

# Analysis of New Energy Storage Economy and Sustainable Development Mode under Carbon Peak and Carbon Neutralization

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**Abstract:** Under the background of carbon peaking and carbon neutralization, it is bound to lead to an energy and industrial revolution, which will also directly affect the future social and economic life. In promoting the development of dual carbon goals, energy storage technology is a key supporting technology. Under this background, this paper explores the actual application of new energy storage technology in the context of carbon neutralization and carbon peaking, and proposes countermeasures to achieve the goal of carbon neutralization and carbon peaking from the perspective of sustainable development mode, for reference only.

**Key words:** carbon peak; Carbon neutralization; Energy storage technology; sustainable development

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## 1 Introduction

In July 2021, the National Energy Administration issued the Guiding Opinions on Accelerating the Development of New Energy Storage, in which the commercial value, economic value and market position of energy storage were recognized and clarified. In October of the same year, the State Council issued the Notice of the State Council on Printing and Distributing the Action Plan for Carbon Peak by 2030, in which the development of new energy storage was promoted as a low-carbon, safe and efficient energy mechanism for the first time. It can be said that under the guidance of the policy document, the energy storage technology has entered the large-scale development stage from the early stage of commercialization. In general, energy storage belongs to the construction of a new power system with new energy as the core and can achieve the scale of renewable energy. At the same time, energy storage is also the most critical core technology under the promotion of carbon peak and carbon neutral development.

## 2 Category of power system energy storage technology under the target of carbon neutralization and carbon peaking

### 2.1 Flywheel energy storage

The so-called flywheel energy storage is to convert the kinetic energy of the rotation of the rotating body into stored electrical energy, and then realize energy storage. Using the driving force of the motor, the tooth flywheel obtains speed, and obtains or releases electrical energy through the conversion of electrical energy. During the operation of the flywheel system, the environment is vacuum, which can reduce the wind resistance, reduce the kinetic energy loss as much as possible, ensure the service life of the system and improve the conversion rate. At the same time, the operating environment of the flywheel system is vacuum, which can also reduce the impact of the environment on the system. In essence, this vacuum environment does not require special maintenance of

systems and equipment. However, there are also some problems during the application of flywheel energy storage, such as low energy density. In the application of battery systems, higher standards and requirements will be put forward for space, and the cost of investment will be higher.

### 2.2 Pumped storage

At this stage, the development of pumped energy storage technology is relatively mature. To achieve pumped energy storage, reservoirs should be built upstream and downstream. When the electrical load is low, equipment should be used to pump water, such as pumping downstream water into the upstream reservoir to achieve the conversion of energy storage. When the electrical load is high, relevant equipment should be used to convert the state of the generator. According to the data, the maximum energy conversion rate of pumped storage can only reach 75%, and the criteria and requirements for selecting terrain and address are relatively strict. In addition, it is difficult to adjust, and the construction has a long period, which affects the large-scale application and promotion.

### 2.3 Compressed air energy storage

The energy storage mode with good development momentum and large-scale application is compressed air energy storage. This energy storage mode can realize the energy storage of excess electric energy, such as compressed air with low load in the power grid. When the power grid has a high load, the stored compressed air can be released. The steam turbine is used to generate electricity to promote the security of the power grid system. Long service life and high efficiency are the advantages of compressed air energy storage mode, and this energy storage mode has high conversion efficiency, which has a very optimistic development prospect in the future.

### 2.4 Electrochemical energy storage

The so-called electrochemical energy storage is carried out by chemical means. Liquid flow battery and sodium sulfur battery are materials frequently used for electrochemical energy storage.

Liquid flow battery has great advantages in practical application, but lithium electronic battery is widely used in the market. The electrochemical energy storage battery can be built in series and parallel, which can improve the capacity of the battery. The characteristics of electrochemical energy storage are relatively low cost and short battery life, which may bring serious environmental pollution and other problems after application. According to the data, in recent years, scholars began to focus on electrochemical energy storage, and also began to promote and research distributed power generation on a large scale, so that electrochemical energy storage began to show the advantages of flexibility and small size.

### 2.5 Super capacitor energy storage

As a new storage mode, super capacitor energy storage has strong pulse power. Generally, during the application of power system, this type of energy storage mode is often used in the scenarios of transient interference suppression and short time.

## 3 Economic development strategy of new energy storage under carbon peaking and carbon neutralization

Nowadays, technologies such as sodium ion battery, lithium ion battery and compressed air energy storage belong to mainstream energy storage technologies under the background of dual carbon. Specific analysis is made below:

### 3.1 Development of energy storage of sodium ion battery

Nanoion batteries have the advantages of high cost performance and good safety performance, so they have been widely used in the field of energy storage. In the 14th Five Year Plan for the Development of New Energy Storage issued by the National Energy Administration in 2022, sodium ion battery is listed as one of the main directions for tackling new energy storage technology and equipment. Therefore, from the perspective of national strategy, how to vigorously develop ion battery technology is also the most important topic for all departments. In recent years, sodium ion battery has achieved a leap from basic research to application engineering. Japan Shoda Chemical Co., Ltd., China Zhongke Haina Technology Co., Ltd. and Dalian Chemical Institute are all typical enterprises that produce sodium ion batteries. Due to their different material systems, these enterprises also produce different battery sample standards. According to the cathode material system, the sodium ion battery can be divided into three types: oxide, Prussian blue type material and due ion type compound. With the continuous maturity of manufacturing and technology in the state-owned market, sodium ion battery technology has entered the market. In addition, various departments have also begun to gradually improve the upstream and downstream industrial chain of sodium ion battery, so that its industrial chain has a certain scale. With the continuous improvement of battery technology, sodium ion battery technology has been applied to large-scale energy storage and user side.

### 3.2 Development of lithium ion battery

Among the new energy storage products, lithium ion batteries occupy a leading position. With the development of the commercialization mechanism of the power market and the improvement of the support of national policies for new energy storage, the cost of lithium ion batteries starts to decline gradually, which makes the energy storage lithium ion battery market enter

a stage of rapid development. In recent years, the cost of lithium-ion batteries began to decline with the drive of the electric vehicle industry, which also promoted the application of lithium-ion battery technology in electric energy storage to some extent. Panasonic of Japan, Mitsubishi, Tesla of the United States and BYD of China are the world's leading manufacturers of lithium-ion battery energy storage. At present, in terms of electric power energy storage, lithium ion batteries are mainly used in power grid side energy storage, power grid frequency modulation and other fields. In addition, although lithium ion has the largest market share in the battery market, problems such as safety and reliability still occur in practical applications. For all departments, they should focus on this field in the future. Lithium ion battery has excellent power multiplying characteristics. In today's mainstream technologies, the response time is relatively short, which can meet the demand for frequency modulation. In the power system, lithium ion battery will be used in the grid measurement, such as in the substation supporting energy storage system, to improve the active regulation performance of the grid through intelligent dispatching of the grid.

### 3.3 Development of compressed air energy storage technology

The advantages of compressed air energy storage technology are long energy storage cycle, high system efficiency, small investment and large energy storage capacity. This energy storage technology is very suitable for long-term energy storage, and has made very obvious achievements in improving the compressed air energy storage technology.

### 3.4 Suggestions on promoting the economic development of energy storage technology

To promote the application and promotion of energy storage technology, all departments should build innovative and perfect energy storage technology incentive and support countermeasures, drive the rapid development of each energy storage technology, improve the flexible adjustment ability of the energy storage system, do a good job in the application demonstration of multiple energy storage technology integration, sort out the basic attributes of each energy storage technology, and make a reasonable layout with reference to different scenarios and practical needs, Accelerate the marketization promotion of each energy storage technology, define its dominant position in the independent market, build a sound market operation mechanism, improve the regulatory mechanism for energy storage compensation and long-term compensation, endow the new energy power generation measurement supporting energy storage system with the dominant position in the auxiliary power service market, build a sound market operation mechanism, improve the price compensation system, and reduce the uncertainty of the market. Guide and encourage the diversified development of investment and trading modes, improve their cost performance ratio, and promote the upgrading and transformation of the power system.

Strengthen the basic innovation research of the next generation of energy storage technology, improve the influence and competitiveness of energy storage technology in the international market, and at the same time, give priority to promoting, guiding, encouraging and supporting the industrialization of existing energy storage technology, develop environment-friendly, long-lived and low-cost long-term energy storage technology, increase the investment in basic research of energy storage technology, and

guide and encourage independent innovation, Make them master more independent intellectual property rights.

Build a national innovation platform for energy storage technology, occupy the commanding height of technology development, promote the rapid development of energy storage technology, integrate the innovative resources of enterprises, universities and scientific research departments, and lay a solid foundation for building a national innovation platform for energy storage technology. Form technology and cluster advantages, develop engineering application research of energy storage technology, build breakthrough and cutting-edge industrial technology, improve the innovation cooperation mechanism of production, teaching and research, realize the transformation of achievements, and drive the development of energy storage industry.

#### 4 Measures to promote the sustainable development mode of new energy storage under the condition of reaching the peak and carbon neutralization

Despite the rapid development of energy storage technology in China, there are still some problems and challenges. Neither the cost, life nor the scale of technology development can meet the needs of practical applications. China has not fully mastered some core technologies, and the energy storage security and standard mechanisms built today are not perfect. According to the survey, energy storage manufacturers are too attached to a certain power entity. Although energy storage can provide a certain service, the cost is still attached to a certain entity. The full investment is greater than the existing income, which also makes the energy storage price mechanism less mature and stable. Therefore, it is necessary to propose countermeasures to promote the sustainable development of energy storage technology. The following analyzes the shortcomings and problems in the development of energy storage technology, as shown below:

First, there is a lack of breakthrough, originality and innovation. In the field of energy storage in China, China has not mastered many innovative and advanced technologies, which affects the progressiveness of energy storage conversion technology. In addition, there are some deficiencies in the research of key common technologies and basic technologies of energy storage, which also leads to the lack of voice in energy storage design concepts and standards.

Second, new energy grids such as photovoltaic and wind power are under great pressure to absorb, which also affects the large-scale promotion and application of energy storage technology. The main application mode of new energy in China is power generation. However, the large-scale grid connection of new energy directly affects the continuous operation of the existing power system, which not only affects the security and stability of the grid, but also brings hidden dangers to the security and stability of the system supply side. The new energy has a low grid related performance standard, and the voltage and frequency can withstand limited tolerance. With the continuous development of the electronic trend, the power system will cause subsynchronous oscillation, which will affect the safe operation of the distributed generation. Photovoltaic and wind power have very obvious intermittent characteristics, and it is difficult to balance power in time and space, which will affect

the security and stability of the power system supply side. At the same time, it is easy to cause the imbalance between demand and power supply. There are problems in the construction of new energy transmission network mechanism in China, which is lagging behind. The demand for new energy power transportation and the power grid construction are not unified, which is also the main reason for the imbalance of power supply and demand.

Third, the establishment of system market mechanism is not mature enough and the system is not perfect, which also limits the application and promotion of large-scale energy storage technology. At present, compared with the past, energy storage technology in China has achieved phased results. The scale of its application in power system generation, transmission, distribution and other fields has also grown with the years. Energy storage technology continues to improve its autonomy. However, there are still problems in the actual application of energy storage technology, such as unclear market subject status and imperfect market mechanism construction. In addition, compared with foreign countries, the competitive power market operating mechanism built in China is not mature enough to make a clear and reasonable verification of the price of various auxiliary power services, which also makes it difficult to achieve the value and income of the energy storage system. In general, there are many problems in the application and development of energy storage technology in China, so it is necessary to put forward safeguard suggestions to promote operation and policy in the perspective of sustainable development, in the context of carbon neutrality and carbon peaking, in the fields of progressiveness and value of energy storage technology.

First, build demonstration projects to drive technological progress. It is suggested that in order to promote the sustainable development of energy storage technology, China can promote several demonstration projects, improve the security, stability and flexibility of the power system, promote the intelligent application model of energy storage, and drive the application demonstration of energy Internet.

Second, we should do a good job of policy guidance and promote industrial application. (1) Sort out the responsible subjects, confirm the responsibilities and obligations of each management subject, strengthen the safety management of the energy storage system, and build a sound and mature standard and normative system. (2) Clarify the identity of the market subject, and sort out the procedures and processes of each project, including land, grid connection, environment, etc. (3) We will build a clear and reasonable price mechanism, adhere to the principle that whoever benefits will bear the responsibility, and improve the price marketization mechanism that users, power grids, and power generation share the responsibility. (4) Implement effective countermeasures to promote the development of electricity marketization. The key and difficult problems of the energy storage system are solved by using the marketization method.

Third, build a long-term mechanism to promote cost facilitation. It is suggested that we should have a forward-looking perspective to make targeted planning and research to avoid ineffective allocation of resources. Implement supporting policies and develop a friendly renewable energy model. In addition, in the case that the current electricity market and price mechanism cannot be fully matched, the state can vigorously promote the transitional policy and pumped storage policy, so that the policy can be coordinated, while improving the energy storage coordination

mechanism, referring to the current renewable energy quota indicators and system, to increase the recognition weight of green power.

## 5 Conclusion

Under the background of carbon peaking and carbon neutralization, energy storage plays a very important strategic role. During the period of promoting the realization of dual carbon goals, it is bound to trigger an energy revolution. As the main

supporting technology under the target of carbon neutralization and carbon peaking, the development of energy storage technology is very important. In this paper, several mainstream energy storage technologies have been studied, and effective strategies for the development of energy storage technology have been put forward. At the same time, from the perspective of sustainable development mode, suggestions for promoting the development of energy storage economy have been put forward. In terms of clear policy guidance, promoting industrial application and other aspects, it will ensure the realization of the dual carbon target.

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