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## Existing problems and future development trend of distributed energy system

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### ABSTRACT

In order to solve the increasingly prominent energy and environment problems in the world nowadays, exploiting the new type distributed energy system becomes a good solution. Especially for the optimization and adjustment of the energy structure in China, the urgency of the exploiting the distributed energy system is obvious. On account of the influence of the policy system, market constraint, environmental protection constraint and technological constraint when China develops the distributed energy system, this paper deems that utilizing the energy coupling concept to develop the distributed energy system is the new trend of the future development as well as the good way to solving the dilemma in China.

### KEYWORDS

Distributed energy system; Energy coupling; Energy saving and emission reduction.



## INTRODUCTION

At present, the energy and environment problems are increasingly prominent in the world. In order to achieve the task of the energy saving and emission reduction, European Union comes up with the comprehensive research plan of the new energy resources. The plan includes a series of the research plans, such as European wind energy, solar energy, biological energy, intelligent power system, nuclear fission, carbon dioxide trapping, transportation and storage. EU considers that exploiting the new type distributed energy system is the inevitable choice of solving the increasingly prominent energy and environment problems in the world nowadays.

The optimization and adjustment of the energy structure in China provide favorable opportunities for the development of the distributed energy system. We can effectively change the extensive development mode and achieve the rapid improvement of total energy efficiency and the potential and later- mover advantage of the emission reduction.

## CONCEPT OF DISTRIBUTED ENERGY SOURCES

The distributed energy resource is also known as distributed energy supply, distributed power generation, and distributed power supply. For example, the definition of WADE for the distributed energy resource is that the distributed energy resource means the efficient combined cooling, heating and power system installed in the user side<sup>[1]</sup>. The distributed energy resource mainly involves small rural hydropower, small independent power station, abandoned biomass power generation, coal gangue power generation, and residual heat, residual air and residual pressure power generation etc. The power generation of applying the renewable energy sources (wind energy, solar energy, hydraulic energy, biomass energy, geothermal energy, ocean energy and other non fossil energies) is also within the scope of the distributed energy resource.

Currently, the distributed energy system contains four meanings. First, close to the load. It is the energy management of the energy demand side, as well as the energy management of building the power generation and energy supply system near the user by utilizing the natural gas and other clean energies, local renewable energy sources or industrial residual heat and residual pressure etc. Second, the gradient utilization and comprehensive utilization of the energy sources. It enhances the comprehensive benefits of the energy sources, and achieves the efficiency of the energy sources, and the economic and environmental benefits. Third, the matching usage of multiple clean energies, to meet the demands of various loads of the users on cooling, heating, power, steam and domestic hot water. Fourth, intelligence. Apply the automatic control system and intelligent management platform, make use of the low fuel gas resources and low power resources to accumulate and store the energies for the users under a range of the optimized operation and dispatching, and achieve the balance between supply and demand as well as the optimization grouping of the fuel gas, electric power, heating, cooling and hot water<sup>[2]</sup>.

## EXISTING PROBLEMS OF DISTRIBUTED ENERGY SYSTEM IN CHINA

The distributed energy resource of China goes through the research and development, engineering construction (project implementation) and preliminary usage phases, and increasingly attracts the attention in all directions. However, due to the policy, economy, technology and other reasons, the development in China is really not smooth, and is relatively lagging compared with that in the foreign countries.

At present, the development and research of the distributed energy system in China have the following problems.

### Policy and system

Our country has successively unveiled some policies of supporting the development of the distributed energy resources, but the imperfect policies and regulations relevant to the distributed power generation project and the unsound systems currently still hinder the development of the combined cooling, heating and power project. The core problem is the air source support and the electricity connection. The implementation of the distributed energy supply system must rely on the fuel gas supply, power grid connection, standby power guarantee, fire safety, and various departments and multiple key technologies. At present, these supporting projects are still short of the explicit system standard and the authority of harmony<sup>[3]</sup>. The electricity connection is the key to the distributed energy system. Now the pertinent policies and regulations of the distributed energy power generation are imperfect, which hinders the development of the distributed energy resources<sup>[4]</sup>.

### Market constraints

The development of the distributed energy system is restricted by the market and supply – demand discipline. At the present stage, the major existing problems are as follows.

(1) System integration: The distributed energy system is the typical system engineering. The system integrates the technologies and equipments for the energy conversion, recovery and storage, such as fuel gas, machinery, electric power, heating ventilation, as well as automatic control. The high requirements of the system integration, larger technical difficulty, together with many influencing factors as needed for grasping effectively in the course of the development, construction and utilization of the project have restricted and impacted the success of the project<sup>[5]</sup>.

(2) Supply of equipment: The equipment and technology employed by the distributed energy system have been fairly mature in foreign countries. Nevertheless, the key power equipment of the system has quite a few problems in our country. A small number of the foreign equipment firms master the core technology and main production of the key power equipment. Although the gas engine and large as well as medium-sized gas turbine can be produced in our country, the power, efficiency, discharge and reliability of single set have some gaps with those in foreign countries. The technologies of the micro gas turbine and Stirling engine are yet to be enhanced, without commercialization. For the price, the imported equipment is very expensive, resulting in the energy saving of the distributed energy system without meeting the requirements of the economic benefits, which impacts the application of the distributed energy resources in China<sup>[6]</sup>.

(3) Operation management: In order to reach the energy saving and environmental protection effect of the distributed energy resources, the operation management of the project plays a very role. At present, there is not the patterned operation management method and operation guide book. The operation management only depending on the clients themselves has many problems. The market lacks the professional operation company, and there is hardly any company adopting the contract energy management mode, without forming the valid operation service ability.

(4) Investment income: The input of the distributed energy system at the earlier stage is larger than the conventional mode, while the incomes at the later stage, influenced by multiple factors, have larger differences. Moreover, the conditions in various aspects are not well coordinated with each other, in the absence of the professional service and demonstration effect. Therefore, the capitals do not pay enough attention to it. The grid connection obstacle of the power grid company for the distributed energy resources leads to the complex application and procedures of the grid connection and the time extension, while the developers with the capital shortages are confronted with more difficulties.

### ENVIRONMENTAL PROTECTION CONSTRAINTS

The distributed energy resources can achieve the energy saving and emission reduction, as well as improve the environment, but CC is mainly used in the regions with the developed economy or abundant natural gas such as various cities in China. Moreover, these regions possess the dense population and are faced with higher requirements of the environmental protection and fire protection<sup>[7]</sup>. Specifically, the influence on the project is mainly embodied in the emission and noise under restrictions in the project implementation. The situations of various regions are different. Some regions have the undefined environmental protection provisions of CCHP. The applicable standards of some regions obviously digress from the development level at the present stage, resulting in too high investment on the environmental protection standard project and reduced earnings.

### TECHNICAL PROBLEMS

The uppermost advantage of the distributed energy system is the energy saving and emission reduction. Now, the distributed energy projects built and used in China have a general yet prominent problem<sup>[8]</sup>, i.e. the poor matching between the system capacity and demand of cooling, heating and power. For the manifestation, some systems have too large capacity, and the cooling, heating or power exceeds the demand at most of the time in the actual operation, with the uneconomical operation, large input at the earlier stage and poor economic benefits at the later stage. Some systems have too small capacity, and the cooling, heating or power can only meet few demands at most of the time in the actual operation. The input at the earlier stage is relatively small, and the energy use efficiency is very high, but the economic benefits of the operation are not obvious.

### ENERGY COUPLING IS THE FUTURE DEVELOPMENT TREND OF THE DISTRIBUTED ENERGY SYSTEM

The energy and environmental problems have increasingly become a bottleneck for restricting the sustainable economic development in our country. The distributed energy system is characterized by the energy saving, economy, environmental protection and reliable energy supply, and possesses the extensive development prospect in our country<sup>[9]</sup>. How to realize the optimal allocation of the matters and energies among different energy utilization systems in virtue of the integration and coupling of the energy system to effectively enhance the comprehensive utilization efficiency of the energy resources as well as reduce the adverse impact of the fossil fuel utilization on the environment is a cutting-edge topic and development trend for the distributed energy system research, and also one of the focal points of the energy strategy implementation in China.

For the distributed energy resources, the theoretical base is the gradient utilization of the energy, the technological base is the conversion and recovery of the energy, and the generation and usage of cooling, heating and power should often be finished at the same time<sup>[10]</sup>. Thus, how to achieve the coupling balance of the energy is very important. In practice, upon the prediction and analysis of the load, the possible economic space of some projects is very small, and the benefit saving is insufficient to employ CCHP mode. For this purpose, it is necessary to develop the coupling between CCHP and other energy systems in the light of the local conditions as for the technical aspect, involving adopting the wind energy, solar energy or other energy- efficient and saving technologies such as water source, ground source heat pump and energy storage, so as to make up their deficiencies, complementation and matching of various resources mutually. As for the demand, it breaks through the restriction that a system only supplies the energy for an energy client, seeks the entire energy balance of the

project, analyzes and predicts the complementarity of the demand within multiple users, couples the capacity of matching the system. Make great efforts from these two aspects, to expand and realize the preferable profit space of the distributed energy system.

## CONCLUSION

China strives to build the “resource saving, environment friendly” society, while “energy saving and emission reduction” provides the excellent solution for the game playing among the economic construction, energy and environment in our country. The coupling system of the distributed energy resources is an energy saving engineering of the system. For the space, it is equipped with the characteristics involving space dispersion, multiple users, and various reference configurations. For the time, it is characterized by the multi-time scale and multiple functional levels. However, the coupling system of the distributed energy resources in allusion to different types possesses the specific mode of energy saving and emission reduction. For example, the coupling among CCHP, ice storage technology and the energy saving technology of flue gas waste heat recovery is a feasible as well as effective solution for energy saving and emission reduction.

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