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# Technical application of typical integrated energy mode

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**Abstract.** With the wide application of distributed energy, new energy, smart grid and internet, integrated energy has become the main form of energy utilization in cities and parks. This is also an important way to promote regional green development and improve energy efficiency. In this paper, the main development modes and characteristics of integrated energy in cities, parks and islands are described. Under different modes, the main links needed for comprehensive energy allocation are decomposed, and the implementation of various technical means is studied and analyzed.

Finally, in this paper, typical practical project cases are analyzed on the main structure and parameters. These characteristic are proved by describe and calculation of these projects. Suggestions for integrated energy development are offered.

## 1. Introduction

Integrated energy is a new trend of social development. Distributed energy, renewable energy smart grid and Internet technology are widely used social development.

Integrated energy system refers to the organic coordination of energy generation, transmission and distribution (energy network), conversion, storage and consumption in the process of planning, construction and operation.

In this paper, Typical integrate energy system and development mode for city and industrial park is introduced. Development and technic characteristic of several typical integrated systems will be discussed.

This paper illustrates the technology and processes of integrated energy system. Some typical integrated energy configuration and mode in South China is described in this document. The base situation of these energy system, experience and solution are described.

## 2. Integrated energy mode

### 2.1. City (Urban ) Energy system

Smart City is an Important Trend of Urban Development in the Future. Integrated energy guarantees the green development of intelligent city.



The city's energy system provides the driving force for the city's development. Energy system design is an important part of urban planning and development. The development of urban energy system needs to comprehensively consider the objective conditions of the city, and achieve an effective balance between green development and economic costs with reasonable energy schemes under the condition of meeting demand.

The urban energy revolution needs to solve the problems of urban energy system self-development and deal with the relationship between energy system and ecological environment, energy system and urban upgrading.

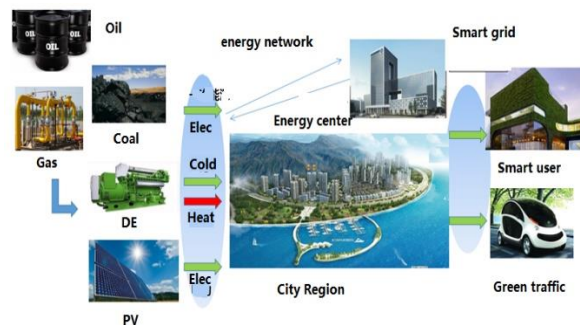


Fig.1 Typical energy system of City(Urban)

## 2.2. Energy system of industrial park

The power system of industrial park is generally composed of external power grid and distributed power grid. Source, Energy Storage System and Thermoelectric Load (including Air Conditioning Load, Building load, etc., hereinafter collectively referred to as load.

The characteristics of energy use in industrial parks are high load density, high reliability requirement, diversification of energy use, and the condition of multi-energy coupling of cooling, heating and power.

The integrated system includes a clean energy supply, smart grid and energy storage and improves the energy efficiency. Industrial park energy system is optimized in terms of overall benefits.

The design of energy systems in industrial parks often focuses on the needs of important users, analyses the operation mode of the parks in detail, designs specific energy allocation schemes, and gives technical allocation and investment proposals for the projects.

## 2.3. Energy system for island

The islands are isolated from the mainland, and the islands can only maintain the power and energy balance of multi-energy flow by themselves. In order to improve the efficiency of comprehensive energy utilization, it is necessary to coordinate and plan the multi-energy supply of the islands.

In view of the main characteristics of the above islands, it is necessary for the energy system of the islands to adopt green energy under strict environmental requirements. Efficient multi-energy coordination mode will be established, to maintain the balance and stability of the independent energy network, and achieve good economic benefits.

The main technical points of energy allocation are the load of island power grid. It is necessary to explore the possibility of electrification from the aspects of power supply, heat supply and transportation, to maximize the use of local renewable energy supply, how to make use of multiple flexible control and smart grid technology to realize the matching of energy supply and energy utilization through the related conversion of multiple types of energy.

# 3. Technology application of integrate energy

## 3.1. Integrated energy planning

Integrated energy system pursues the coordinated optimization of energy system. Different forms of energy will play different roles in different applications, and the dominant energy will vary with the application scenarios.

Planning is the guide of project implementation. Integrated energy planning is based on regional needs and development goals, integrating multiple sources of energy to formulate reasonable energy supply, transmission and utilization programs in the region.

The construction and proceeding of integrated energy planning method is shown as follows:

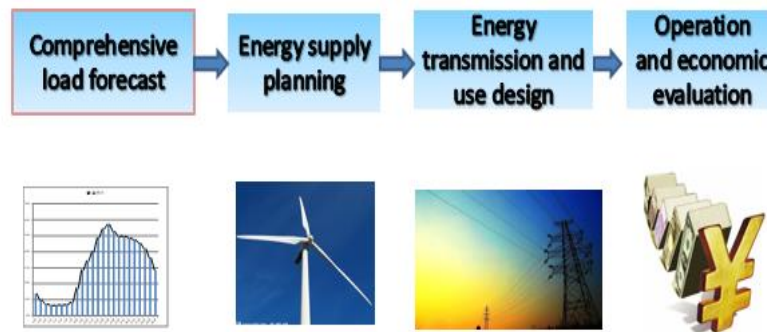


Fig2 construction of integrated energy planning.

According to regional function orientation, municipal planning, main network planning and load density, the resource conditions in the area are analyzed, the overall energy consumption and energy consumption characteristics are comprehensively predicted and analyzed, the rational and optimized comprehensive energy allocation scheme is designed, and the advanced smart grid planning and construction scheme is put forward in the relevant key areas.

Urban intelligent energy system is a complex system, and its construction and operation need to fully consider the integration of various energy varieties.

From energy production to consumption, to consumption, loss and pollutant emissions will be reduced. Energy should be used effectively.

From the perspective of the city, many kinds of clean energy and efficient utilization schemes are set up as a whole.

Urban energy development is the driving force and an important part of urban development. It should be coordinated from the perspective of urban overall situation and energy integration. collaborative optimization of energy system will be analyzed. the sustainable supply of social energy will be realized. Performance of energy system should be improved obviously.

The overall energy allocation of the city is the integration of industrial park, specific users, transportation facilities and municipal facilities.

Urban energy allocation covers a wide range of areas and has comprehensive design technology. Urban energy schemes need to be determined through energy balance, energy substitution, comprehensive comparison and a number of special studies on new technologies.

### 3.2. Smart grid

The main characteristic of the smart grid is accurately automated control and monitoring based on modern communication technology.

Smart grid consists of intelligent DE, smart substation, multi-energy management center, and intelligent consumer.

The main construction of smart grid is shown as follows:

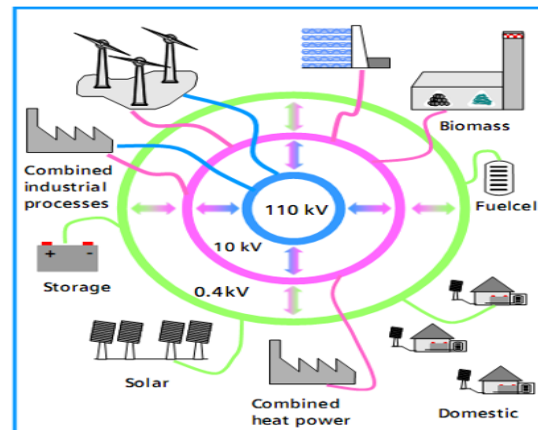


Fig3 construction of smart grid

Smart grid has the characteristics of high-speed, bidirectional, real-time, integration and other communication technologies, which can realize the interconnection of various intelligent electronic devices, protection systems and networking among users.

Advanced measurement technology can obtain real-time data of power grid operation and provide it to all aspects of smart grid. Advanced data acquisition, dynamic monitoring, data and control technology can realize the analysis, diagnosis and prediction of the status of each unit in smart grid, and determine and take appropriate measures.

Smart grid refers to a brand new communication and control system characterized with integration, modularization, and intelligence, the architecture of which is SOA based (Service Oriented Architecture) and loosely-coupled.

It is designed to meet the operation requirements of four levels of control centers and all substations above 10kV

### 3.3. Unified Energy management

Based on the status of distributed energy generation, energy storage unit and power grid, the energy integrated management and control center system manages the operation status of distributed energy generation unit and energy storage unit with reasonable energy management strategy, synthesizing the information provided by distributed energy and load local control system.

The system consists of two parts: the integrated energy management and control center system, the distributed energy monitoring system and the load monitoring system. Information exchange between power system dispatching center and regional distributed energy system is managed by energy integrated management and control center system.

Regional integrated energy management system platform should be combined with the actual needs of the project. Regional integrated energy management platform will be configured, adopting the integrated control system,

The computer monitoring system of each plant and station transmits information to the energy integrated management and control center through the special information network to realize remote monitoring.

## 4. Project example

### 4.1. ZhuHai western region energy project

The western ecological region of Zhuhai is located in the western part of Zhuhai, with an area of about 1100 square kilometers and a core area of about 130 square kilometers.

The construction of demonstration projects of micro-grid at all levels in the region, demonstration of urban clean energy supply system and pilot areas of smart grid have formed a modern urban energy supply security system.

According to the plan, there are 4 cogeneration units in the city, with capacity of about 1800 MW, 6 distributed energy units in the current period, capacity of 60 MW, and solar photovoltaic power is distributed all over the city.

In the region, the proportion of clean energy consumption is more than 90%; the thermal efficiency of energy comprehensive utilization is more than 55%, the primary energy consumption is reduced by 1.62 million tons of standard coal per year; and the carbon dioxide emission is reduced by 8.76 million tons per year.

#### 4.2. Mingzhu industrial park

The development planning area of Mingzhu Industrial Park is about 110 square kilometers, which located in the north of Guangzhou with superior geographical position

The demonstration area is located in the Mingzhu Industrial Park of Guangzhou, about 55 square kilometers of area.

In 2016, Annual electricity consumption of park is about 250 million kWh. Annual heat consumption of park is about 200,000 tons of steam.

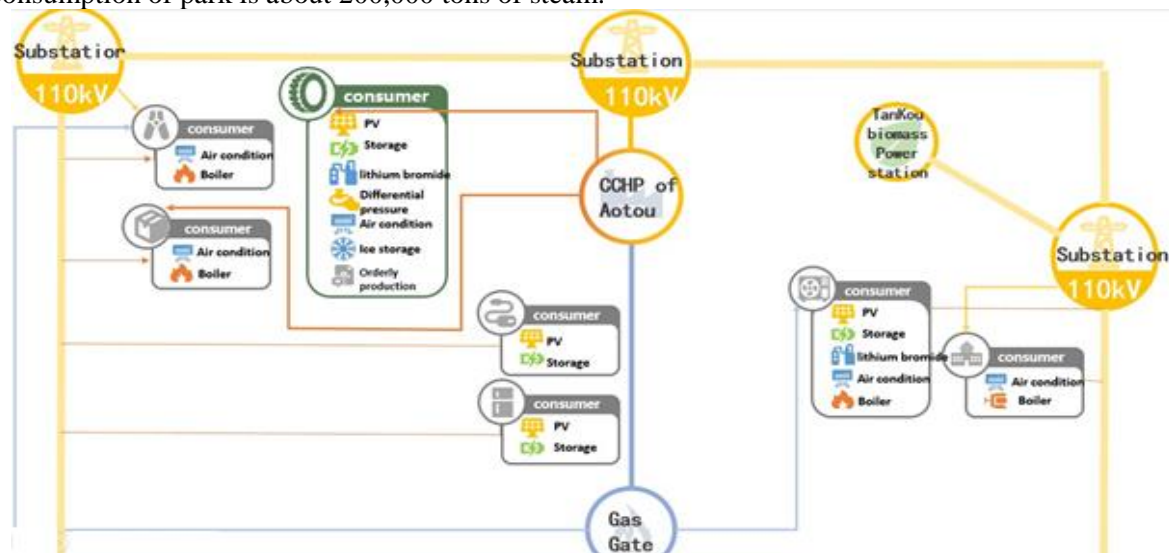


Fig4 Illustration of Mingzhu energy system

Energy system indicators are shown as follows:

Installed capacity of photovoltaic can reach 26MW in the park.

Distributed energy, photovoltaic and biomass power plants provide more than 82% of the park's electricity consumption.

Energy storage devices and intelligent energy management centers can effectively reduce the peak value by about 23%.

The comprehensive energy efficiency of Aotou Distributed Energy Station reaches 84% by increasing heat consumption and multi-energy planning.

Through the cooperation of all kinds of energy resources at the whole park, the local absorption of renewable energy resources can be configured in the park, the load should be effectively reduced, the efficiency of asset utilization is improved, and the coordinated operation of energy supply, transmission and users can be achieved.

#### 4.3. Island in Southern Sea (Island A)

Island A of south Asia is located in the northwest of the South China Sea, the island is in the tropics, with an annual average temperature of about 29 degrees Celsius. The annual average rainfall is about 2000 mm. The island covers an area of about 70 square kilometres, with a coastline of about 60 kilometres and a distance of about 110 kilometres from land.



According to the statistics of professional power demand in different industries, the future demand of the whole island can be predicted as 3000 kWh power load and 11 million kWh power consumption. The diagram of the load curve is shown below.

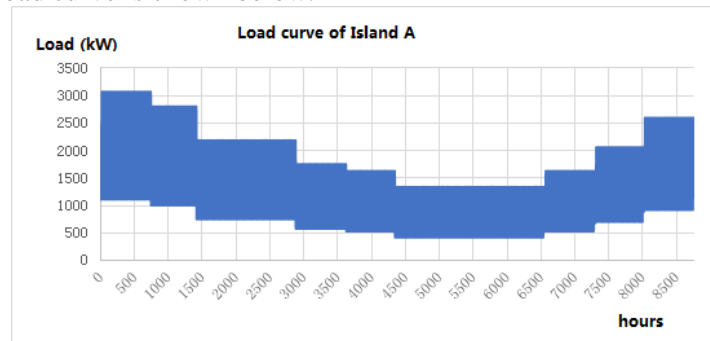


Fig5 Illustration of island A load curve

The lithium battery energy storage system is recommended for the island's hybrid power supply system. Considering the lower operating cost and better renewable energy utilization, a hybrid lithium battery supply system with 900 kW diesel generator power configuration is recommended for centralized hybrid system. The photovoltaic scale is 2700kWp, and the lithium storage capacity is 3820 kWh.

The energy system takes the flexible, reliable, clean and efficient smart grid as the core. Based on the development of renewable energy and clean energy power generation business, it builds a multi energy complementary comprehensive utilization system to provide users with internet and integrated energy new services.

## 5. Conclusion

Integrated energy is main trend of energy supply and utilization in the future. There are three main modes for planning and allocation: urban energy system, Park energy system and energy system of independent regions (islands).

Urban energy system mainly focuses on synchronizing with urban development planning, combining the development conditions and resource characteristics of the city, energy balance as the main means of energy allocation

The energy system of industrial parks is mainly concerned with multi-energy coordination to ensure the needs of all users, but also to have the best economic benefits. In order to achieve real-time energy and power balance, Island-based energy systems require higher control and stability.

In the allocation of various integrated energy sources, attention should be paid to the following important technologies: fine demand forecasting, integrated energy planning, smart grid design, unified energy management and application of new technologies.

## Acknowledgments

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