's research achievements, research and development institutions, industry distribution, and degree of marketization in the field of energy storage technology [6]. Through horizontal comparison, the technological innovation in the field of artificial carbon fixation in Shandong was compared with advanced provinces and cities such as Guangdong Province, Jiangsu Province and Beijing, and the gap and problems in Shandong are analyzed in depth.

2. Patent analysis of Shandong Energy Storage Technology Innovation

Through the analysis of domestic energy storage technology patents and the horizontal comparison with other provinces, the study analyzed the current situation of Shandong energy storage technology innovation and development.

2.1 Number of patent applications for energy storage technology

As shown in Fig. 1 and 2, among the 36000 domestic energy storage technology patent applications, Shandong Province ranks 6th, accounting for 4.2%. Guangdong ranked first, accounting for 17.4%; Jiangsu Province ranked second, accounting for 14.7%; Beijing ranked third, accounting for 12.7%; Zhejiang Province ranked fourth, accounting for 6.6%; Shanghai ranked fifth, accounting for 6.2%.

It can be seen from the above results that more than 50% of the energy storage technology patents are concentrated in the top 4 provinces of Guangdong, Jiangsu, Beijing and Zhejiang. There is a big gap between Shandong and advanced provinces and cities.

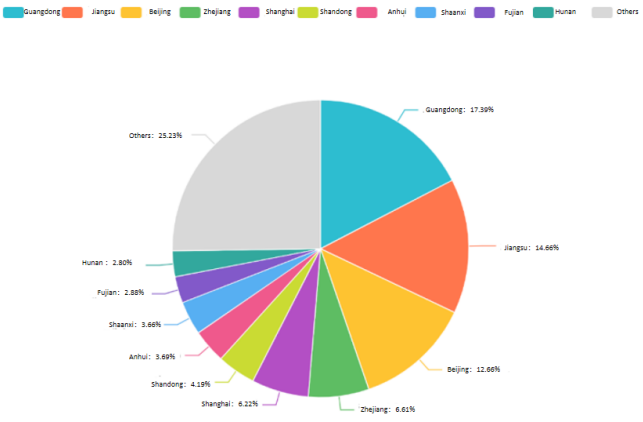

Fig. 1. Patent application number of energy storage technology in various provinces and cities.

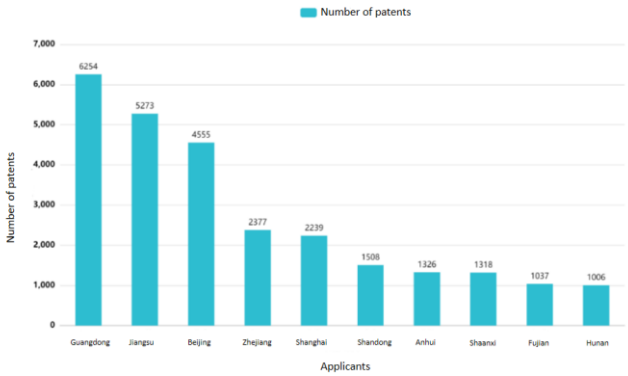

Fig. 2. Patent application number of energy storage technology in various provinces and cities.

2.2 Number of R & D institutions of energy storage technology

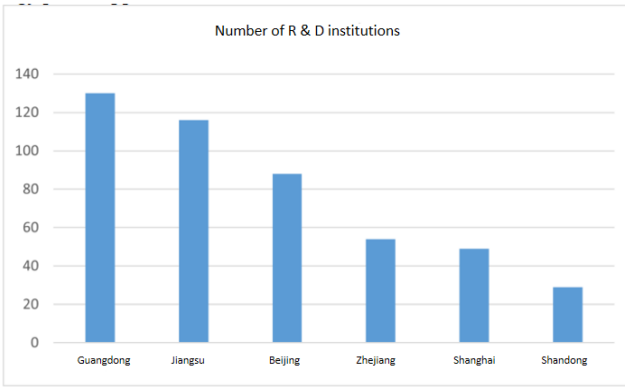

Fig. 3. Number of R&D institutions of energy storage technology in advanced provinces and cities.

As shown in Fig. 3, through screening and denoising of R&D institutions with more than 10 patent applications, it is found that the largest number of R&D institutions is 130 in Guangdong Province. Followed by 116 in Jiangsu, 88 in Beijing, 54 in Zhejiang, 49 in Shanghai and 29 in Shandong, ranking 6th in Shandong. The number of R&D institutions with more than 10 patents in the above-mentioned provinces and cities is completely consistent with the number of energy storage technology patent applications.

2.3 Distribution of energy storage technology industry

As shown in Fig. 4, domestic energy storage technologies are mainly concentrated in 9 national economic sectors (accounting for more than 10%), of which 73.45% are in the field of metal products, machinery and equipment repair, 73.41% in the field of instrument manufacturing, 71.87% in the field of electrical machinery and equipment manufacturing, 55.48% in the field of motor vehicles, electronic products and daily products repair, 40.03% in the field of power and thermal production and supply, 34.47% in the field of general equipment manufacturing, 30.43% in the field of special equipment manufacturing, 23.41% in

the field of computer, communication and other electronic equipment manufacturing, and 15.26% in the field of comprehensive utilization of waste resources.

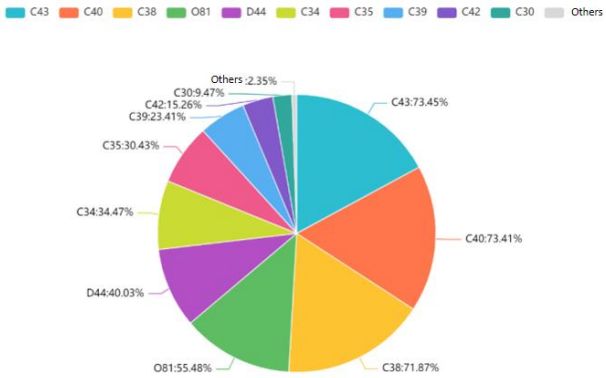

Fig. 4. Number of R&D institutions of energy storage technology in advanced provinces and cities

As shown in Fig.5, Shandong's energy storage technology is mainly concentrated in 9 industrial sectors of the national economy (accounting for more than 10%), of which 72.92% is in the field of instrument manufacturing, 72.06% in the field of metal products, machinery and equipment repair, 66.45% in the field of electrical machinery and equipment manufacturing, 53.83% in the field of motor vehicles, electronic products and daily products repair, 40.09% in the field of power and thermal production and supply, 38.77% in the field of general equipment manufacturing, 33.62% in the field of special equipment manufacturing, 20.61% in the field of computer, communication and other electronic equipment manufacturing, and 16.97% in the field of comprehensive utilization of waste resources. Compared with the national average level, Shandong is higher than the national average level in four fields: general equipment manufacturing, special equipment manufacturing, power and thermal production and supply, and waste resources comprehensive utilization, while the other five fields are lower than the national average level.

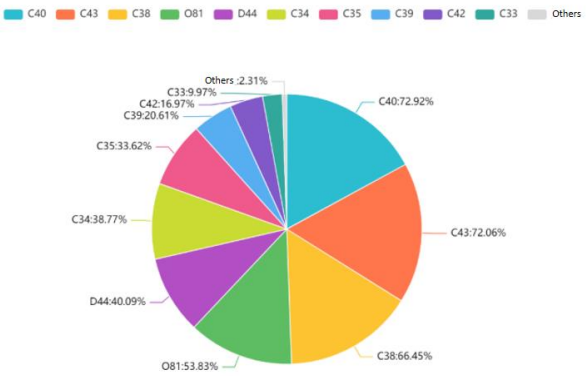

Fig. 5. Industry classification of Shandong energy storage technology national econom

3. Problems in the Innovation and Development of Shandong Energy Storage Technology

3.1 Weak R&D capability

The number of energy storage patent applications in Shandong Province ac-counts for about 4.2% of the total number of energy storage technology patents authorized in China, and the overall proportion is relatively low, ranking the 6th in the country. The number of patent applications for energy storage technology in Guangdong, Jiangsu, Beijing and Zhejiang, the top five provinces, exceeds 50% of the national total. In terms of technology research and development, there is a certain gap between Shandong and advanced provinces and cities, and the research and development achievements of energy storage technology can hardly meet the huge carbon reduction market demand in the province.

3.2 The number of R & D institutions is not large

There are 29 R&D institutions with more than 10 patent applications in Shan-dong, ranking 6th in China. There is a certain gap with the top 5 provinces of Guangdong, Jiangsu, Beijing, Zhejiang and Shanghai. The insufficient number of R& D institutions has affected the breakthrough of Shandong to a certain extent.

3.3 The development of some industries lags behind

Shandong's energy storage technology is mainly concentrated in 9 national economic sectors, including electrical machinery and equipment manufacturing, computer, communication and other electronic equipment manufacturing, motor vehicles, electronic products and daily products repair, metal products, machinery and equipment repair and instrument manufacturing, which are 5.42, 2.80, 1.65, 1.39 and 0.49 percentage points lower than the national average level, respectively.

3.4 The marketization scale of energy storage industry needs to be improved

There is still a certain gap between the market scale of Shandong energy storage technology and advanced provinces and cities, and the number of enterprises applying for patents accounts for 67.0%. The degree of marketization is 11.9, 9.0, 6.5, 1.4 and 0.4 percentage points away from Guangdong, Jiangsu, Zhejiang, Beijing and Shanghai respectively. Shandong's low degree of marketization has affected the research and development of energy storage technology to a certain extent.

3.5 Research and development of energy storage technology can hardly meet the demand of carbon reduction

Shandong's carbon reduction work time is tight and the task is heavy, and non fossil energy consumption accounts for a high proportion. According to the data re-leased by the National Development and Reform Commission, for every 10000 yuan of GDP increase, about 1.5 tons of CO2 will be produced. Shandong's per capita GDP is currently at the level of 10000 US

dollars. With the rapid development of economy, carbon emissions are still in a rapid rising period. Reducing CO2 emissions and adjusting the energy structure are the main measures. The focus of scientific and techno-logical research on increasing the proportion of non fossil energy consumption such as nuclear energy, wind energy and light energy is to develop energy storage technology. Compared with the first carbon emission volume in China, Shandong's patent application only accounts for 4.2%, and technological research and development urgently needs a breakthrough.

4. Countermeasures and Suggestions for the Innovation and Development of Shandong Energy Storage Technology

First, it is necessary to give full play to the driving and demonstration role of leading R&D institutions, so as to form a head effect, and lead the benign development of Shandong energy storage industry. The existing research and development institutions in Shandong with strong scientific research capacity mainly include Shandong University, Qingdao Jiuhuan Xinyue New Energy Technology Co., Ltd., Shandong University of technology, Electric Power Research Institute of State Grid Shan-dong electric power company, CRRC Qingdao Sifang Rolling Stock Research Institute Co., Ltd.

Second, it is necessary to actively expand inter provincial cooperation, strengthen cooperation in energy storage technology innovation through investment attraction and building an exchange platform, explore the establishment of a high-level talent exchange mechanism in the field of energy storage technology, and carry out joint research and knowledge sharing. Focus on and connect with units and R & D personnel with strong R & D capability of energy storage technology in China, such as State Grid Corporation of China, State Grid Corporation of China, Tsinghua University, State Grid Xinyuan Holdings Co., Ltd., China Electric Power Research Institute Co., Ltd., Xi'an thermal Research Institute Co., Ltd., North China Electric Power University, Xi'an Jiaotong University, China Electric Power Research Institute, Southeast University and other R & D institutions.

Third, it is necessary to optimize the allocation of scientific and technological re-sources, closely follow the actual situation of Shandong, investigate and sort out the advantages and disadvantages of energy storage technology in Shandong as soon as possible. It should formulate and issue the action plan and technical route for the innovation and development of energy storage technology in Shandong, and incorporate the development of energy storage technology into relevant plans for overall deployment. In combination with major scientific and technological innovation projects and other scientific and technological projects in Shandong Province, we will concentrate our efforts on tackling the "bottleneck" technology in the field of energy storage.

Fourth, focus on the key core technologies of energy storage technology, actively prepare to build a number of provincial laboratories, provincial key laboratories, provincial technology innovation centers, new R&D institutions and other technology R&D platforms. At the same time, support leading R&D institutions to lead the establishment of energy storage technology innovation alliance, accelerate the transformation of achievements, and promote collaborative innovation of industry, University and research.

Fifth, on the basis of investigating and sorting out the "bottleneck" technologies in the field of energy storage technology, and focus on the "blocking points" restricting the development of energy storage technology, support basic research, applied basic research and development of leading-edge disruptive technologies, carry out scientific and technological breakthroughs, build a market-oriented energy storage technology innovation system, so as to promote the industrial development.

Sixth, deepen the marketization reform of energy storage technology. Adhere to market orientation, encourage competition, accelerate the transformation of scientific research achievements, explore the construction of business models, and improve the market-oriented trading mechanism. In combination with resource endowment, technological advantages, industrial foundation, human resources and other conditions, a number of provincial-level high-tech industrial bases will be reserved and arranged to promote technological innovation, industrial upgrading and cost reduction, and effectively support the marketization and sustainable development of the new energy storage industry.

Finally, we should promote the large-scale, industrialized and market-oriented development of Shandong's new energy storage industry and strive to realize the comprehensive marketization of new energy storage.

5. Conclusions

There are five problems in Shandong Province: weak R&D capacity, low number of R&D institutions, lagging development of some industries, marketization of the energy storage industry needs to be improved, and energy storage technology R&D is difficult to meet the needs of "carbon reduction". Increasing the number of R&D institutions and the degree of marketization is the key to promoting the development of the energy storage industry in Shandong Province. We must focus on supporting the development of leading institutions, refine the list of "double recruits and double introductions", optimize the allocation of scientific and technological re-sources on this basis, and prepare for the establishment of energy storage technology innovations. platform, strengthen key technology research, and make great efforts to deepen the market-oriented reform of energy storage technology.

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